Multiple Regression and Structural Analysis of Foreign Direct Investment (FDI) in Ghana (1994-2010)

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ARTICLE INFO	ABSTRACT
	Foreign Direct Investment (FDI) has been one of the topical issues in international economics, especially, from the past decade. Empirical research on FDI in developing countries, such as Ghana, has been relatively scarce even though there has been a lot of work on the trends in FDI. This study attempts to examine the trend of Foreign Direct Investment (FDI) in Ghana and its relationship with some selected economic indicators such as exchange rate, inflation, interest rates, Gross Domestic Product (GDP) as well as employment and the structural stability of FDIs with respect to the variables. Yearly data on FDI was used for the study spanning from 1994 to 2010. Results from the study indicated that FDI inflows into the country had experienced an increasing trend and undergone structural changes over the period under study. Furthermore, exchange rates and GDP growth played a significant role in attracting FDI into the country.

1.0 Introduction

Studies on Foreign Direct Investment (FDI) have been one of the topical issues in international economics, especially, from the past decade. It has assumed prominence in intellectual discourse (Pan 2002). Empirical research on FDI in developing countries, such as Ghana, has been relatively scarce even though there has been a lot of work on the trends in FDI.

The trend of FDI's is expected to have some degree of relationship with some economic variables which is subject to further examination in this study. It is against this background that the trend of foreign direct investment and its relationship with exchange rates, inflation, interest rates, Gross Domestic Product and expected FDI employment is being studied.

According to project data from GIPC, there were 65 approved projects in 1990 either as wholly owned or by joint venture agreement. The figure rose to 86 in 1991 and again jumped to 133 in 1992. Total capital inflow in the form of cash through FDI amounted to $37.52million and $41.12 million in 1990 and 1991 respectively. It however increased to $53.30million in 1992. In 1993 total number of registered project again rose to 223 with $98.76 million in total equity. Between 1990 and 1992, the British investment topped the list of registered projects with 12 projects amounting to $12.40 million in 1990, 18 projects ($7.36million) in 1991 and 18 projects ($4.64) in 1992. The lead of British FDI in Ghana can be attributed to the positive long-time relationship between the two countries and Ghana having most of its political and economic structures familiar with the British (Source: GIPC data on registered project).

The Ghana Investment Promotion Centre (GIPC) developed a 5-year corporate plan, which was implemented from 1995 – 1999 but later extended to the year 2000. The main objective of the plan was to stimulate increased investment through aggressive promotional efforts both at home and abroad (GIPC Annual Report 2000). At the end of the plan period the centre had registered 1,084 FDI projects in the services (314) manufacturing (300), tourism (129), building and construction (92) and agriculture (87) sectors of the economy. These projects were made up of 763 joint Foreign-Ghanaian and 321 wholly foreign owned projects. The second medium term plan 2000-2004 incorporated the last year of the first plan into a programme designed to transform the centre's promotional strategy from a general approach to a specifically targeted promotion directed to firms and sectors pre-determined in a Foreign Direct Investment

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demand study. Results of this programme have been modest, partly due to insufficiency in funding and prevailing downward trend in the world investment since the events of September 2001(GIPC Annual Report, 2000).

This study takes a look at the trend, structural analysis of FDI flow from 1994 – 2010 and its influence on flow variables such as exchange rate, inflation, interest rate, expected employment and GDP. It seeks to contribute to filling the gap of scientific information on FDI and recommends practical ways to boost its inflows for economic growth and development.
The research seeks to provide answers to the following problems;
  (i)   Does FDI follow the same pattern over the 17-year period?
  (ii) Has there been any structural breaks in FDI over the period?
  (iii) Has there been any structural breaks in the relationship between   FDI and exchange rate, inflation, Interest rates, GDP and employment for the period 1994-2010?
  (iv) Has exchange rates, inflation, Interest rates, GDP and employment impacted FDIs for the period 1994-2010?

1.1 Relationship between FDI and Exchange Rates

Exchange rates, defined as the domestic currency price of a foreign currency, matter both in terms of their levels and their volatility. Exchange rates could affect both the total amount of FDI that takes place and the allocation of this investment spending across a range of countries. When a currency depreciates, meaning its value declines relative to the value of another currency, this exchange rate movement has two potential implications for FDI. First, it reduces the country's wages and production cost relative to its foreign counterparts. When a country's currency devalues, it is viewed as an opportunity for foreign investors to purchase assets at a reduced cost; this is especially true when foreign firms have identified specific assets in their targeted or the host markets (Blonigen, 1997). Barrell and Pain (1996) suggested that investors tend to postpone their investment when the currency in the targeted markets strengthens, speculating the currency to depreciate in the future therefore they could maximize profit on their investment at a later stage. Ahnetal (1998) reported that there were mixed sentiments towards increasing FDI competitiveness by devaluating currency. Moreover, they found that empirical research generally showed a positive impact. Furthermore, Kyereboah-Coleman and Agyire-Tettey (2008) found out that volatility exchange rate has a significantly negative impact on FDI inflows and that the appropriate macroeconomic policy can result in over valuing the currency thereby discouraging FDI. Their findings were also similar to that of Barrel and Pain. They noted that the lag in FDI is highly significant. However, high exchange rate volatility does not always imply a negative effect on FDI inflow. Exchange rate movements can influence FDI by affecting the home currency cost of acquiring assets abroad (Froot and Stein, 1991). All things being equal, the country experiencing real currency depreciation has enhanced "locational advantage" or attractiveness as a location for receiving productive capacity investments. By this "relative wage "channel, the exchange rate depreciation improves the overall rate of return to foreigners contemplating an overseas investment project in this country Goldberg (2006).

1.2 Relationship between FDI and Inflation

Inflation is most often discussed because it changes the purchasing power of money and real values of variables such as interest rates, wages and many others. Inflation is defined as the persistent and appreciable increase in the general price level. Glaister and Atanasova (1998) reported the effect that high inflation had on employment in Bulgaria. Even though they did not draw direct inference to the relationship between FDI and inflation, they seem to suggest that high inflation can cause various problems within the country to reduce its attractiveness to foreign investors. Wint and Williams (2002) suggested that a more stable economy attracts more FDI thus a low inflationary environment was desired in countries that promote FDI as a source of capital flow.

1.3 Relationship between FDI and Interest rates

Real interest rate helps to determine the trend of investment in an economy. When the interest rates are high, borrowing becomes quite expensive for the investors so they make less real investment. The high interest rates make it difficult for investors to cover their expenditure because their products becomes less competitive in both the domestic and the international market .On the other hand, if the interest rate is low, more and more investment takes place in the economy which results in more production, more employment opportunities and increase in the potential GDP. Thus the real interest rate through their effect on investment improves growth and future living standards of a nation. Cavallari and D'Addona (2007) found out that output and interest rate volatility mainly act as push factors, i.e. they are more effective in deterring

rather than encouraging foreign investments. A rise in host country volatilities does reduce the amount of FDI outflows in the recipient country, even after controlling for the state of the cycle. Source country volatilities, on the contrary, do not have a systematic effect on foreign investments. Their results indicated that the responses of FDI are indeed asymmetric along the cycle: interest rate volatility reduces FDI flows more in booms than in recessions while the opposite is true for output volatility in the host country.

1.4 Relationship between FDI and GDP

Gross Domestic Product (GDP) refers to the market value of all final goods and services produced within a country in a given period. GDP per capita is often considered an indicator of a country's standard of living. GDP can be determined in three ways, all of which should, in principle, give the same result. Relationships between FDI and a country's economic growth are still a subject of great debate. GDP growth is largely measured by the level of productivity in the country. The rates at which the country can grow, based on the growth theory, depends on the way countries deploy their resources, such as their technology, labour force, stock of capital. At any point in time countries lacking these resources within their borders, could rely on foreign investors to bring in these resources in the form of foreign direct investment (Sawyer & Sprinkle, 2006; Lipsey & Chrystal, 2006). Moran, Graham and Blomström (2005) have compiled various studies, questioning whether FDI can improve the host country's economic growth. They concluded that the effect of FDI on the host country's GDP growth depends much on the host country's economic openness. The more liberalized the economy, the more likely the positive benefits of FDI to be transferred to the host country. On the converse, the more restricted the economy, the more negative the impact of FDI on growth. Seetanah and Khadaroo (2007) found out that not only does FDI generate GDP growth, though the contribution is small when compared to other growth factors, FDI also follows economic growth. Nonnemberg and Cardoso de Mendonça (2004) found out that strong GDP growth can induce FDI inflow but FDI does not necessarily induce economic growth.

1.5 Relationship between FDI and Employment

Employment is a contract between two parties, one being the employer and the other being the employee. Foreign direct investment was expected to create employment to both foreigners and the host country. Keynes (1936) suggested the existence of a direct relationship between investment and employment. However, there was still considerable divergence in views among economist about the employment effect of FDI (Pugel, 1985).Baldwin (1995) argued that the discourse on FDI and employment relationship encompassed three key issues such as the extent to which FDI substitutes for domestic investment; the extent to which FDI stimulates increase of exports of intermediate goods; and whether FDI involves the construction of new plants or the acquisition of existing facilities.

Field and Stein (1994) argued that there was ample evidence that total employment in an economy with a well-functioning labour market will not be affected by the volume or of character FDI.

2.0 Material and Methods

Regression analysis seeks to find regression models or mathematical equation that best describes the relationship between two or more variables .Regression may be linear or non linear and simple or multiple. The major purpose in each of such situation is to explore the dependence of one variable on the other, or others. When there evidence that two variables are related, it may be of interest to describe the relationship between them using regression analysis. For the focus of this paper, we discuss the simple and multiple regressions briefly.

2.1 Simple linear regression model

This is when one independent variable is being used to explain or predict one dependent variable. The

general form of the simple linear regression model is $y = \mu_{y/x_{,}+\varepsilon} = \beta_0 + \beta_1 x + \varepsilon$ ... ...   (**1**)

Where y is the dependent or the response variable; x is the independent variable or the predictor variable;

β_0 and β_1 the regression coefficients, and ε the random error term. The random error term is assumed to be normally distributed with a mean of zero (0) and variance of one (1).This indicates that the expected value or ε for a given value of x is 0. Hence,

$$\mu_{y/x_, + \varepsilon} = \beta_0 + \beta_1 x + \varepsilon \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (2)$$

Where $\mu_{y/x_,}$ is the mean value of the independent variable y when the value of the independent variable is x

2.1.1 Estimating the Regression Coefficients of Simple Regression

The two methods of estimating regression coefficients are the eyeball fitting and least squares method of estimating. The eyeball fitting method requires a scatter diagram of the data points. A straight line that most accurately fits the linear trend in the data is then superimposed. Interestingly, this method is not reliable since different researchers may draw different lines to the same data set. The second method-least square chooses estimates, commonly b_0 and b_1, respectively for the parameters β_0 and β_1, so as to minimize the sum of squares of the differences between the estimated values of the dependent variable, y and their corresponding observed values.

The method leads to the following normal equations;

$$b_0 = \frac{\sum_{i=1}^{n} y_i}{n} - b \frac{\sum_{i=1}^{n} x_i}{n} \text{ and } b_1 = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n\sum_{i=1}^{n} x_i - \left(\sum_{i=1}^{n} x_i\right)} \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (3)$$

2.1.2 Interpretation of Regression Coefficient of simple linear Regression

The regression coefficient, b_0 is the estimated value of dependent variable when the value of x is zero, b_1 is the change in y for a unit change in the predictor variable. In regression analysis, apart from fitting the regression equation to the data, we often go beyond to make inferences about the population from which the data was drawn.

Since the regression coefficients are estimates, using the resultant equation for prediction may not give exact results. The standard error, s, of an estimate is a measure that indicates how precise a prediction is. Geometrically, the standard error measures the spread of observed values around the regression line. Mathematically, the standard error of the simple linear regression is given as:

$$s = \sqrt{\frac{\sum_{i=1}^{n} (y_i - \hat{y})}{n-2}} \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (4a)$$

Where:

s = standard error, y_i = observed values of the dependent variables, and $\hat{y}_i$ = Estimates from the regression line

For purposes of easier computation equation 4a can be simplify as: $s = \sqrt{\frac{\sum_{i=1}^{n} y_i^2 - a\sum_{i=1}^{n} y_i - b\sum_{i=1}^{n} x_i y_i}{n-2}}$ ...

$\ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad$ (4b)

x_i = Observed values of the independent variables

2.1.3 Inference on the Slope of Simple Regression

Making reference to the equation, $y = \beta_0 + \beta_1 x + \varepsilon$, if $\beta_1 = 0$, then y assumes a constant value β_0 no matter the value of x. This means that the values of y do not depend on the values of x when $\beta_1 = 0$. In

such situation, x is said to be unimportant or insignificant; and so can be dropped from the equation. On the other hand, if $\beta_1 \neq 0$, then the values of y depend on the values x. This means that x is important or significant and therefore cannot be dropped from the equation. The significance or otherwise, of x, can be ascertained by testing the hypothesis:

$H_O = 0$ (x is not significant)

$H_a \neq 0$ (x is significant)

The test statistic for testing H_O is calculated from

$$t = \frac{b}{s / \sqrt{S_{xx}}} \quad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (5)$$

Where

b is the estimated regression coefficient for β; s is the standard error of the

estimate; $S_{XX} = \sum_{i=1}^{n} (x_i - \overline{x})$; and t has the Students $t-$distribution with $n-2$ degrees of freedom.

2.1.4 Model assumptions on simple regression
1. At any given value of the independent variable, the population of potential error term values has a mean of zero.
2. **Constant Variance Assumption;** at any given value of the independent variable, the population of potential error term values has a variance that does not depend on the value of the independent variable. We denote its constant variance as σ^2.
3. **Normality Assumption;** at any given value of the independent variable, its population of potential error term values has a normal distribution.
4. **Independence Assumption;** at one value of the error term is statistically independent of any other value of corresponding to an observed value of the dependent variable is statistically independent of the error term corresponding to any other observed value of dependent variable, thus $E(y, \varepsilon) = 0$.

2.1.5 F test for The Simple Linear Regression Model
Supposing the regression assumption hold, we define the overall F statistic to be

$$F_{model} = \frac{\exp lained \ \text{var}iation}{un \exp lained \ \text{var}iation \Big/ (n-2)} \quad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (6)$$

We can reject $H_o : \beta_1 = 0$ and conclude on $H_a : \beta_1 \neq 0$, the alternate hypothesis at a level of significance, α, if either of the following equivalent conditions holds:

  i. $F_{model} > F_{(\alpha, df_1, df_2)}$ ii $p - value < \alpha$

2.2 Multiple regression
In real world, there may be the need to use several variables in prediction one dependent variable and this is what we refer as multiple regression. The linear regression relating a dependent variable, y to several independent variables.

$x_1, x_2 \ldots \ldots \ldots x_k$ is $y = \mu_{y/x_1, x_2 \ldots \ldots x_k + \varepsilon} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots \ldots \ldots \ldots \ldots \beta_k x_k + \varepsilon$ ...
        ...   ...   (7)

Where, $\mu_{y/x_1,x_2\ldots\ldots\ldots x_k+\varepsilon}$ is the mean value of the dependent variable y when the values of the independent variables $\beta_0, \beta_1\ldots\ldots\ldots\beta_k$ are the unknown regression parameters to be estimated; ε is an error term that describes the effect on y of all factors other than the independent variable $x_1, x_2\ldots\ldots\ldots x_k$.

In general, the normal equation s involving k independent variable using the least squares estimates are given by:

$$b_0 \qquad +b_1\sum_{i=1}^{n}x_{i1} \quad +\ldots\ldots\ldots+b_k\sum_{i=1}^{n}x_{ik} \quad =\sum_{i=1}^{n}y_i$$

$$b_0\sum_{i=1}^{n}x_{i1} +b_1\sum_{i=1}^{n}x_{i1}^{2} +\ldots\ldots\ldots+b_k\sum_{i=1}^{n}x_{i1}x_{ik} =\sum_{i=1}^{n}x_{i1}y_i$$

$$. \qquad . \quad . \qquad +\ldots\ldots + \quad . \qquad = \quad . \qquad \ldots\ldots \qquad \ldots \qquad \ldots \qquad (8)$$

$$. \qquad . \quad . \qquad +\ldots\ldots \quad + \quad . \qquad =$$

$$. \qquad . \quad . \qquad +\ldots\ldots\ldots + \quad . \qquad = \quad .$$

$$b_k\sum_{i=1}^{n}x_{i1} +b_1\sum_{i=1}^{n}x_{i1} +\ldots\ldots\ldots+b_k\sum_{i=1}^{n}x_{i1}^{2} =\sum_{i=1}^{n}x_{i1}y_i$$

Analysis of multiple regression by hand can be tedious and time consuming, especially when $k > 2$. Any case regression analysis was done using statistical soft wares such as SPSS and SAS

2.2.1 Assumptions of Multiple Regression

1. At any given combination of values of $x_1, x_2\ldots\ldots\ldots\ldots x_k$, the population of potential error term values has a mean of zero.

2. **Constant Variance Assumption:** Any given combination of value $x_1, x_2\ldots\ldots\ldots\ldots x_k$, the population of potential error term values has a variance that does not depend on the combination of values of $x_1, x_2\ldots\ldots\ldots\ldots x_k$.

3. **Normality Assumption:** At any given combination of values $x_1, x_2\ldots\ldots\ldots\ldots x_k$, the population of potential error term values has a normal distribution.

4. **Independence Assumption:** At any one value of the error term ε is statistically independent of any other value of any other value of ε

Suppose the linear regression model:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots\ldots\ldots\ldots\beta_k x_k + \varepsilon \qquad \ldots \qquad \ldots \qquad \ldots$$

(9)

Utilizes k independent variables and thus have k+1 parameters $\beta_0, \beta_1, \ldots\ldots\ldots\ldots, \beta_K$ then if the regression assumption is satisfied, and if **SSE** denotes the sum of squared residuals for the model. A point estimate of σ^2 is the mean square error whiles a point estimate of σ is the standard error. The standard error s, given as:

$$s = \sqrt{\frac{SSE}{n-(k+1)}} \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (10$$

2.2.2 Model Utility: R², overall f test and p – value.

As a regression model gives a small s, then the model will accurately predict individual y values. For this reason, s is one of measure of usefulness or utility, of a regression model. Another way to assess the utility of a regression model is the use of the multiple coefficient of determination R^2. The R^2 is the proportion of

the total variation on n observed values of the dependent y variable that is explained by the overall

regression model. By definition the R² lies between 0% and 100 percent (%), a high R^2 indicates a reliable regression model for prediction.

The R^2 is computed by:

$$R^2 = \frac{Explained\ Variation}{Total\ Variation} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \tag{11}$$

Where the total variation = $\sum (y_i - \overline{y})^2$, explained variation = $\sum (y_i - \overline{y})$ and the

unexplained = SSE = $\sum (y_i - \hat{y}_i)$

Suppose that the regression assumption hold and that the linear regression model has $k+1$ parameters, and consider testing

$$H_0 : \beta_1 = \beta_2 = \dots\dots\dots\dots = \beta_K \,,$$

against

$$H_a : \beta_1 \neq \beta_2 \neq \dots\dots\dots\dots\dots \neq \beta_k$$

We define the overall F statistic as:

$$Fmodel = \frac{Explained\ Variation/k}{Unexplained\ Variation/(n-k-1)} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \tag{12}$$

We can reject H_0 in favour of H_a at the level of significance α if either of the following holds:

    i. $F_{\text{mod}el} > F_{(\alpha,df\,,df_2)}$ ii. $p - value < \alpha$

Just as in the case of simple regression. Again, the point F_α is based on k numerator and $n - (k+1)$ denominator of degrees of freedom.

2.3 Transformations
Sometime there may be the need to transform variables as a remedy to a violation of some assumptions. A possible remedy for violation of constant variance assumption, corrects functional form and normality assumption is given by transforming the dependent variable. Common transformations from y to y^* include:

    (i)   Square root transformation; $y^* = \sqrt{y}$

    (ii) Quartic root transformation; $y^* = \sqrt[4]{y}$

    (iii) Logarithmic transformation; $y^* = \ln(y)$

    (iv) Reciprocal transformation; $y^* = \dfrac{1}{y}$

    (v) Arcsine transformation; $y^* = \arcsin\sqrt{y}$

The transformation not only tends to equalize its error variance but also tend to "straighten out" certain types of non-linear data plots.

2.4 Variable Selection
One of the important steps in the construction of regression models is the elimination of insignificant or unimportant variables from the equation. Fewer variables are easier and simpler to interpret. When statistically insignificant variables are omitted from a model, the error of estimation reduces. However, the omission of significant variables may lead to bias in prediction. Hence, the significance of estimated parameters be to be assessed before including them in the model. Two common method for choosing

variables, All-possible regression and the stepwise regression. The latter have three options: forward stepwise selection, the backward elimination and the stepwise selection.

This paper made use of the forward stepwise selection – where the predictor that accounts for the largest variation in the response variable is chosen and continues by adding one variable at a time the previously chosen subset until the best model is establish.

2.5 Chow Test (*Structural or Parameter Stability of Regression Models*)

To examine whether structural changes had taken place in FDIs over the period as well as in the relationship between FDI and the regressors (exchange rate, inflation, interest rates, employment and GDP), the study employed the chow test in this situation. By structural change we mean that the values of the parameters of the model do not remain the same over the different periods. The study tried to examine the changes that had taken place in FDI inflow into the country during the implementation of the first and the second medium term corporate plan including the implementation of the restructured gateway projects under the trade facilitation components by the GIPC.

The sample data was divided into two time period: 1994-2000 (a period of implementation of the first medium plan by GIPC) and 2001-2010 (a period of implementation of the second term medium plan as well as implementation of the restructured gateway projects under the trade facilitation components). Two possible regressions were developed for the sub-periods:

$$y_t = \lambda_1 + \lambda_2 x_t + \mu_{1t} \qquad \text{for 1994 – 2000 ... ...} \qquad ... \qquad ... \qquad ... \qquad ... \qquad \textbf{(13a)}$$

$$y_t = \gamma_1 + \gamma_2 x_t + \mu_{2t} \qquad \text{for 2001 – 2010 ... ...} \qquad ... \qquad ... \qquad ... \qquad ... \qquad \textbf{(13b)}$$

$$y_t = \beta_o + \beta_1 x_t + \mu_t \qquad \text{for 1994 – 2010 ... ...} \qquad ... \qquad ... \qquad ... \qquad ... \qquad \textbf{(13c)}$$

2.5.1 Hypothesis

H_O: *Regression model (3) assumes that there were no differences between the three time periods and therefore estimates the relationship between FDI and the independent variables respectively, for the entire period of 17 years. In other words, this regression assumes that the intercept as well as the slope coefficient remain the same over the entire period, and therefore states there were no structural changes.*

This means $\lambda_1 = \gamma_1$ and $\lambda_2 = \gamma_2$

H_1:   Equations (1) and (2) assume that the regressions in the two time periods are different; that is, the intercept and the slope coefficients are different.

That is $\lambda_1 \neq \gamma_1$ and $\lambda_2 \neq \gamma_2$.

The test statistics to test the hypothesis above is the chow test which is given as:

$$F = \frac{(RSS_R - RSS_{UR})/k}{(RSS_{UR})/(n_1 + n_2 - 2k)} \quad \text{compare to} \quad F = (k, n_1 + n_2 - 2k) \text{ Where,}$$

RSS_R denotes the restricted residual sum of square
RSS_{UR} denotes the unrestricted sum of squares
But $RSS_{UR} = RSS_1 + RSS_2$.
k= Number of parameters estimated, ***d.f.*** = (n₁+ n₂ – k)   Degree of freedom, ***n₁***= sample size for period 1, and ***n₂***= sample size for period 2

2.5.2 Assumptions Underlying The Chow Test

1. The error terms U_{1t} and U_{2t} are independently distributed.
2. The error terms in the sub-period regressions are normally distributed,

U_{1t} .....   (0, σ^2).

The paper estimated the parameters of the model below:

$$\ln FDI = B_0 + B_1 EXC + B_2 INF + B_3 INT + B_4 GDP + B_5 EMP + \varepsilon \text{ ... (14)}$$

Where ln *FDI* is the natural logarithm of foreign direct investment, *EXC* represents exchange rates , *INF* denotes inflation, *INT* are the prime interest rates, *GDP* represents gross domestic product (used as a proxy for economic growth), *EMP* represent the expected employment creation by enterprises under

FDI (used as a proxy for employment). B_0 is the intercept represents other possible independent variables that could explain FDI, not included in the model). ε is the error term.

3.0 Results and Discussion

3.1 Introduction
Statistical tools such as the trend estimation, Chow Test, regression as well as time series analysis were used for the analysis. The first part of the chapter looks at the trends in foreign direct investment, exchange rates, inflation, interest rates, GDP and expected employment creation by enterprises under FDIs in Ghana and goes on further to look at the direct relationship between FDI and the selected economic indicators individually. Subsequently, it examines the structural changes or breaks in FDI over the period as well as the structural stability in the relationship between FDI and the selected economic indicators which were found to be statistically significant, such as exchange rates and GDP. Furthermore, the significance of these economic indicators on FDI's in Ghana is examined.

3.2 Trends of FDIs and Economic Variables in Ghana
3.2.1 Trend of FDIs in Ghana
Figure 1 shows the trend of FDIs in Ghana from 1994 to 2010. Figure 1 suggests that the trend of FDIs in Ghana is not linear over the period. There was an upward trend up to 1997 and then flattened out to 2004. This was followed by a sharp rise with a peak in 2007 and then dropping sharply to 2009. Again there was a small rise to 2010.

From Figure 1 it can be realized that the year 2007 recorded the highest amount of FDI ($5029) million dollars representing about (32.61%) of the total FDI's registered over the period 1994-2008, whiles the year 2008 recorded the second largest amount of FDIs ($3540.13) million dollars representing (22.95%).
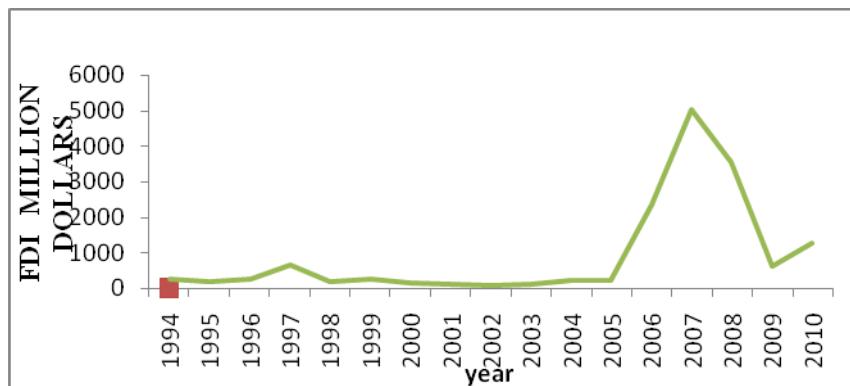

Figure 1: Trend of FDI in Ghana (1994-2010)

The year 2006 recorded the third largest amount of FDIs ($2367.87) million dollars representing (15.35%). It could be realized that the year 2002 recorded the least amount of FDIs ($69.67) million dollars representing (0.45%) of the total FDIs recorded over the period. It could also be realized that a year after the presidential and parliamentary elections (2001 and 2009) in Ghana there was a decline in FDI. For instance, FDI dropped from 132.06 million dollars to $97.94 million dollars representing 25.8% from 2000 to 2001 also declined sharply by 82.3% from $3540.13 million dollars to $627.73 million dollars from the year 2008 to 2009.

3.2.2 Trend of Exchange Rate
Figure 3 shows the trend of exchange rate over the study period. The rate employed is the Ghana cedi/US Dollar rate.

From Figure 3, it can be realized that exchange rates seemed to have had an increasing positive trend over the period under review.
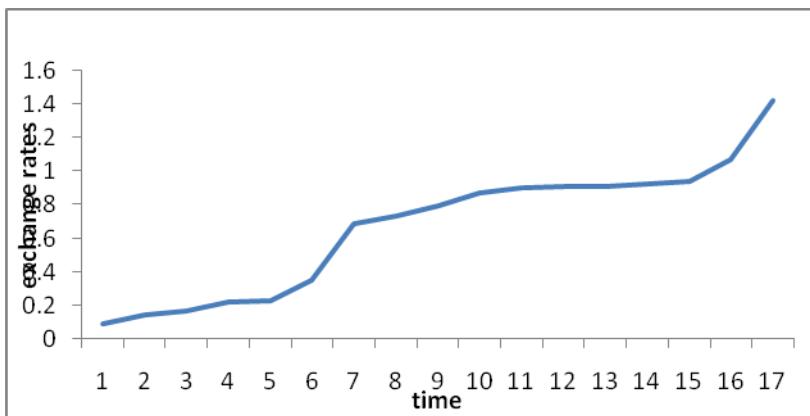
Figure 3: The trend of exchange rate (1994 – 2010)

Figure 3 shows that there was a positive relationship between exchange rates and time over the period. Critical assessment of the graph indicated that exchange rates depreciated slowly from 1994 -1999 but depreciated quickly from 1999-2000 representing 79.7%. Moreover, the rest of the years had experienced relatively lower depreciation rates until 2009 when it began to rise again.

3.2.3 Trend of Inflation

The effects of high inflation include decrease in the real value of money and other monetary items over time and also uncertainty over future inflation may discourage investment and savings. Figure 4.3 depicts the trend of inflation in Ghana for the period 1994 - 2010:Inflation over the period showed a general downward trend.
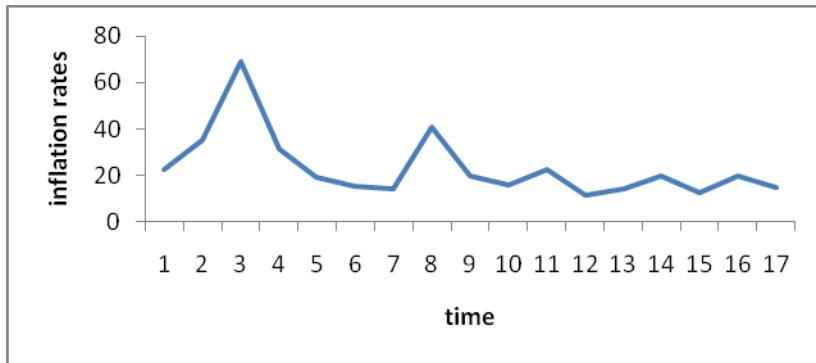

Figure 3: The trend of inflation (1994-2010)

Inflation attained its peak in 1996 at a rate of 69.20% but declined continuously till the year 2001 when it begun to rise   again   and has had a mixed experience since then. Generally from 2008, Ghana had experienced persistent slow inflation (Akuffo and Mintah, March 2013)

3.2.4 Trend of Interest Rate

There are several types of interest rates operating in the market, but the study made use of the prime interest rates. The prime interest rate, or prime lending rate, is largely determined by the Bank of Ghana, which is the overnight rate, which Banks lend to one another. The prime rate is also important for retail customers, as the prime rate directly affects the lending rates, which are available for mortgage, small businesses and personal loans. Most often, Banks within the country set their lending rates based on the Central Bank's prime rates. Figure 4 shows the trend or pattern of interest rates in Ghana for the period:
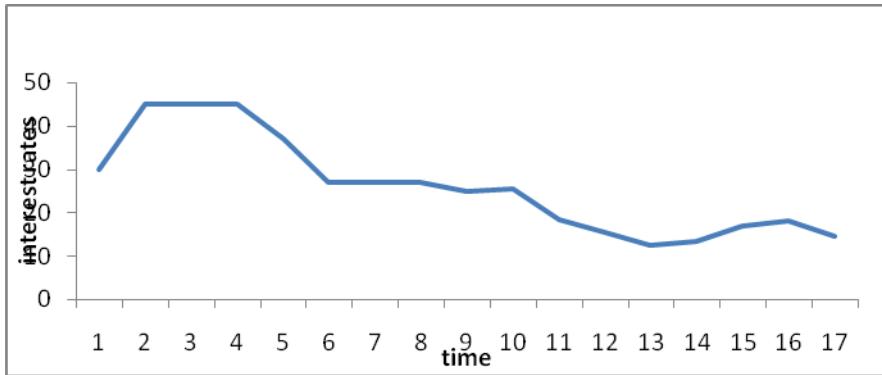
Figure 4: Trend of time on interest rates (prime 1994-2010)

With reference to Figure 4, over the period the interest rate appears to had have a downward trend. Interest rate relates negatively to time over the period. It attained its peak from 1995-1997 recording a stable value of interest rate at 45%. It has declined consistently from 1997 to 2006 with 12.5% but begun to rise during 2007and 2008 of the period under study.

3.2.5 Trend of GDP

Gross domestic product (GDP) is one of the important economic indicators in the world and thus Ghana. Gross domestic product is the total market value of goods and services that are exchanged for money or trade in a market system over a certain period (usually a year or a quarter) regardless of who owns the productive assets. GDP measures the value of all economic activity within a country's border.
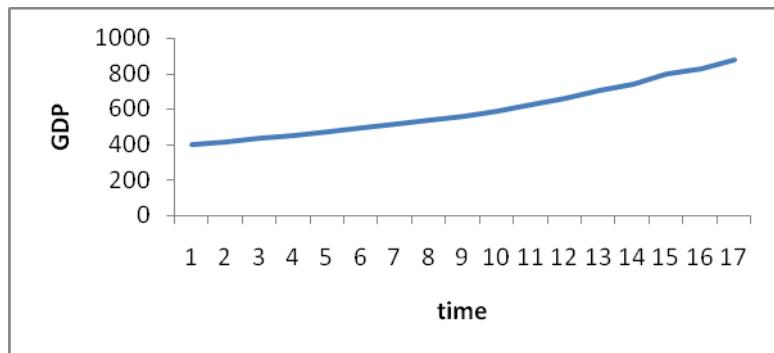

Figure 5: Trend of GDP (constant 1993 prices 1994-2010)

The Figure 5 shows the pattern of GDP for the period 1994 - 2010.GDP had been increasing consistently from the start of the period to the end of the   period.

3.2.6 Trend of Employment

Foreign direct investment is expected to create employment for both Ghanaians and foreigners. For the purpose of this study employment is defined as the number of jobs enterprises under FDI are expected to create for Ghanaians. Figure 6 depicts the trend of employment expected to be created by enterprises under FDIs.
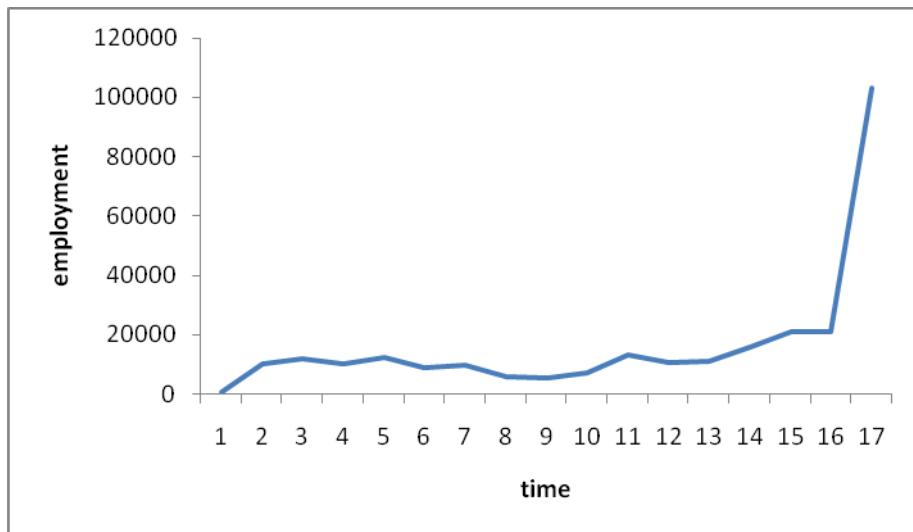
Figure 6: The trend of expected employment (1994-2010)

Expected employment creation by FDIs has not been consistent over the period. Obviously there had been upward and downward trends. Employment attained its peak in the year 2010 representing by 36.9% whiles the year 1994 recorded the least number of expected employment creation by enterprises under FDIs representing 0.26%.

3.3 Relationship between FDI and the Economic Variables
We examine the relationships between FDIs and the some identifiable economic variables in respect to the study.

3.3.1 Regression of individual variables on FDIs
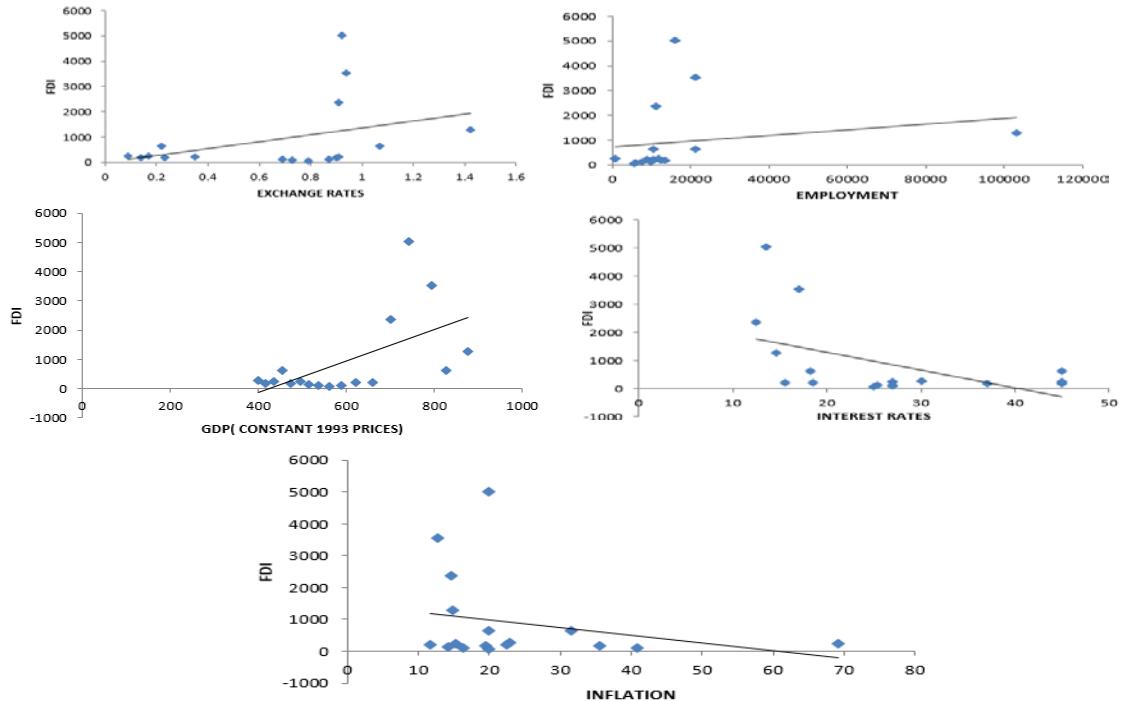Figure 7 shows the relationships between FDIs and the individual economic variables.

Figure 7: Relationship between variables and FDI

From Figure 7, it can be seen that exchange rate, expected employment and GDP relate positively with FDI. That is all things been equal, increase in these aforementioned variables will lead to an increase in FDI into the country. However, interest rate and inflation had inverse relationship with FDI. It is important to state however, that these relationships are in varying degrees. Table 1 shows the regression result for individual variables on FDI. This is to be able to examine the quantitative impact of these relationships.

Table 1: Simple Regressionon FDIs

	estimate	s.e.	t	P - value	R - square (R²)
Exchange model					
Constant	-6.6316	666.37	-0.01	0.9922	*0.142*
Exchange rate	1368.66	867.63	1.58	0.1355	
Inflation model					
Constant	1476.95	680.60	2.17	0.0465	*0.0592*
Inflation	-24.140	24.855	-0.97	0.3468	
Employment model					
Constant	717.56	434.714	1.65	0.1196	*0.0346*
Employment	0.0115	0.01573	0.73	0.4747	
GDP model					
Constant	-2302.028	1221.554	-1.88	0.0790	*0.3279*
GDP	5.40316	1.9973	2.71	0.0163	
Interest rate model					
Constant	2567.223	801.023	3.20	0.0059	*0.2514*
Interest rate	-63.679	28.369	-2.24	0.0403	

Table 1 shows the results of simple regression on FDIs of the identifiable economic indicators. From Table 1 it can be realized that, among the variables in the study, GDP accounts for 32.79% of the total variation in FDIs. More so, Interest rates accounts for 25.14% of the total variation in FDIs as shown in the regression results in Table 1. Meanwhile exchange rate, inflation and employment could explain for 14.2%, 5.92% and 3.46% of the total variation in FDIs respectively as indicated by R-Square. Interestingly, fromTable 1 it can be seen that GDP and interest rates are significant with their P values 0.0163 and 0.0403 respectively less thanthe level of significance at $\alpha = 0.05$ whereas exchange rate, employment rate, and inflation are not significant at 5% significance level.

A closer look at Table 1 shows that interest rate and inflation have inverse relations with FDIs as they exhibit regression coefficients of -63.679 and -24.140 respectively. This means that a unit increase in inflation will results to a decrease in FDI by 63.679 units. Again a unit increase in inflation will result to a decrease of FDI by 24.14 unitsThis results is consistent with existing literature that countries with stable or low interest and inflations rates attract much higher levels of FDIs.

From Table 1 another set of variables being GDP, employment and exchange rate exhibited positive influence on FDIs. The results from Table 1 shows that a unit increase in GDP will give rise to FDI by 5.403; a unit increase in exchange rate will also results in an increase in FDI by 1368.66 units.

3.3.2 Regression of Variables on FDI
After assessing the behaviour of individual variables on FDI, we seek to look at a single model of exchange rate, interest rate, employment rate, GDP and inflation on FDI to examine the significance and behaviour of these variables in a single model.

Table 2: Multiple Regression on ln (FDI)

parameter	estimate	s.e.	t	P - value	R - square (R²)
Constant	1.28050000	2.516000	0.51	0.6209	
Exchange rate	-4.2383300	1.450000	-2.92	0.0139	
Inflation	-0.0012100	0.018000	-0.07	0.9488	*0.677*
Employment	0.00000886	0.000120	3.58	0.4775	
GDP	0.01277000	0.003570	0.74	0.0043	
Interest rate	-0.0148800	0.045680	-0.03	0.7508	

Table 2 shows the results of the regression analysis. The resulted model can be stated as:

$\ln(FDI)$=1.28–4.24*exchange rate*+0.013*GDP*+0.00000886*employment*–0.01488int*erestrate*–0.0012inf *lation*

From Table 2 it can be realize that 67.7% of the total variation in FDIs is accounted for by exchange rates, interest rates, inflation, employment and GDP. Again Table 2 suggests that inflation, expected employment and interest rates were not significant in the model since their p – values, 0.9488 ,0.4775 and 0.7508 respectively were all greater than the level of significance at $\alpha = 0.05$ .Nevertheless exchange rates and GDP were found to be significant with p – values 0.0139 and 0.0043 respectively at the same level of significance since their p – values were found to be less than 0.05.

3.3.2 Selection of Variables; a Reduced Model for FDI
Haven realize that GDP and exchange rates are significant a different model was run on them to examine how they influence FDIs. Table 3 shows the results of the regression.

Table 3: Reduced model of Multiple Regression on ln (FDI)

parameter	estimate	s.e.	t	P - value	R - square (R²)
Constant	0.17720	1.09959	0.16	0.8743	
Exchange rate	-3.92111	1.12618	-3.48	0.0037	*0.6610*
GDP	0.01381	0.00293	4.72	0.0003	

From Table 3, the model for FDI can be stated as

$$\ln(FDI) = 0.17720 - 3.92 exchange\ rate + 0.0138 GDP$$

The above model indicated that both exchange rates and GDP were significant with their P values 0.0037 and 0.0003 respectively which were far less than the level of significance at $\alpha = 0.05$. It could be realized that 66.10% of the total variation in FDI could be accounted for by exchange rates and GDP along. Consequently, a unit decrease in exchange rates would increase FDIs by 392.1% holding GDP constant. On the other hand, a unit increase in GDP would increase FDIs by 1.38% holding all exchange rate constant.

It is worth noting that only exchange rate and GDP accounts for 66.10% of the variations in FDI whereas inclusion of the other variables as interest rate, inflation and expected employment accounts for 67.7% of the variation in FDI even though these other variables were not significant.

3.3.3 Structural Stability in FDIs
To determine whether there were structural changes in FDI over the period under study (1994 – 2010), three models were developed for three segmented time period. These period are first medium term plan, 1994 – 2000 and the second medium term plan, 2001 – 2010 and the overall period 1994 – 2010.

Table 4 shows the results of the structural analysis of time on FDI for the three period segment.

Table 4: Structural stability of FDI on time segment

Period	Variable	Intercept	Co-efficient	RSS	R^2	p - value	F_{chow}
1994 - 2000	time	5.75124	-0.07109	1.34825	0.0950	0.5013	
2001 – 2010	time	3.75172	0.10878	0.59799	0.6201	0.0068	*12.1*
1994 – 2010	time	4.76091	0.11140	14.30676	0.2641	0.0359	

The models emanating from the analysis are as follows:

$$Model\ 1:1994-2000:\ln(FDI)=5.75124-0.071TM \qquad \ldots \qquad \ldots \qquad (\textbf{15a})$$

$$Model\ 2:2001-2010:\ln(FDI)=3.75172+0.10878TM \qquad \ldots \qquad \ldots \qquad (\textbf{15b})$$

$$Model\ 3:1994-2010:\ln(FDI)=3.76091+0.11140TM \qquad \ldots \qquad \ldots \qquad (\textbf{15c})$$

A careful look at the estimated regressions, suggest that the relationship between FDI and time were not the same in the three sub periods. The marginal propensity to invest (MPI) that is, the (mean) change in FDI as a result of a unit increase in time were as follows: For the period 1994-2000 the MPI was about -0.07109, whereas the period 2001 – 2010 recorded MPI of 0.10878. Furthermore, the whole period under study recorded 0.11140. In other words, the average annual growth of FDIs during the various period (1994 - 2000, 2001 - 2010 and 1994 - 2010) under study were recorded as -7.1%, 10.8%, and 11.1% respectively.

Again, the resulting model from the first medium term plan period, 1994 – 2000 was not significant with a p – value of 0.5013. However, the second term plan period and the overall period were found to be significant with p – values of 0.0068 and 0.0359 respectively.

A test for structural stability of FDI over the period using the Chow test was conducted to examine whether there were structural changes between the two sub - periods under study. The following hypotheses were tested:
H_0: There were no structural differences between the two time period in the relationship between FDI and time.
H_1: There were structural differences between the two time period in the relationship between FDI and time.

From Table 4 the Chow test showed a significant result since F_{chow} = 12.1 was found to be greater than $F_{(2,13)}$ = 3.81, we therefore rejected H_0 and concluded that where were structural differences between the two sub - period relationship between FDI and time.

The period 1994 - 2000 recorded a p – value of 0.5013 which is greater than the level of significance at $\alpha = 0.05$. Hence, we can conclude that time was not significant in determining FDIs. On the converse, 2001 – 2010 and 1994 - 2010 recorded p – values of 0.0068 and 0.0359 respectively, which were all lesser than the level of significance at $\alpha = 0.05$ and we can conclude that time was significant in determining FDIs in the second term plan and the overall period under study.

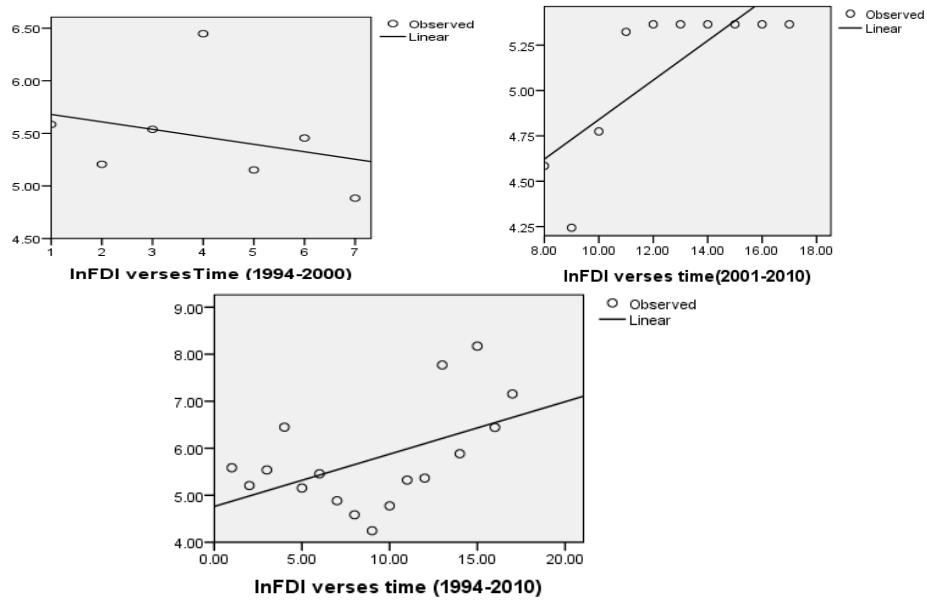Figure 8 shows the structural plots of the various time periods.

Figure 8: Plot of structural stability of FDIs (1994 – 2010)

A part from the period 1994 – 2000 period for the first medium term plan for FDI, which had a negative relationship with FDI, the rest of the periods recorded positive relationship with FDI over time as shown in Figure 8.

3.3.4 Structural Stability of FDI on Significant Variables

Studying the structural changes that had taken place over the period in the relationship between FDI and exchange rate, the following models were developed for the periods:(1994-2000, 2001-2010 and 1994-2010) since GDP and exchange rate were found to be statistically significant on FDI. Table 5 shows the results of structural stability between FDI on exchange rate and GDP.

Table 5: Structural stability of FDI on time segment

Period	Variable	Intercept	Co-efficient	RSS	R^2	p - value	F_{chow}
1994 - 2000	Ex. rate	5.77054	-1.12469	1.17834	0.2090	0.3023	
2001 – 2010	Ex. rate	3.96580	1.21100	1.10155	0.3202	0.1011	*8.47*
1994 – 2010	Ex. rate	5.49652	-0.35758	3.27090	0.0874	0.2493	
1994 - 2000	GDP	7.22257	-0.00385	1.33411	0.1045	0.4795	
2001 – 2010	GDP	3.26958	0.00267	0.69355	0.5594	0.0129	*9.31*
1994 – 2010	GDP	5.34710	-0.00015	3.57599	0.0023	0.8554	

Table 5 shows that FDI and exchange rates had not been the same in the two sub- periods, recording $F_{CHOW} = 8.47$, which was greater than $F_{(2,13)} = 3.81$. In any case the coefficients were not significant for any of the periods. Interestingly, for all the models developed exchange rates were found to be not significant since the P values recorded were all greater than the level of significance at $\alpha = 0.05$. Moreover for the period 1994-2000 exchange rates were inversely related to FDIs as well as 1994-2010 but 2001-2010 recorded a positive relation with FDIs. From Table 5 it can be seen that GDP were not significant for the periods 1994-2000 and 1994 -2010 with P values 0.4795 and 0.8554 respectively but showed a significant result for the period (2001 - 2010) under study. FDI was expected to decline by 0.38% (1994 - 2000) but declined by 0.015% for the whole period (1994 - 2010).

Using the Chow test to find whether there were structural changes between the three sub-periods under study, the following hypotheses were tested:

H_0: *There were no structural change s between the two time period in the relationship between FDI and GDP.*
H_1: *There were structural differences between the two time periods in the relationship between FDI and GDP.*

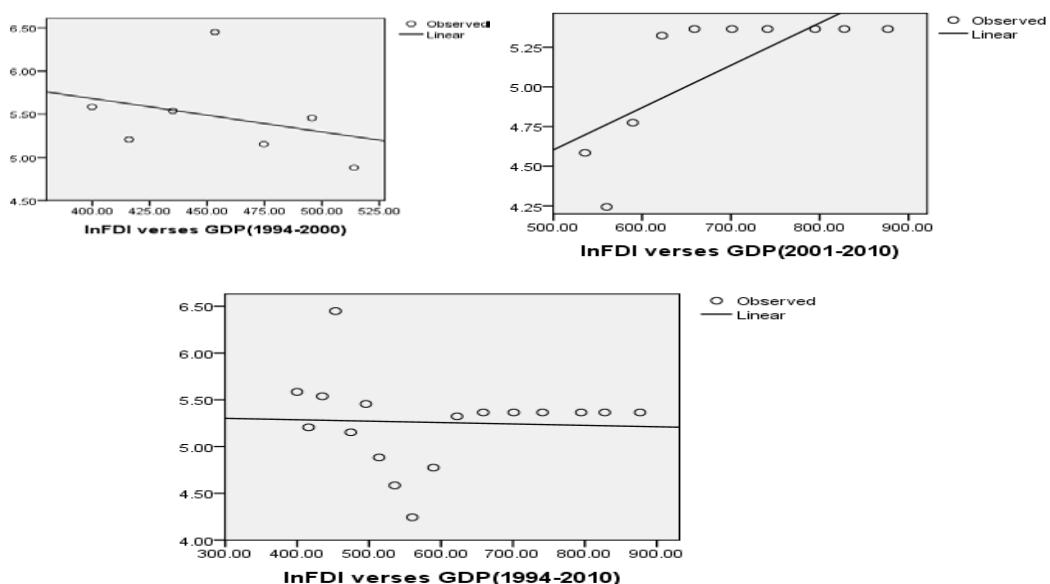Figure 9 shows the plots of FDI and GDP to examine the structural stability.

Figure 9: *Structural forms of FDI and the other variables*

The Chow test showed a significant results since $F_{chow} = 9.31$ for GDP was found to be greater than $F_{(2,13)} = 3.81$, we therefore rejected H_0 and concluded that there were structural differences between the three sub- periods in the relationship between FDI and GDP. However, since the $F_{chow} = 8.47$ for exchange rate was also found to be statistically insignificant we therefore examine the structural plots of GDP.

4.0 Conclusion

FDI has been an important component of capital financing for developing countries such as Ghana. From the findings, FDI inflows into the country had experienced a reasonable increasing trend (11.1%) over the period under study (1994-2010). Again, FDI inflows had undergone structural changes over the entire period (1994-2010). The changes were such that FDI grew by -7.1% for the period 1994-2000 and 10.8% for 2001-2010.Moreover, there had been structural changes in the relationship between FDI and exchange rates as well as FDI and GDP. Lastly, exchange rates and GDP were found to be significant and had the signs expected of them by economic theory; meanwhile inflation, interest rates and expected employment were found to be insignificant.

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