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加纳的股票价格和汇率的关系：实证�" 究

The Relationship Between Stock Prices and Exchange Rates of Ghana-Empirical Analyses

指导教师�" 名：

�" 业名称：

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摘 要

本文�" 究加纳的股票价格和汇率之间的协整关系、格兰杰因果关系。使�"�的数据为从1998年1月1日到2011年12月31日的加纳股票市场、汇率市场的日数据。利�"�ADF方法检验数据的单位根过程，�" 果显示，汇率和股价都具有一阶差分平稳性I（1）。利�"�Engle-Granger（1987）两步协整检验法检验汇率和股价之间的协整关系。�" 果显示，汇率和股价之间不存在协整关系。而�"，本文发现，自从2007年7月3日，加纳货币（塞地）重新选币定值后，汇率和股价的关系存在�" 构性突变。事实上，本文选取选币定值前后的子样本，对股价和汇率进行了VAR估计，并�" 检验了两者的格兰杰因果关系。�" 果发现，在选币定值前，从汇率到股价存在着单向的因果关系，但是在加纳货币（赛地）选币定值后，两者之间不存在因果关系。关�"�词：关�"�词；加纳股票市场；汇率；股价；协整和格兰杰因果关系

Abstract

This study investigates the cointegration relationship and the Granger causality between exchange rates and stock prices of Ghana using daily data spanning from January 1, 1998 to December 31, 2011. The Augmented Dickey-Fuller test is employed to test for unit root process in the data series and the results show that both variables are integrated at order one, I (1). I use Engle-Granger (1987) two-step cointegration test to test for cointegration between the two variables. The results show that there is no

cointegration relationship between the two. Also, I find that there is a structural break in the relationship between the two variables after the redenomination of the Ghana’s currency (Cedi) on July 3, 2007. In effect, I estimate the VAR between the stock price and exchange rate returns for pre-redenomination and post-redenomination sub-sample periods and consequently test for Granger causality between the two. I find that there is a unidirectional causality from exchange rates to stock prices before the redenomination but no causality between the two after the redenomination of the cedi. Keys Words: Ghana Stock Exchange; Exchange Rates; Stock Prices; Cointegration and Granger Causalityl.

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Chapter 1 Introduction

Globalization and the continuous deepening of financial integration among global economies coupled with the economic role that stock markets play in the allocation of resources to various productive sectors has increasingly generated a lot of research interest in the relationship between exchange rates and stock prices in the recent past. Liberalization of foreign capital controls and the adoption of floating exchange rate regimes by many countries have increased the traffic of funds among economies unleashing its concomitant effects on the foreign exchange rates. The dynamic interactions between exchange rate and stock prices are explained from the two theoretical standpoints, namely, the flow-oriented model and the stock �" oriented model. Dornbusch and Fischer (1980) who propounded the flow-oriented model argue that exchange rates lead changes in stock prices. Thus, if the domestic currency depreciates; the country’s global competitiveness is improved. This implies that domestic firms that consist in exports are placed in a strategic competitive edge and all things being equal implies more cash flows for the domestic firms and the opposite holds for import-oriented companies in case the domestic currency appreciates. However, the stock-oriented theory pioneered by Frankson (1983) and Branson (1993) posits that stock price changes lead exchange rate changes. The stock oriented model theorises that if the prices of domestic stocks rise, investors will be influenced to augment the weight of the domestic assets in their portfolio by selling-off foreign assets to obtain domestic assets. Consequently, increase in the demand for domestic currency will lead to an appreciation in the value of the domestic currency. According to Bodnar et al. (1993), movements in the exchange rates can essentially affect the values of firms especially if the cost of input for their operations and the values of their assets are denominated in foreign currencies. Also, Kim (2003) argues the S&P 500 stock price is negatively related to exchange rate in a study conducted on the relationship among some key macroeconomic variables of US. He also argued that the consistent increases in the global trade volume and the growing traffic in capital across economies have positioned the exchange rates as one of the cardinal determinants of business profitability and equity prices.

1. 1 Motivation

The openness of a country’s economy is seen as an important conduit of influence on its markets. Ghana is one of the small open economies in the world and it is essentially engaged in international trade with several countries across the globe. Also, Ghana has adopted the floating exchange policy since 1992 which implies that its various markets, the stock markets, forex markets, etc are not immune to foreign markets' influences. Furthermore, over the past few years the Ghana cedi continues to depreciate against the major convertible currencies. The continuous fall in the value of the cedi is paralleled to the Ghana stock market going bearish most often over the past few years. This worrying development has a lot of serious development implications for the Ghanaian economy. Moreover, the continuous depreciation of the Ghana cedi against the major international currencies may affect the profitability of firms and by extension the performance of the Ghana Stock Exchange (GSE). On July 3, 2007 Ghana redenominated the cedi by striking off four zeros and consequently renamed the cedi as Ghana cedi. Since, the redenomination of the cedi could possibly have effect on the interactions between the Ghana cedi and the stock market prices, I find it essential to investigate the post-redenomination effect on the interactions between the two markets. Furthermore, the literature survey I conducted shows that Ghana has a research vacuum with respect to the relationship between exchange rates and stock market prices, and against this backdrop, I find it necessary to conduct studies on this issue principally because this study employs a more recent data which comparatively captures more recent developments and also fills the research gap. Moreover, considering the significant implications of changes in the exchange rates for the development of the Ghanaian economy coupled with the essential role that the stock market plays as an investment hub which plays a critical role in the allocation of economic resources for productive activities, it is important to understand the dynamics between the exchange rates and stock markets. Thus findings from this study will help augment the information set available to policy makers, investors and regulators alike.

1. 2 Research Objectives

The objective of the research is to find out whether there are any long-term interactions between the foreign exchange rates and stock prices. Secondly, to investigate whether the redenomination of the Ghanaian currency had any effects on the interactions between the two markets. Thirdly, to establish whether there is any Granger causality between the foreign exchange rates and stock price which may either be unidirectional, bi-directional or none at all.

1. 3 Overview of the Ghana Stock Exchange

The Ghana Stock Exchange (GSE) was formed in July 1989 under Act (179) of Ghana’s Companies’ Code 1963 as a private company and eventually was recognised as a Stock Exchange in 1990 and the same year trading began on the floor. The initial trading began with two brokerage firms which conducted over-the-counter trading activities on behalf of foreign companies.

1. 3. 1 Main Indices on the Ghana Stock Exchange

There are four main indices on the GSE, namely, Ghana Stock Exchange All-Share Index (GSE-ASI), CBL All-Share Index (CBL-ASI), GSE Financial Stocks Index (GSE-FSI), and GSE Composite Index (GSE-CI). I will briefly discuss the GSE-ASI since I used this index in my studies. The Ghana Stock Exchange All-Share Index (GSE-ASI) is the main index on the Ghana Stock Exchange. It comprises all listed stocks on the GSE. It has its base as the average capitalization for the period covering November 12, 1990 to December 31, 1993 with 100 as the base and it is published by the GSE.

1. 4 Overview of Evolution of Exchange Rate System in Ghana

Cedi is the name of the Ghana currency and it is divided into 100 pesewa. The successive governments of Ghana have been faced with the tough decisions of either maintaining a fixed exchange rate system or a floating exchange rate regime. Ghana'sexchange rate management policies have strongly been influenced by the different political regimes (both democratic and military) that have been in place since independence in 1957. From 1957 to 1982, Ghana adopted a fixed exchange rate regime in the management of its exchange rate. During this period, the Ghanaian cedi was pegged to the core international currencies, the British pound and the American dollar. The fixed exchange rate was not maintained by active intervention in the forex market, on the contrary, the exchange rate was pegged by decree and a series of administrative controls were instituted to deal with any possible excess demand for foreign currency. In 1986, the government developed an auction market model in an attempt to speed up the adjustment of the exchange rate so as to reach the goal of trade liberalisation. This system was open mostly to importers of raw materials and components but excluded consumer goods. The Bank of Ghana (BOG) accepted bids from bidders once in a week and allowed the exchange rates to float within bands that it aimed at in each week. Later in 1998, importers of consumer goods were allowed to acquire license and consequently had access to the auction market. In 1990, BOG stopped the direct sale of foreign exchange to end-users and in lieu accepted bids from licensed banks (dealers) and these licensed banks traded among themselves as well. This development helped to partially subject the market to the control of the market forces to determine the cedi-dollar exchange rates. In 1992, the inter-bank market system was introduced. With respect to this particular exchange rate regime, banks trade foreign exchange among themselves whereas forex bureaux serve a number of clients including individuals, tourists, small and medium scale enterprises, etc. The inter-bank system introduced competition between the forex bureaux and the commercial banks. From that time till present, both the commercial banks and the forex bureau have operated in a competitive environment.

1. 5 Redenomination of the Cedi

According to Dogarawa (2007) redenomination of a currency is a policy to change the denomination of a currency at a particular ratio. On July 3, 2007, Ghana redenominated the cedi by striking off four zeros and consequently renamed the cedi as Ghana cedi. Thus, one Ghana cedi was equal to ten thousand cedi (1GH¢=¢10000). The authorities at the Central Bank of Ghana explained that the former note regime placed a heavy burden inter alia and was in several folds such as the huge cost of transaction at the cashiers and high level risks involved in carrying huge amount of currency for transaction purposes and the resulting pressure it unleashed on the payments systems, particularly the automated teller machines (ATMs). Against this background, the authorities stated that the exercise would bring about substantial efficiency gains when undertaken within the framework of strong economic fundamentals and macroeconomic stability. Thus, the redenomination exercise was aimed at helping to do business in the most effective and efficient way on the heels of sound and sustainably prudent and disciplined economic policies.

1. 6 Scope of the Research

The rest of the work is organised as follows; chapter two for review of literature, chapter three for estimation techniques, chapter four for empirical results, and chapter five for conclusions.

Chapter 2 Literature Review

There is a large body of literature on the relationship between stock prices and exchange rates with a lot of mixed results. Some of the pioneer researchers along this line are Frank and Young (1972) and Aggarwal (1981). The former did a study on the relationship between stock prices of some multinational firms and the changes in the US dollar and found that stock prices react rapidly in response to the expectation of dollar devaluation and the latter did a study on the relationship between changes in the US dollar and that of US stock prices between 1974-1978 and found a positive correlation between the two. Abdalla and Murinde (1997) employed co-integration test to analyse the nexus between stock prices and exchange rates for four Asian countries namely, Philippines, India, South Korea and Pakistan for a period ranging from 1985 to 1994. They concluded that there was a unidirectional causality from exchange rates to stock prices for India, South Korea and Pakistan but found that causality runs from the opposite direction in the case of Philippines. According to Mishra (2000), foreign investments in domestic stocks could increase over time as a result of the benefits from international diversification which accrue to foreign investors. Therefore, movements in stock prices may affect exchange rates and money demand balances because investors’ wealth and liquidity demands strongly consist in the performance of the stock markets. Granger et al. (2000) studied the relationship between exchange rates and stock prices consisting of nine countries in Asia with sample period starting from 1986 to 1998. They found that the markets exhibit bidirectional Granger causality between stock prices and exchange rates. Simon et el. (2004) examined the effectiveness of the domestic stock prices as the leading indicators of the financial crises in five east Asian countries, namely, Thailand, Malaysia, South Korea, Indonesia and the Philippines using monthly data ranging from January 1996 to December 1996. They argued that the respective domestic markets performed poorly as the leading indicators of currency crises except that of Hong Kong. Consequently they argued that volatilities in Hong Kong market may have affected the neighbouring economies. Moreover, they also concluded that therewas bidirectional causality between the exchange rates and stock prices. Stavarek (2005) studied the relation between exchange rates and stock prices in the US as well as in four old and new members of the European Union employing monthly data series. His findings concluded that causality between the variables is very sharp in countries with more mature forex markets. Stavarek further argued that causality is more pronounced in the later period both in the short term and long term implying that as capital markets get more mature and integrated coupled with relax capital controls, the nexus between exchange rates and stock prices becomes more pronounced. Agyasi et el. (2008) studied the effect of the exchange rate volatility on the Ghana stock exchange with data spanning from 1995 to 2005. They concluded that there is an inverse relationship between exchange rates volatility and stock market returns with volatility transmission running from exchange rates to stock prices. Usman and Aliyu (2008) examined the short-run and long-run interactions between the exchange rates and stock prices in Nigeria based on the sample from February 1, 2001 to December 31, 2008. They decimated the data into pre-crises and post-crises period (after the 2007 global financial crises). The Granger (1969) causality model was employed to establish bidirectional causality between the exchange rates and stock prices within these periods. Also, it was found that there was no causality between the exchange rates and stock prices in the pre-crises period, however there was bidirectional causality between the exchange rates and stock prices in the post �" crises model as well as the entire period model. Zhao (2009) analyzed the dynamic relationship between the exchange rates and stock prices of China using monthly data from January 1991 to June 2009. He Concluded that there is a bidirectional volatility spillover effect between the two markets, indicating that past innovations in stock market have great effect on the future volatilities in foreign exchange market and vice versa. Chien-Hsiu (2011) investigated the comovement between the exchange rates and stock prices in the Asian emerging markets. He concluded that the comovement between the exchange rates and stock prices during the crises period was more pronounced than during the stable period. He further argued that most of the causality ran from stock prices to exchange rates. Thus, the economic slowdown affected equity prices which prompted international investors to withdraw their investment which consequently affected the exchange rates. Liu and Wan (2012) investigated the relationship between the Shanghai stock market and the foreign exchange rates. They found that there is a cross correlation between the stock prices and exchange rates. Furthermore, by employing both the linear and non-linear Granger causality tests, they found no causality between the exchange rates and stock prices before the financial crises. However, they found a uni-directional causality from the exchange rates to stock prices after the financial crises.

Chapter 3 Estimation Techniques

Researches on the causal relationship between equity prices and exchange rates have been conducted with various econometric methods. In this study, I employ the vector autoregressive model and dynamic Granger (1969) causality test to examine the relationship between the variables under study. Empirical studies which are premised on time series data assume that the underlying time series is stationary. On the contrary, many empirical studies have shown that this assumption is not always true and that a significant number of time series variables are non-stationary (Engle and Granger, 1987). Thus, employing a non-stationary time series data in a regression analysis may result in spurious results (Granger and Newbold (1974)). Therefore, embarking on studies involving time series data necessitates that stationary test is conducted to establish the underlying process of the data series.

3. 1 Stationarity Test

A data generating process is considered stationary if it has time-invariant first and second moments, and the covariance of two time periods is constant notwithstanding which time periods are used and the distance between them, Gujarati (2003). The process is said to be weakly stationary if the two first conditions are fulfilled but the covariance between two time periods depends on the distance between the time periods, but not on when it is calculated. If the process is stationary around a trend, it is said to be trend-stationary. There are a variety of unit root tests used in the econometric literature principally Augmented Dickey-Fuller (ADF), Dickey-Fuller, Phillip-Perron, Ng-Perron tests, etc to investigate whether the time series data used in a study are stationary or not. I employ the Augmented Dickey-Fuller to examine the stationarity of the variables.

3. 1. 1 Augmented Dickey-Fuller (ADF) Test

The ADF model tests the null hypothesis that there is unit root, against the alternative hypothesis that there is no unit root in the regression. The regression for the ADF test is estimated as follows:(1)where represents the variable that we are examining its properties, is the difference operator, , and are the coefficients to be estimated, p is the chosen lag length, t is the time trend, and t is the white-noise error term. has a stochastic trend under the null hypothesis but under the alternative hypothesis is stationary. Generally, the lag length for conducting the ADF test is unknown but can be estimated using information criteria such as the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) applied to the regressions of the form in equation (1). If the Data Generating Process (DGP) is stationary in the data series at levels, then it will be concluded to be integrated of order zero, I (0). On the contrary, it is not always the case and the underlying process of the data series may be non-stationary. In effect, the original series need to be transformed into a stationary state by taking difference (d) times. If after taking first difference of the series, it is found out that they are all stationary then we can conclude that the DGP is integrated at order one, I (1). Moreover, if the original series used in the study are found out to be integrated of the same order, it is useful to test for cointegration relationship between the integrated variables.

3. 2 Cointegration Test

It is generally accepted that regression which involves non-stationary time series will lead to spurious results. However, Engle-Granger (1987) proposed that a linear combination of these non-stationary series may be stationary in which case we can say that the series are cointegrated. To compute the Engle-Granger test, let the vector denotethe tth observation on N time series, each of which is known to be I (1). If these times series are cointegrated, there exists a vector such that the stochastic process with observation is I (0). However, if they are not cointegrated, there will be no vector with this property, and any linear combination of y1 through yN and a constant will still be I(1). The cointegration regression is estimated as follows: Yt1= (2)for a sample of size T+1. With respect to this regression, it is assumed that all the variables are I (1) and might cointegrate to form a stationary relationship, and thus will result in a stationary residual term. The null hypothesis of non-cointegration is that the residual term is non-stationary. Unit root test is conducted on the residuals to find out whether they are stationary or otherwise. To this end, the ADF test is employed to conduct the unit root test. If the residuals are stationary, then one rejects the null hypothesis of non-cointegration. However, if they are non-stationary, then one accepts the null hypothesis of non-cointegration.

3. 3 Vector Autoregressive (VAR) Model

A vector autoregression is a set of k series of regressions in which the regressors are lagged values of all the k series. The underlying assumption of the model is that all variables are endogenous a priori, and allowance is made for rich dynamics. VAR models offer some level of flexibility and therefore easy to use for analysing multiple time series. This is against the backdrop that one needs not to specify which variables are exogenous or endogenous. However, there are still some difficulties associated with VAR models. In the first place, it is not easy to identify which variables have significant effect on the dependent variable. Also, there is a strict condition that all the data series in the VAR should be stationary. However, most financial time series are non-stationarity. In case the variables are found not to be stationary at levels, then according to Granger (1969), it is more appropriate to estimate VAR or Vector Error Correction Model depending on whether the series are cointegrated or not. The vector error correction model is discussed in the subsequent section. The simplest form of the VAR is the bivariate model. The bivariate model can generally be estimated as follows: (3)where ???? it is a white noise term with E (???? it) = 0, E (u1tu2t) = 0.

3. 4 The Granger Causality Test

According to Granger (1969) a variable X could be defined as causal to a time series variable Yif the former helps to improve the forecast of the latter. Thus, X does not Granger-cause Y ifPr (|) = Pr (|) (4)where Pr (.) is the conditional probability, is the information set at time t on past values of Y and is the information set containing values of both Xand Yup to time point t. If the variables are found not to be cointegrated, then the following VAR will be estimated and the Granger causality test is consequently conducted:(5) (6)where SI is the stock market price in terms; ER is the exchange rate of the Ghana cedi to the US dollar andare uncorrelated white noise terms, ln represents the natural log, �" difference operator and t denotes the time period. If the lagged coefficient of vector in equation (5) is significant but that of vector of in equation (6) is not significant then the results imply that there is unidirectional causality from exchange rate to stock price returns. However, if the lagged coefficient vector in equation (6) is statistically significant but the lagged coefficient vector in equation (5) is not statistically significant then the results imply that there is unidirectional causality from stock prices returns to exchange rate returns. Moreover, if the lagged coefficient vectors of both equations (5 and 6) are statistically significant then the results imply that there is a bidirectional causality from the stock returns and exchange rate returns. Finally, if both lagged coefficient vectors are statistically insignificant, then this implies that there is no causality between these variables.

3. 5 Vector Error Correction Model (VECM)

According to Engle and Granger (1987), the VECM is a preferable model to the VAR in equations (4 and 5) if it is found that there is no-cointegration relation between and or among the data series. The VECM discriminates between both the dynamic short-run and long-run Granger causality. The VECM equations are written as follows: where SI is the stock price in terms; ER is the exchange rate, is the error correction term lagged one period; and are uncorrelated white noise terms. The error correction term () is derived from the long run cointegration relationship between the variables. The estimates of the error correction term of () also shows how much of the deviation from the equilibrium state is corrected in each short period. To find out the presence of long-run causality between the two data series, one will test for the significance of the coefficient of the error correction term in equations (7 and 8) by employing the t-test. Finally the Wald or F-statistic is used to test for the joint significance of both the error correction term and the various interactive terms in equations (7 and 8). If the lagged coefficient vector of equation (7) is statisticallysignificant but the lagged coefficient vector in equation (8) is not significant then the results imply that there is a unidirectional causality from exchange rate to stock price returns. However, if the lagged coefficient vector in equation (8) is statistically significant but the lagged coefficient vector in equation (7) is not statistically significant then the results imply that there is unidirectional causality from stock prices returns to exchange rate returns. Moreover, if the lagged coefficient vectors of both equations (7 and 8) are statistically significant then the results imply that there is a bidirectional causality from the stock returns and exchange rate returns. Finally, if both lagged coefficient vectors are statistically insignificant, then this implies that there is no causality between these variables.

3. 6 Lag Length selection Criteria

To estimate the VAR/VECM model requires choosing the lag length that reduces the information loss. Thus, choosing the lag length involves neutralizing the trade-off between adding more lags against the marginal benefit of additional estimation uncertainty. Thus, too many lags included in the model will lead to additional estimation errors and whiles too few lags may leave out potentially valuable information. To contain this problem, there are so many models to use to select the lag order, namely the Akaike Information (AIC) and Bayes Information Criteria (BIC). I use the BIC to determine the lag order to the estimate model and therefore I will discuss it briefly. The BIC and AIC are expressed as follows:(9)(10)where SSR(p) is the sum of squared residuals of the estimated AR(p). The BIC estimator of , is the value that minimizes BIC(p) out of the range of lags available. The SSR decreases as more lags are introduced, however the second termincreases as more lags are introduced. Moreover, the amount of penalty in the second term of the AIC is relatively smaller to that of the BIC. Thus, the BIC awards more penalty factor relative to the AIC. This implies that BIC gives a consistent estimate of the true lag length unlike the BIC. This makes the BIC preferable to AIC which tends to overestimate the lag order with positive probability. Thus, the second term of the AIC is smaller compared to the BIC.

3. 7 Test for Structural Breaks

To test for structural break(s) in the regression coefficients, I estimate an autoregressive distributed lag (ADL) with dummy variables to represent the periods before and after the redenomination of the cedi. Moreover, to choose the appropriate lag length for both the dependent and independent variables to include in the ADL, I estimate the regression equations with different lag lengths and compare the resulting BICs. In effect, the lag length that resulted in the lowest BIC is chosen to estimate the ADL and then the structural break test is conducted. The ADL is estimated as below: whereSIt = stock price returnsERt = exchange rate returnsDt = Dummy variable where Dt = 1 if t ≥ 3 July, 2007; Dt = 0 if t ≤ 3 July, 2007Δ = difference operatorT = time period; d, are the coefficients of the parametersChow (1960) model tests for structural break in which case the break dates must be known a priori and the decision is made on the F-statistic that tests the null hypothesis of no break; against the alternate hypothesis that at least one of d is nonzero. Thus, in case of the Chow (1960) test the investigator has to pick an arbitrary break date or pick a known date based on the feature of the data series. In effect, the results can be highly sensitive to these arbitrary choices and as thetrue break date can be missed. However, in this study, the break date is identified by the redenomination of the cedi.

3. 8 The CUSUM of Squares Test

In an attempt to test for the constancy of the variance, I employ the CUSUM of square test (Brown, Durbin, and Evans, 1975). This test is principally based on the square of the residuals on the plot of the quantities. This test involves drawing a pair of critical lines on the diagram which is parallel to the mean value line so that the probability that the sample path crosses one or both critical lines is the significance level. If the sample path stays between the pair of critical lines without crossing any of the two lines, then one can conclude that the variance is constant over the period. However, movement outside of the critical lines implies parameter or variance instability. The CUSUM of squares test is based on the test statistic:(12)where the mean value of is given by:. (13)

Chapter 4 Empirical Analyses

4. 1 Data Sources and Definition of Variables

Data used for these studies are the daily stock market index of the Ghana StockExchange and the daily exchange rates between the Ghana cedi and the USD dollar. I use the Ghana Stock Exchange-All Share Index (GSE-ASI) to proxy the stock market prices. The data series start from January 1, 1998 to December 31, 2011. The data are taken from the Ghana Stock Exchange and the Central Bank of Ghana data bases. The US dollar to Ghana cedi was chosen as a proxy for the exchange rate principally because it is the most largely traded currency on the forex market of Ghana also according to the IMF’s Direction of Trade Statistics (DOTS, 2011), the United States ranks as one of the major trading partners of Ghana. Both the exchange rate series and the stock prices are expressed in their natural logarithm. In fact many researchers have used various data of different frequencies in conducting studies on this topic, namely, daily, weekly, monthly, quarterly and yearly observations. I choose the daily observations over the monthly and yearly ones based on the argument put forward by Granger (2000) that studies based on daily observations are more likely to find Granger-causality and also able to capture capital movements. In order to capture the effect of the redenomination of the cedi on the interactions between the variables, I divide the sample period into two, the pre-redenomination and post-redenomination periods. In effect, three models are estimated, the basic model which refers to the entire sample period, pre-redenomination model which is the model estimated based on the sub-sample period before the redenomination and finally the post-redenomination model which is based on sub-sample period after the redenomination. I provide below the graph of both exchange rate and stock price returns (Figures 1 and 2). The graph of the daily stock index returns shows the GSE posted negative returns in most part of the sample period. However, the series plot of the exchange rate returns shows relatively positive returns (depreciation of the cedi) in most part of the sample period. Moreover, the summary statistics shows a negative mean and skewness in the case of the stock price returns but positive mean andskewness with respect to exchange rate returns. The return series for both stock index and the exchange rates are obtained as follows: Rt= ln (Pt/Pt-1)*100. (14)The E-views 7 software was used in running all the econometric models.

Figure 1: Graph of exchange rate returns

Figure 2: Graph of stock price returns

Table 1 Summary Statistics of variables

SIERMean-0. 0395860. 064282Median0. 0568670. 013872Maximum19. 537345. 254275Minimum-18. 77655-5. 071232Std. Dev. 1. 2750290. 240571Skewness-4. 5144631. 276291Kurtosis91. 58829151. 0140Jarque-

Bera1174874. 3247024. Probability0. 0000000. 000000Sum-140. 7680228. 5879Sum Sq. Dev. 5779. 357205. 7442Observations35563556

4. 2 Unit Root Tests

The unit root test is conducted with different lag lengths and then the resultant BICs are compared to select the lag that yields the lowest BIC. According to Stock and Watson (2007) it is beneficial to use higher lag length than fewer lags to conduct the unit root test. Against this background, I try several lags to carry out the stationary test and choose the lag that yields the lowest BIC. Therefore, stationary test is carried out on the data at log levels and also in returns using the ADF test with constant only and then constant and trend with lags 22 and 11 respectively for stock price index and exchange rate (See Appendix A4). With respect to the log levels, the t-statistic are less than all the critical values at all the conventional levels of significance and therefore I fail to reject the null hypothesis that they are non-stationary. However, the t-statistic are greater than all the critical values at 5% levels of significance in terms of returns (after taking first difference) and consequently, I reject the null hypothesis that there is unit root in the data series. Therefore, both series follow an I (1) process (See Table 2)

Table 2 Unit Root Test of Variables

Panel A: Log Levels

ADF

Variable Constant Constant and Trendt-statistic P-Value t-statistic P-Valueln(SI) 2. 0016 0. 2863 1. 7967 0. 7064ln(ER) 1. 7571 0. 4023 1. 4001 0. 8611Critical Values: Constant: 10% (2. 56714), 5% (2. 86216) and 1% (3.

432013)Constant and Trend: 10% (3. 12735), 5% (3. 41107) and 1% (3. 960636)

Panel B: Log Returns

ADF

Variable Constant Constant and Trendt-statistic P-Value t-statistic P-Valueln(SI) 7. 6166 0. 0000 7. 6634 0. 0000ln(ER) 6. 5389 0. 0000 6. 6859 0. 0000Critical Values: Constant: 10% (2. 567141), 5% (12. 862155) and 1% (3. 432002)Constant and Trend: 10% (3. 127355), 5% (3. 411069) and 1% (3. 960621)

4. 3 Cointegration Test

The results of stationary test shown in Table 2 confirm that both return series follow an I (1) process and therefore according to Engle-Granger (1987) it is essential to further test for cointegration relation between the variables. The cointegration test is conducted using Engle-Granger (1987) cointegration test. The two- step cointegration test is employed as discussed in section (3. 1. 2). I find the residuals of the cointegration regression are not stationary since the t-statistics are less than the critical values (See Table 3). Consequently, I accept the null hypothesis that the series are not cointegrated at 5% significance level.

Table 3 Engle-Granger Two- Step Cointegration Test

t-StatisticP-ValueAugmented Dickey-Fuller test statistic-1. 1634460. 9165CriticalValues: 1%(-4. 3266); 5%(-3. 7809); 10%(-3. 4959)

4. 4 VAR Lag Length Selection Criteria

The results of the stationary test shown in Table 2 confirm that both series follow an I (1) process. Also according to Engle-Granger (1987) cointegration test, there is no cointegration relation between the two variables. Accordingly, I proceed to estimate the vector autoregressive model. However, I need to select the optimum lag length to estimate the VAR. The optimum lag length is chosen based on the BIC. The lag length that minimises the BIC is selected as the optimal lag length. Based on the results, lag 9 is finally selected with respect to the basic and the pre-redenomination model but lag 1is chosen in the case of post-redenomination model (see Appendix A4)

4. 5 Vector Autoregressive (VAR) Model

I estimate VAR instead of VECM on the returns of the series (equations 6 and 7) in the light of the fact that the series are found not to be cointegrated. For want of space and simplicity I show the VAR functions up to only lag 3 (See Equations 14 and 15). I therefore conduct Wald test to find out whether the lagged values of the regressors are jointly significant in explaining the changes in the dependent variable in the short-run. Premised on the results of the Wald test, I reject the null hypothesis that the lagged coefficients of the exchange rates returns are jointly equal to zero because the F-statistics are bigger than the critical values. In effect, this statistical evidence implies that exchange rates returns in the short term help predict changes in the stock price returns. However, since the F-statistic of the Wald test is smaller than the critical value, I accept the null hypothesis that the lagged coefficients of the stock price returns are jointly equal to zero; which implies that in the short-run, stock price returns are not significant in predicting changes in the exchange rate returns (SeeAppendix A1). VAR equations of the full sample period:

�" lnSIt = -0. 0198 - 0. 0066�" lnSIt-1+ 0. 0197�" lnSIt-2+ 0. 0007�" lnSIt-3- 0. 1054�" lnERt-1

(0. 0384) (0. 0168) (0. 0168) (0. 0167) (0. 1003)

-0. 3137�" lnERt-2- 0. 0. 1914�" lnERt-3

(0. 1024) (0. 1019) (15)

�" lnERt = 0. 0096 + 0. 0551�" lnERt-1- 0. 1335�" lnERt-2+ 0. 113�" lnERt-3+ 0. 0016�" lnSIt-1

(0. 0064) (0. 0170) (0. 0169) (0. 0169) (0. 0028)

-0. 0020�" lnSIt-2- 0. 0052�" lnSIt-3

(0. 0028) (0. 002) (16)

where the figures in parenthesis represent standard errors.

4. 6 Granger Causality Test

Based on the VAR, I examine the direction of causality between the foreign exchange rates returns and the stock price returns by using the Granger (1969) causality model. I choose the Granger causality test above the other methods because of its favourable response to both small and large sample sizes (Odhiambo, 2008). I reject the null hypothesis that exchange rate returns do not Granger-cause stock price returns because the F-statistic is bigger than the critical values. However, I accept the null hypothesis that stock returns do not Granger-cause exchange rate returns since the F-statistic is less than the critical value (See Table 5).

Table 5 Granger Causality Test: Basic Model

Null HypothesisF-StatisticP-Valueln(ER) does not Granger cause ln(SI)3. 204330. 0007ln(SI) does not Granger cause ln(ER)1. 079540. 3743Critical Values are: 10% (1. 63), 5% (1. 88) and 1% (2. 41)

4. 7 Tests for Structural Break

4. 7. 1 Chow Test

I employ the Chow (1960) test to test for structural break in the data series principally because of the redenomination of the cedi. Based on Chow (1960) test, the test statistic is greater than the critical value at 5% and therefore, I reject the null hypothesis of no structural break in the data series (see Table 6). This implies that the redenomination of the cedi did have some effect on the relationship between the exchange rate returns and stock price returns.

Table 6 Chow (1960) Test

StatisticValueP-ValueMaximum Likelihood Ratio1. 89590. 0144Maximum Wald1. 89590. 0141Critical Values are: 10% (1. 46), 5% (1. 62) and 1% (1. 97)

4. 7. 2 CUSUM of Square Test

I proceed to further test whether the redenomination of the cedi impacted the stability of the Ghana cedi and consequently its causal relationship with the stock prices returns. To this end, I tested for variance constancy by employing the CUSUM of Squares test. The graph of the CUSUM of Squares test (see Figure 3) shows that the sample plot crosses both pair of critical lines (5%) which suggests that the variance is not constant over the period. Moreover, to further consolidate this statistical evidence, I notice based on the summary statistics of the pre-redenomination and post-redenomination sub-sample data that the variance{exchange rates returns(0. 24); stock prices returns(1. 45)} of the pre-redenomination sub-sample period is relatively higher than that of the post-redenomination{exchange rates returns(0. 21m); stock prices returns(0. 79)}

Figure 3: Graph of the CUSUM of Squares

4. 8 VAR and Granger Causality Test Before and After the Redenomination of the Cedi

Against the backdrop of structural break in the data series after the redenomination of the cedi, I decide to estimate the VAR before and after the redenomination of the cedi and similarly test for Granger causality between exchange rate and stock price returns. I estimate the VAR (see equations 16, 17, 18 and 19) and conduct Wald test on the lagged values of the regressors. Consequently, with respect to the pre-redenomination model, the Wald test shows that the lagged values of the stock exchanges returns jointly help explain changes in the stock price returns. On the contrary, those of the stock price returns do not jointly help explain changes in the exchange rate returns. However, in the case of post-redenomination model, the Wald test shows that the lagged coefficients of both the stock price returns are not significant in explaining each other (See Appendix A2). Interestingly, the results of the Granger causality follow the same pattern as the Wald test. In the case of the pre-redenomination model, the F-statistic of the Granger causality test is greater than the critical value and therefore, I reject the null hypothesis that exchange rate returns do not Granger cause stock returns. However, the F-statistic of the post-redenomination model is less than the critical value and therefore I accept the null hypothesis that exchange rate returns do not Granger cause stock returns. Moreover, with respect to the post-redenomination model, there is no Granger causality between the exchange rates and stock returns since the F-statistics in both cases are less than the critical values. VAR equations of the pre-redenomination period:

�" lnSIt = 0. 0337 - 0. 0183�" lnSIt-1+ 0. 0174�" lnSIt-2+ 0. 0049�" lnSIt-3- 0. 1627�" lnERt-1

(0. 0339) (0. 0205) (0. 0204) (0. 0205) (0. 1410)

- 0. 4823�" lnERt-2- 0. 2579�" lnERt-3

(0. 1429) (0. 1433) (17)

�" lnERt = 0. 0137 - 0. 101�" lnERt-1+ 0. 1697�" lnERt-2+ 0. 1126�" lnERt-2- 0. 0019�" lnSIt-1

(0. 0049) (0. 0205) (0. 0206) (0. 0207) (0. 0029)

- 0. 0050�" lnSIt-2- 0. 0002�" lnSIt-3

(0. 0029) (0. 0029) (18)

VAR equations of the post-redenomination period:

�" lnSIt =-0. 0495 + 0. 0557�" lnSIt-1+ 0. 0494�" lnERt-1

(0. 0237) (0. 0294) (0. 4958) (19)

�" lnERt = 0. 0520 - 0. 2859�" lnERt-1+ 0. 01045�" lnSIt-1

(0. 052) (0. 0284) (0. 0085) (20)

where the figures in parenthesis represent standard errors.

Table 7 Granger Causality Test

Panel A: Pre-Redenomination Model

Null HypothesisF-StatisticP-Valueln(ER) does not Granger cause ln(SI)3. 429580. 0003ln(SI) does not Granger cause ln(ER)0. 835370. 5834

Panel B: Post-Redenomination Model

Null HypothesisF-StatisticP-Valueln(ER) does not Granger cause ln(SI)0. 406080. 9323ln(SI) does not Granger cause ln(ER)0. 963570. 4687Critical Values are: 10% (1. 63), 5% (1. 88) and 1% (2. 41)

Chapter 5 Conclusion

The study investigates the relationship between exchange rate and stock prices. The Augmented Dickey Fuller test is employed to test for unit root process in the data series. I find that both series are not stationary at levels but stationary after taking first difference. This implies that the two series are integrated at order one (1). I, furthermore test for cointegration relationship between the two variables by employing the Engle-Granger (1987) two-step cointegration test. In effect, I estimate the vector autoregressive model on the returns of the series. The Wald tests, I conduct on the coefficients of the regressors of the VAR show that in the short-run, the lagged values of the exchange rates help predict changes in the stock prices. However, the Wald test shows the lagged values of the stock prices are not significant to explain changes in the exchange rate returns. Additional statistical evidence based on the Granger causality test shows that there is a uni-directional causality from the exchange rates to stock price returns before the redenomination of the cedi. I then conduct structural break test to examine whether the redenomination of the cedi had any structural impact on the cedi by employing the Chow (1960) test and the CUSUM of Squares test. The results of the Chow test show that there is a structural break in the relationship between the two. Moreover, the mean value in the CUSUM of squares graph crossed the critical lines at 5% significance level which implies that there is parameter and variance instability. Therefore, statistically inferred, I notice that the redenomination of the cedi had structural impact on the relationship between the exchange rates and the stock price returns. In effect, I estimate VAR models for the sample period before (pre-redenomination model) and after (post-redenomination model) of the Cedi and then test for Granger causality respectively. Thus, with respect to the basic and pre-redenomination, there is a uni-directional causality but no causality in the case of the post-redenomination model. Also, I notice that the variance of the exchange rate and stock price returns reduced after the redenomination of the cedi. Thus, statistically, I therefore infer that the redenomination policy helped to stabilize the cedi comparatively and therefore the fluctuations in exchange rates could not significantly cause changes in the stock prices after the redenomination of the cedi.