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Regressing Consumer Price Index on selected Financial Market Indicators in Nigeria

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Abstract
The post-2008 fear of the financial meltdown seems to have reduced the interest of investors in financial investments such as treasury bills, Government bonds and Development stock. Was there a relationship between these indicators and inflation in Nigeria? Using a times series data from 1987-2010, a multiple regression model was adapted (with some adjustments in consideration to the Nigerian Situation) from the model of Norliza, Malaysia. The Augmented Dickey Fuller Unit root diagnostic test (ADF) was used to test for Stationarity. Government bond rate was stationary (p = 0.0000) at level. Development stock was stationary (p = 0.0343) at 5% first difference. Treasury bill rate time series data however was stationary (p = 0.0064) at first difference. Commercial papers rate was stationary (p = 0.0002) at level, The data for annual inflation rate in Nigeria was not stationary up to 4th difference, hence it was removed from the model and replaced with Consumer Price Index (CPI) which was stationary at 5% level (p = 0.0357). The coefficients of the explanatory variables were -0.0600, -0.047, -1.073, -0.045 and -0.005, for commercial papers rates, Interest rates, government bond rates, Development stocks and Treasury bills rates, respectively. Consequently, the empirical regression function indicated that all the explanatory variables were negative to the CPI. This implies that when an incremental change occurs in any of the explanatory variables, CPI will fall. The necessity was the relevance of sustaining investment interest in the indicators, which called for Investment Interest Sustenance Program (IISP) and/or Investment Holding Trap (IHT).
Key words: Consumer Price Index, financial market indicators, Inflation rate, Development stock and rates of returns.
JEL Classification: *C25, E44, G13, E43*

1. Conceptual Introduction

After the economic recession of 2008, which was characterized by crash in the value of stocks in the stock market, it becomes important to carry out a research to direct investors on the tradeoff between risk and rewards of short and long term securities. Investors in these areas have either become risk averse or totally disinterested. There is a direct movement between Treasury bill yields and inflation (Ruben and Barbara, 2010), however, the returns are nominal and not real. Therefore, the returns may not be sustained in the real market situations. The outlets are in stocks and bonds, which serve as much more realistic long-run protection against inflation than treasury bills. This calls for inflation-protected securities (Chu, Pittman and Chen, 2007) and inflation-adjusted returns on indexed bonds (Kothari and Shanken, 2004). From the foregoing, one wonders whether the returns on Government bonds, Commercial papers, Development stocks Treasury bills and Interest rates can be adjusted for inflation (proxy by Consumer Price Index)in Nigeria.Therefore this paper seeks to explore the relationship and possible effects of financial market instruments such as Treasury bill returns, Stocks and Government bonds returns, commercial papers, certificate of deposits on Consumer Price Index in Nigeria.

2. Empirical Review

Ruben and Barbara (2010) examined the historical performance of treasury bills related to bonds and stocks under different inflationary conditions. They found out that Treasury bill yields were positively correlated with inflation and provided nominal returns on the average before taxes above the inflation rate. They also assert that stocks and bonds provided better long-run protection against inflation than Treasury bills but it performs better than bonds and stocks in years when inflation was very high and when inflation increases were large. They suggest that Treasury bills could temporarily serve as a refuge when there are high inflation levels and/or large increases in inflation since bonds and stocks are more adversely affected by them. Norliza, Joriah and Tajul (2009), worked on those factors that influence yield spreads of Malaysian bonds. They used this model;

Yield spreadsi, t = $\beta 0 + \beta_1 1$ CPIi, t + $\beta 2$ IRi, t + β 3 KLCIi, t +$\beta 5$ IPIi, t + βi, t
Where,

Yield spreadsi, t represents the difference between Yield to Maturity (YTM) of Malaysian Government Securities, and conventional corporate bonds against 3-month treasury bills rates.
CPIi,tis the monthly Consumer Price Index as a proxy for country's inflation.
IRi,tis the monthly interest rates (3 month Treasury-bill).
KLCIi,tis the month end closing of Kuala Lumpur Composite Index (KLCI index).
IPIi,tis the monthly Industry Production Index.
βi,tis the stochastic error term

And found out that Consumer Price Index and Interest Rate are the major drivers that influence the changes in Malaysia Government Securities yield spreads.
Chu, Pittman and Chen (2007), in their work on the possible effect of CPI on Inflation or disinflation looking into maturing US Treasury Inflation-Protected Securities say that time series behavior of CPI forecasts can provide timely feedback to the Federal Reserve Open Market Committee. This means that CPI is a very strong tool to indicate possible inflation and disinflation in United State of America.
In the quest to know how availability of inflation protected bonds might affect asset allocation decision of investors, Kothari and Shanken (2004) found out that, the real (inflation-adjusted) returns on indexed bonds are less volatile than the returns on similar conventional bonds. Also, the correlation with stock returns is much lower for the indexed bonds. An examination of asset allocation among stocks, indexed bonds, conventional Treasuries, and a riskless asset suggests that substantial weights should be given to indexed bonds in an efficient portfolio.
Mark and Aris (2002) studied whether macro-economic factors do affect aggregate Stock Returns with GARCH model of daily equity returns and used nominal variables like; Consumers Price Index, Producers Price Index and used real factors; balance of payment, employment reports and Housing Starts. They found out that all these variables are related to lower return volatility except Real Gross National Product which is statistically significant at 1%.
Treasury bill returns and common stock returns were examined in Turkey and it was observed that its equity premium was different from that of developed countries (Erdem& Mehmet, 2005). Such a research has not been carried out in Nigeria. In a bid to explain the reason for bond premium, they introduced inflation risk and default risk to an existing set-pricing model by Mehra and Presscott (1985) to them, inflation risk is not sufficient to bring about such alarming equity premium. The report of Economic and Political weekly in 2009 shows that Consumer Price Index is a worthy measure of inflation than Wholesale Price Index.
The work of Bong-soo (1999) on Causal Relations among Stock Returns, Interest Rates, Real Activity, and Inflation using Vector Auto-regression (VAR) Approach shed more light on the relationship among them. His major findings are; Stock returns appear Granger-causally prior and help explain a substantial fraction of the variance in real activity, which responds positively to shocks in stock returns. With interest rates in the VAR system, stock returns explain little variation in inflation. However, interest rates explain a substantial fraction of the variation in inflation, with inflation responding negatively to shocks in real interest rates. Inflation explains little variation in real activity, which responds negatively to shocks in inflation for the postwar period in United State of America.
To Timothy and Erling (2005), CPI overstated changes in the cost of living which they measured with budget share of food. They used Engel Curves to Estimate Bias in the Canadian CPI as a Cost of Living Index.
James & Robert (1999) conducted a survey on the effect of errors in CPI on Social Security trust fund not including housing error in the CPI and found out that CPI can overstate inflation but the effect is substantial on the trust fund.
Kanokwan, Sel and Ike (2005) investigate the relationship between domestic macroeconomic variables and stock excess returns to evaluate the effects of macroeconomic variables on excess returns and assess market efficiency in the Southeast Asian economies prior to the 1997 Asian crisis. They identified interest rates to have predictive power for excess returns and their volatility. They found a strong evidence of the significant impact of inflation uncertainty on monthly stock excess returns or on their time-varying variance in Southeast Asia.
Sherris, Tedesco and Zehnwirth (1999) carried out a survey on investment returns and inflation models in Australia using Co-integration tests which indicate that a long-run equilibrium relationship exists between the interest rates, whereas there was no evidence to support such a relationship between equity values, as measured by the SPI, a dividend index, and the level of the inflation index (CPI). Pierluigi, Edwin and Clifton (2001) attempted to investigate the effect of macroeconomic announcements on prices, volumes and bid ask spreads and they found that announcements have a significant effect on at least one of the instruments; however the effects vary significantly according to maturity. Therefore they concluded that public news can explain price volatility of money market substantially. Apart from Norliza et. al (2009), Turan (2007) equally looked deeply into the perfect method of measuring interest rate volatility and he used an Extreme Value Approach (EVA) to evaluate interest rate volatility in which he found out that the volatility of maximal and minimal changes in interest rate

declines as time-to-maturity rises. His study examined the asymptotic behavior of extreme interest-rate changes in the U.S. Treasury securities market from 1982 through 2001. The maximal and minimal changes in interest rates were obtained from daily observations for constant-maturity Treasury yields on the 3-month, 6-month, 1-year, 2-year, 3-year, 5-year, 7-year, 10-year, and 30-year U.S. government bonds. Jesus and Ernest (2007) discussed about Natural Rate of Interest (NRI) and believed that real interest rate should strongly predict inflation. Wicksell (1898) as cited in Jesus et.al (2007) asserts that NRI is a certain rate of interest on loan which is neutral to commodity prices and as prices increase, the interest rate should increase and as the prices of commodity fall, the rate of interest is to be reduced. Woodford (2003) as also cited in Jesus et. al (2007) defines the NRI as the equilibrium real interest rate that would result with prices being flexible.

From the above, it was observed that the possible effect of money market variables as well as their associated growth rate on CPI has not been attempted. Hence, there is need to carry out this research to illuminate this dark corner.

3. Methodological framework

Multiple linear regression models is employed to examine the relationship between treasury bills return, Government bonds return, Corporate stock and Consumer Price Index (CPI) and to determine whether the variables can predict CPI as proxy to Inflation.

The model is stated thus;

$$CPI = f\ (T_{Br}, G_{Br}, CS, IR)$$

$$CPI = \beta_0 + \beta_1 T_{Br} + \beta_2 G_{Br} + \beta_3 CS + \beta_4 IR + \beta_5 CD_{gr} + \beta_6 CP_{int} + ut$$

Where;

CPI is Consumers Price Index (a proxy for Inflation), T_{Br} is Treasury Bills Returns, G_{Br} is Government Bonds return, CS is Corporate Stock, IR is the interest rate CD_{gr} is the Certificate of Deposit growth rate, CP_{int} is the interest on Commercial Papers and Ut is the stochastic error term.

The model of Norliza et.al (2009) of Malaysia was adopted in this research with little modification to suit the available data in Nigeria.

Augmented Dickey Fuller (ADF) Unit root diagnostic test was carried out on the individual time series data to ascertain their suitability for times series functionality based on their levels of stationarity. In addition, the ADF test guards against spurious results in OLS analysis. (Gary, 1997). After the ADT tests, certificate of deposits and inflation rates were dropped from the original because of insufficient data rage and lack stationarity, respectively.

4. Data analysis and output

Times series data of government bond rates (GBR), consumer price index (CPI), commercial papers rates (CPR), Development stocks (DS), Treasury bills rates (TBR) and interest rates (INTR)

YEAR	LOGBR	LOGCPI	LOGCPR	DS	LOGTBR	INTR
1987	3.910021	0.806476	4.518522	2.100000	4.096010	17.50000
1988	3.600048	1.252763	5.616407	-3.060000	4.234107	16.50000
1989	3.086487	1.660131	NA	-2.730000	NA	26.80000
1990	4.433195	1.731656	3.499533	-4.893000	NA	25.50000
1991	1.252763	1.851599	NA	-4.123000	2.174752	20.01000
1992	2.406945	2.222459	3.742420	-6.159700	1.945910	29.80000
1993	2.066863	2.674149	4.736198	-5.788900	2.653946	18.32000
1994	2.128232	3.125444	4.021774	-10.22860	2.709383	21.00000
1995	1.252763	3.672496	4.511958	-5.373100	2.938103	20.18000
1996	1.757858	3.929470	NA	-6.624600	2.561096	19.74000
1997	1.410987	4.030872	4.239887	-4.054100	2.484907	13.54000
1998	1.131402	4.106602	NA	-5.633800	2.833213	18.29000
1999	1.131402	4.170688	5.205654	-8.955200	2.561096	21.32000
2000	1.029619	4.237723	NA	-13.52460	2.484907	17.98000
2001	1.098612	4.410614	4.456670	-13.27010	2.505526	18.29000
2002	0.741937	4.531847	1.568616	-10.92900	2.525729	24.85000
2003	NA	4.663062	-0.916291	-9.816000	2.525729	20.70000
2004	NA	4.802955	4.928702	-14.96600	3.292126	19.18000
2005	NA	4.967171	4.779963	-21.60000	3.044522	17.95000
2006	NA	5.046324	2.517696	-26.53060	2.708050	17.26000
2007	NA	4.355426	3.768153	-13.90000	2.862201	16.94000
2008	NA	4.496471	4.738827	-16.10000	2.862201	15.14000
2009	NA	4.626932	NA	0.000000	2.463853	18.99000
2010	NA	4.737951	NA	-5.700000	2.463853	17.59000

Source- Central Bank of Nigeria, Statistical Bulletin, 2008, 2009 and 2010.

Augmented Dickey Fuller Unit root diagnostic test (ADF) was carried out on the individual time series data of which Government bond rate was stationary (p = 0.0000) at level after taking the logarithm in appendix 1. Development stock was used in place of corporate stocks and the data was stationary (p = 0.0343) at 5% first difference. The data for annual inflation rate in Nigeria was not stationary up to 4th difference hence it was removed from the model and replaced with CPI of 12MMA which was stationary at 5% level (p = 0.0357). Treasury bill rate time series data however was stationary (p = 0.0064) at first difference. Commercial papers rate was stationary (p = 0.0002) at level, which shows that interest rate is stationary (p = 0.0065) at level.

4.1 Findings and discussion

The data was run on an E-views package, to derive times series outputs which have been summarized below.

4.1.1 Output outlay from time series OLS analysis

Variables	Statistics outlay	
	ADF	Coefficients and significances
CPI	(3.163)	-
BR	(9.083)	(1.073), 0.002
CPR	(-)	(0.060), 0.529
DS	(3.212)	(0.045), 0.174
TBR	(4.111)	(0.0045), 0.982
INTR	(3.946)	(0.046), 0.124
Model figures		
Parameters		Values
Constant		6.124
F-statistics		64.518
S.E. of regression		0.219
Probability		0.00648

This specifies that $LogCPI = 6.124180 - 0.060logCPR - 1.073logGBR - 0.047INTR - 0.045DS - 0.005logTBR$.

The regression function indicates that all the regressors are negative to the directional movement of the CPI. This implies that though at varying rates, when an incremental change occurs in any of the explanatory variables, inflation will fall. Specifically, a 1% increase in CPR will lead to a 6% fall in inflation rate in Nigeria. The highest effect is on GBR, which will have a 107.3% fall due to a 1% increase in GBR. These empirical analyses are rather nominal. In the real Nigerian situation, the sustenance of increased investment in any of the selected indicators is dependent on the investors' interest and risk dispositions towards the investment option. In addition, with dwindling yields in these financial market indicators, other investment outlets such as Forex (Foreign Exchange), property and manufacturing become more attractive to investors. Again, the yield rates of these indicators are lower than other investment outlets and they are fixed-rated, and not open to the economic dialogue between demand and supply in the functional market place. This means that increase in investment amount on the indicators does not qualify for increase in their yield rates.

4.2 Policy implications

The research findings gave rise to certain policy issues;

Investment Interest Sustenance Program (IISP). The 2008 economic down-turn has a long-lasting effect on the Nigerian investor. As such investor is cautious about their investment in the selected indicators. If this continues, then increase in inflation will reduce the value of the returns on the investment. To avoid this, the returns on these indicators should be subjected to real market process of the invisible hands of demand and supply. In addition, moral suasion may be applied to encourage increase in investment and new financial products may be introduced concerning investment on the indicators. These will help to sustain increase in investment and thus reduce inflation as was indicated by the empirical regression function.

Investment Holding Trap (IHT). The selected indicators may serve as holding investment options for property, FOREX and manufacturing investments, which attract more investment interest due to the hedge against inflation element on their returns. Thus, for example, Treasury Bills may become a vent through which to invest in any of the real investment options. This will create more investment interests in these indicators and also,

these real investment options may serve as insurance for the returns on investment from those of the indicators. This will introduce a win-win situation for the Nigerian investor.

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