



Weighted Least Squares Regression on Some Selected Micro-Economic Variables

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Abstract

This study investigate the relationship between the All Share Index (ASI) as a dependent variable and some selected micro-economic variables, including the Inflation rate, Interest rate, and the Exchange rate, as independent variables using weighted least square (WLS) regression analysis. The ASI is a crucial indicator of overall market performance, reflecting the collective value of all shares traded on a stock exchange. The aim of this research is to examine how changes in the changes in the Inflation rate, Interest rate, and Exchange rate impact the ASI, providing insight into the dynamics of the stock market in response to macroeconomic factors. WLS regression is chosen for its ability to address heteroscedasticity, which may be present in financial data where the variance of errors is not constant across observations. The methodology involves collecting secondary data from Nigerian Bureau of Statistics (NBS) for a period of ten years from 2010 to 2020 on the ASI. Inflation rate, Interest rate, and Exchange rate. By applying WLS regression, The coefficient of determination (R^2 statistic) is 0.975 which is better than the value of 0.542 obtained by the ordinary least squares (OLS) for the period under study. Therefore, it implies that 97.5% of the variability in All share index can be explained by the explanatory variables (interest rate, inflation rate, and exchange rate) while the remaining 2.5% can be attributed to other factors that is not under consideration in this study. The correlation coefficient between the dependent variable and explanatory variables (table 2) is 0.987, which indicates a very strong positive linear relationship. The test of overall significance (table 3) is highly significant because p-value is 0.000. Therefore, the model is adequate and fit well to the data.

Keywords: Weighted Least Square Regression, All Share Index, Inflation Rate, Interest Rate, Exchange Rate and Micro-economic Variables.

1. Introduction

In the realm of economics and finances, several key indicators play crucial roles in shaping and reflecting the overall economic landscape of a country. Among these indicators are the All-share Index, Inflation Rate, Interest Rate, and Exchange Rate. Understanding these indicators is essential for policy makers, investors and the general public to gauge the health and performance of an

economy. All-share Index is a measure of the performance of a stock market index that reflects the composite value of listed companies shares. It provides insights into the general trend of stock prices and market sentiment. A risen ASI typically indicates a buoyant stock market, while a declining index may signal investors pessimism or broader economic challenges. The Inflation Rate measures the percentage change in the general price level of goods and services over a specific period. Inflation erodes purchasing power, affects consumer behaviors and influences monetary policy decisions. Moderate inflation is generally desirable for economic growth, while, high inflation can lead to economic instability. Interest Rate represent the cost of borrowing money or the returns on investments. Central Banks use interest rate as a tool to manage inflation, stimulate economic growths, or control currency value. Lower interest rates encourage borrowing and spending, while, higher rates curb inflation but may dampen economic activity.

The Exchange rate reflects the value of one currency relative to another and influences international trade, investment flows, and economic competitiveness. Exchange rate fluctuations impact import and export prices, inflation, and overall economic stability. Stable exchange rates are desirable for fostering economic predictability and growth. These four indicators are interconnected and collectively provides a comprehensive overview of an economy's health, stability, and growth prospects. Changes in one indicator can have ripple effects on the others, affecting investment decisions, business strategies and government policies.

Weighted Least Square Regression is an extension of the ordinary least square (OLS) regression that weights each observations scale factor (weight) included in the fitting process, improves the fit and allows handling cases with data of varying quality.

Abiola et al (2017) used quarterly time series data and applied the ARCH and GRACH models, they found out that exchange rate and stock prices are volatile and negatively affect the aggregate output. Izuchukwu et al (2015) used the error correction models and ordinary least square (OLS). The results from their study shows that inflation and monetary policy rate (MPR) had a negative relationship with stock market returns, the GDP on the other hand had a positive relationship with stock market returns. Ladan et al (2014) applied multiple regression analysis to model the relationship between macroeconomic variables (Inflation rate, Interest rate, and exchange rate) and stock prices in Nigeria. They found that exchange rate was the significant indicator while inflation rate and interest rate were not significant in estimating All-share Index. Their results also shows high correlation coefficient between the dependent and the explanatory variables.

2. Materials and Method

The data used is a secondary data collected for a period of ten years (2010-2020) from the Nigerian Bureau of Statistics (NBS) which is the source of our data. All-share Index is the dependent variable while inflation rate, interest rate, and exchange rate are the independent variables. Data was analysed using Statistical Package for Social Science (SPSS 20.0), employing the tools of correlation, ordinary least square (OLS) and weighted least square (WLS) regression.

3. Results and Discussion

Results:

The data was analyzed using the statistical package for social science (SPSS 20.0), employing the tools of correlation, ordinary & weighted least –squares regression. Below are the results of the analyses:

Table 1.0 : Ordinary Least squares regression analysis based on raw data

All share index				
<i>Variables</i>	<i>Estimates</i>	<i>Std. Error</i>	<i>T value</i>	<i>P</i>
Intercept	-644.505	11283.181	-.057	.955
Interest rate	18.974	636.997	.030	.977
Inflation rate	-77.004	121.605	-.633	.533
Exchange rate	184.281	51.688	3.565	.002

R=.736, R² =.542, Adjusted R² =.477 , (F-value) =8.294, Model P =.001

From the above table 1, the correlation coefficient for the fitted model was 0.736 that shows a strong relationship between all share index and the explanatory variables (interest rate, inflation rate, and exchange rate). Furthermore, the coefficient of determination (R²) obtain was 0.542 which implies that 54.2% of the variability in All share index can be explained by the explanatory variables (interest rate, inflation rate, and exchange rate).

The anova for the fitted regression model is significant at 95% confidence level during the period under consideration with the Fishers value (F-value) = 8.294 and a p-value of 0.001. Therefore, the explanatory variables (interest rate, inflation rate, and exchange rate) were significant in estimating All share index at the specified level of confidence. In addition, only exchange rate is significant in at 95% confidence level in estimating All share index during the period of study because the p-value is less than 0.05 while the p-value for inflation rate and interest rate was greater than 0.05. The model reveals that if all the explanatory variables are zero, all share-index will be reduced by 644.505 in value.

WEIGHTED LEAST SQUARES REGRESSION

Table 2.0: Model adequacy

Model Summary ^{b,c}				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.987 ^a	.975	.972	.10757

a. Predictors: (Constant), Exchange rate, Inflation rate, Interest rate

b. Dependent Variable: All share index

c. Weighted Least Squares Regression - Weighted by Weight for all share from WLS, MOD_11 EXCHANGE** -5.000

Table 3.0: Test of Overall Significance

Model	ANOVA ^{a,b}					
	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	9.532	3	3.177	274.594	.000 ^c
	Residual	.243	21	.012		
	Total	9.775	24			

a. Dependent Variable: All share index

b. Weighted Least Squares Regression

c. Predictors: (Constant), Exchange rate, Inflation rate, Interest rate

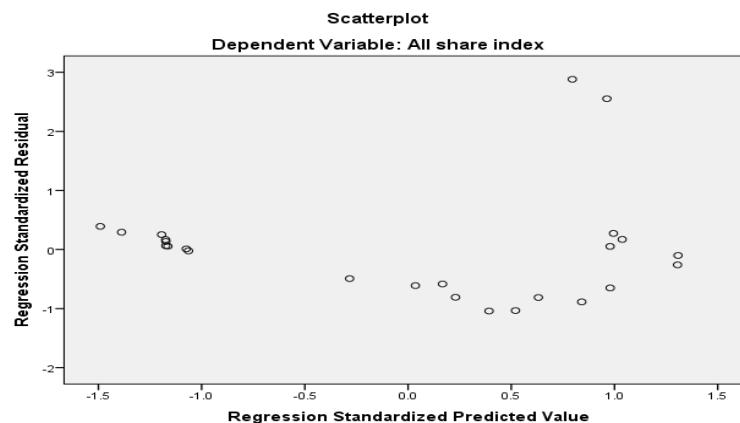
Table 4.0: Model Parameter Estimation

Model	Coefficients ^{a,b}					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error	Beta			
1	(Constant)	229.982	9.884		23.267	.000
	Interest rate	-27.437	1.886	-1.886	-14.549	.000
	Inflation rate	-1.517	.152	-.578	-9.961	.000
	Exchange rate	95.141	4.788	3.045	19.872	.000

a. Dependent Variable: All share index

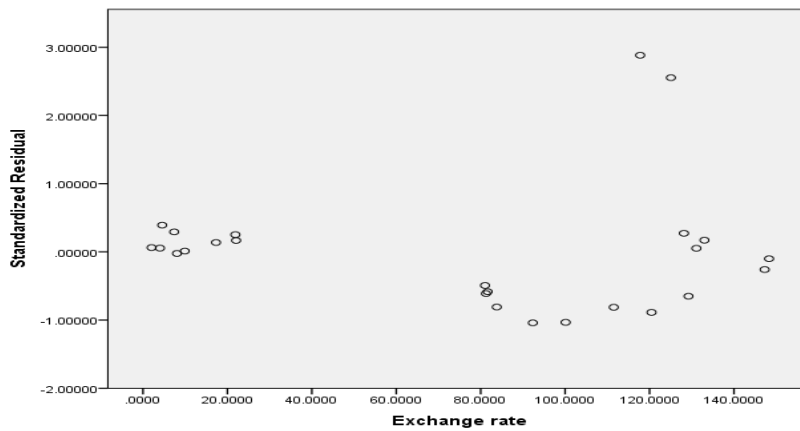
b. Weighted Least Squares Regression - Weighted by Weight for allshare from WLS, MOD_11 EXCHANGE** -5.000

Fig 1.0: Scatter plot of standardized residual vs. standardized predicted values



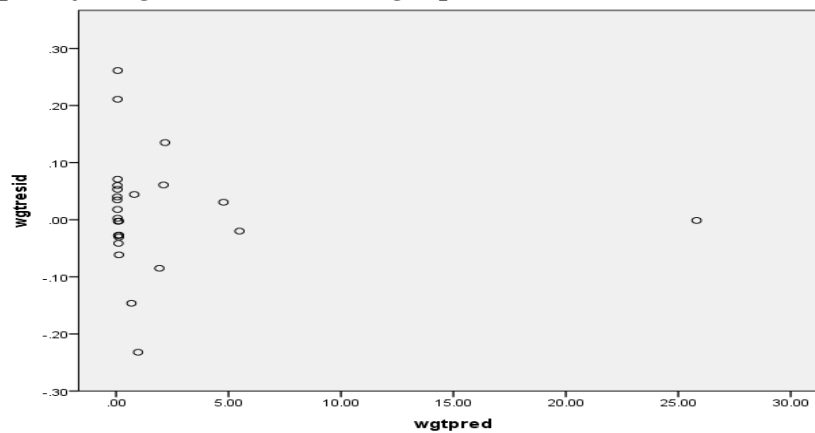
The scatter plot of standardized residual against standardized predicted values in fig 1.0 shows heteroscedasticity (i.e. the variance of the residuals across values of the predicted values). In this plot, the spread of the residuals increases with increasing predicted values. This violates the assumption of the ordinary least squares; therefore, we need to compute weighted least squares model to obtain valid estimates. Before running the weight estimation procedure, there is a need to determine the variable associated with the source of heteroscedasticity among the explanatory variables.

Fig 2.0: Scatter plot of the Standardized residual vs. exchange rate



The scatter plot in fig 2.0 shows the pattern that was evident in the residuals vs. predicted values (fig 1.0) plot. Therefore, exchange rate should be acceptable as source variable for generating weights to correct for the heteroscedasticity. Hence, weight estimation analysis is required at this stage.

Fig 3.0: Scatter plot of weight residual vs. weight predicted



The scatter plot reveals that the weights of residual vs. weight of predicted have correct the heteroscedasticity since there is no systematic pattern in the graph.

Discussions

At first the resulting ordinary least squares(OLS) model in table 1 appears to be reasonable. This is because the model summary reports R^2 statistic of 0.542 that implies that 54.2% of the variability in all share index can be explained by the explanatory variables (interest rate, inflation rate, and exchange rate). In addition, there is strong positive linear relationship between the dependent variables and the explanatory variables since multiple correlation coefficient value is 0.736. The explanatory variables (interest rate, inflation rate, and exchange rate) were significant in estimating the dependent variable ($p = 0.001$). In addition, the significance value of the estimates of exchange rate coefficients is less than 0.06 indicating that its effect is not due to chance. The coefficients of inflation rate and interest rate are not significant at 95% confidence level for the period under consideration.

The results of the weighted least squares regression are presented in tables 2, 3 & 4. The coefficient of determination (R^2 statistic) is 0.975 which is better than the value of 0.542 obtained by the ordinary least squares (OLS) for the period under study. Therefore, it implies that 97.5% of the variability in All share index can be explained by the explanatory variables (interest rate, inflation rate, and exchange rate) while the remaining 2.5% can be attributed to other factors that is not under consideration in this study. The correlation coefficient between the dependent variable and explanatory variables (table 2) is 0.987, which indicates a very strong positive linear relationship. The test of overall significance (table 3) is highly significant because p-value is 0.000. Therefore, the model is adequate and fit well to the data.

Moreover, the parameter coefficients make more sense and the coefficients for inflation rate and interest rate are now significant at 95% confidence interval. Lastly, there is no systematic pattern in the scatter plot(fig 3.0) anyway the weights have corrected for heteroscedasticity.

4. Conclusion

The appropriate estimated regression model by using weighted least squares regression is :All share index = 229.982 - 27.437 (interest rate) – 1.517 (inflation rate) + 95.141 (exchange rate). Finally, our results in this research work has improved on some of the findings of Ladan et al (2014), for example the coefficient of determination (R^2) is 0.975 as against 0.542 in Ladan et al (2014). This means that 97.5 % of the variability in All- share index can be explained by the explanatory variables the remaining 2.5% can be attributed to other factors that are not under consideration in our work.

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