Original Research Article

Key Determinants of Inflation in Ghana

ABSTRACT

Inflation, and its deleterious effects on economies, has for long been the worry of governments especially among developing countries including Ghana. Several studies on the Ghanaian economy, have concluded that inflation in Ghana is purely a monetary phenomenon though in reality, the causes of inflation are numerous and vary. The main objective of this paper was to identify the key determinants of inflation in Ghana using the most recent monthly data from January 2000 to December 2014 (data period of 180 months). The study tested whether or not Crude Oil Price at the World Market, Exchange Rate, and Electioneering Spillover Quaternary Effects (ESQE) statistically affect inflation in Ghana either individually or jointly. The study found that crude oil price at the world market, exchange rate, and ESQE are key determinants of inflation in Ghana. The findings indicate a positive relationship between Crude Oil Price at the world market and Inflation, Cedi-Dollar Exchange Rate and Inflation as well as ESQE and Inflation (in the case ESQE, the study considered the first quarter of each post-election year within the data period). Each of the determinants: Crude Oil Price, Exchange Rate and ESQE was statistically significant at 1%.The study also indicated a high R-squared of more than 95% for the joint impact of all three determinants on inflation. This means that jointly, Crude Oil Price, Exchange Rate, and ESQE explain more than 95% of the variation in inflation in Ghana.The paper recommends further study into this subject matter by considering many other potential determinants of inflation in Ghana and the developing world as a whole.

Keywords: Inflation, Exchange Rate, Elections, Crude Oil Prices, Ghana

1. INTRODUCTION

Basic Economic theory indicates that prices of goods and services have enough power to deteriorate the purchasing power of the limited income and capital of individuals, households, firms and the central government[1][2]. Inflation has, for years, been one of the major obstacles of development for both developed and developing countries and is widely regarded as one of the most vital macroeconomic indicators[3][4]. It has gained much reputation and has become a major focus of economic policy appearing in yearly budgets of most countries[5]–[9][3], [4][10][11]. The developed countries have found some ways of limiting the adverse effect of inflation[12], [13][10], [11] but their developing counterparts still suffer from the snares of inflation[14]–[17]. Whereas most developed countries record single digit inflation values, more of the developing ones record double and sometimes triple digit inflation values. Ghana, Uganda, Sierra Leone and Zimbabwe are among the countries in Africa that has experienced triple and over inflation[14][10], [11], [18]. Inflation data reported by the Reserve Bank of Zimbabwe showed a yearly average of 52211.77% from 1999 until 2015, reaching an apex of 2660522.20% in July 2008 and a minimum of -7.50% in December of 2009[17][16], [19].

A major prerequisite to join the Economic Community of West African States (ECOWAS) common currency zone is to achieve a single-digit rate of inflation[3][20][21]. Regrettably, inflation has persistently remained above a single-digit mark in Ghana[3].In a study of the determinants of inflation across different countries[22],it was found that the causes of inflation are numerous and vary from one country to the other; and that the forces that drive

the inflationary process are country-specific. The significance of establishing the determinants of inflation for any given country therefore cannot be overemphasized.

Most studies on the determinants of inflation in Ghana have all concluded that inflation in the country is purely monetary phenomenon; money supply by the central bank is the main driving force of inflation in Ghana[3][23][24][25].However, studies have also shown that the determinants of inflation are numerous and vary from country to country[22].Other findings and theories, for instance, cites electioneering activities as probable determinant of inflation especially during the early part of the post-election year[26][27][5], [9]. Researchers have attributed the rise in inflation after elections to pre-electoral expansionary policies by governments[28]. This study therefore considers among other factors, the after effects of elections on inflation in what is termed Electioneering Spillover Quaternary Effects (ESQE) in Ghana. Many studies on inflation in Ghana have relied on quarterly and yearly data to draw conclusions. Meanwhile, Quarterly or Yearly data have the capacity to overshadow actual effects of a variable since such data are normally multiple averages[29][30][31].

The main objective of this paper is to identify the key determinants of inflation in Ghana using the most recent monthly data from January 2000 to December 2014(data period of 180 months). The study tests whether or not crude oil price at the world market, exchange rate, and Electioneering Spillover Quaternary Effects (ESQE) statistically affect inflation in Ghana either individually or jointly. The findings of this study will be invaluable insight to policy makers in fiscal policy management in Ghana and other countries

1.1 Literature Review

1.1.1 Crude Oil Prices and Inflation in Ghana

Crude oil has become an essential part of the Ghanaian economy[32]. Any Fluctuations in the world price of crude oil therefore has detrimental effects on the growth of the Ghanaian economy especially when the country is heavily dependent on imported crude oil to meet her energy needs[32].

Many describe the period between 1973 and 1983 as the dark years of the Ghanaian economy. The country within this period experienced a downward spiral in economic growth, high rates of inflation, shortage of goods and services among others[33][34][32].These literature report a cumulative inflation rate reaching as high as 117% by 1977.This period, as reported, coincided with the first two oil price shocks experienced by the world economy as well as periods of political unsteadiness and economic maladministration in Ghana[32][34].

Globally, headline inflation started increasing in 2004 reflecting higher prices of crude oil.[7] Moreover, in its outlook for 2005, the Bank of Ghana expressed the likelihood that oil prices will increase in 2005 and contribute to the build-up of inflationary pressures[7]. In the view of the Bank of Ghana, oil price hikes is a dilemma for central banks in creating a stable economic policy[7]. This stems from the fact that higher oil prices not only push up inflation (thus calling for a rise in interest rates), but also stifle growth (necessitating rates to be lower than otherwise)[7].The report also indicated that high oil prices had eroded some terms of trade gains of the nation even though Ghana's economy recorded the highest growth rate in twenty years with inflation declining significantly[7].

In a study to explore the long run and short run linkages between the world crude oil price and economic activity in Ghana, for the period January 1970 to April 2006, found that an unexpected oil price shock is followed by an increase in inflation rate and a decline in output in Ghana[35]. A similar study was conducted to investigate the impact of oil price change on real Gross Domestic Product growth, money supply and Consumer Price Index in Ghana using Structural Vector Autoregressive approach. The study revealed that oil price change has a lag effect on inflation. The study therefore concluded that oil price thus contribute to output growth, money supply and inflation volatilities[36].

Bank of Ghana reveals that headline inflation increased marginally by 0.26 percentage points in 2012[5]. The impact of crude oil prices on inflation in Ghana cannot be overstated. For instance, at 8.6 percent in January 2012, inflation rose to 9.5 percent by July 2012 on the back of among other factors, upward adjustment in petroleum prices earlier in the year[5].. Inflation subsequently declined to 8.8 percent by the end of 2012 as the price effects of the petroleum and exchange rate adjustments were offset by good staple harvests and tight monetary policy stance which countered potential inflationary pressures[5].

The effects of oil price increases on inflation is best explained through the use of an oil price change transmission model[32] as shown in Figure 1. Firstly, an increase in the international price of oil can affect an economy through an increase in the domestic price of the commodity[5], [6], [8], [9], [32]. In most developing countries, as has been the case in Ghana[32][7], the governments (through subsidies) only pass a portion of the price increase to the domestic consumers (as indicated in Figure 1 by link between oil subsidy and pass-through ratio)[32], [37]. Similarly, due to the changes in terms of trade that is likely to occur as a result of the oil price increase, the country's exchange rate will be affected and this is likely to affect the prices of commodities in the domestic market[5], [6], [14], [15], [24], [32], [38][39]. This is also indicated by the link between the exchange rate and pass-through ratio. Eventually, this proportion of the price increase (Pass-Through Ratio) that is passed onto the domestic market cause a rise in the level of inflation and subsequently lead to a rise in the cost of living and or production[32][24][37]. This phenomenon is indicated in Figure 1 by the link from international oil price to inflation, Producer Price Index(PPI), investment to long-term capacity utilization and interest rates and then to Gross Domestic Product(GDP).

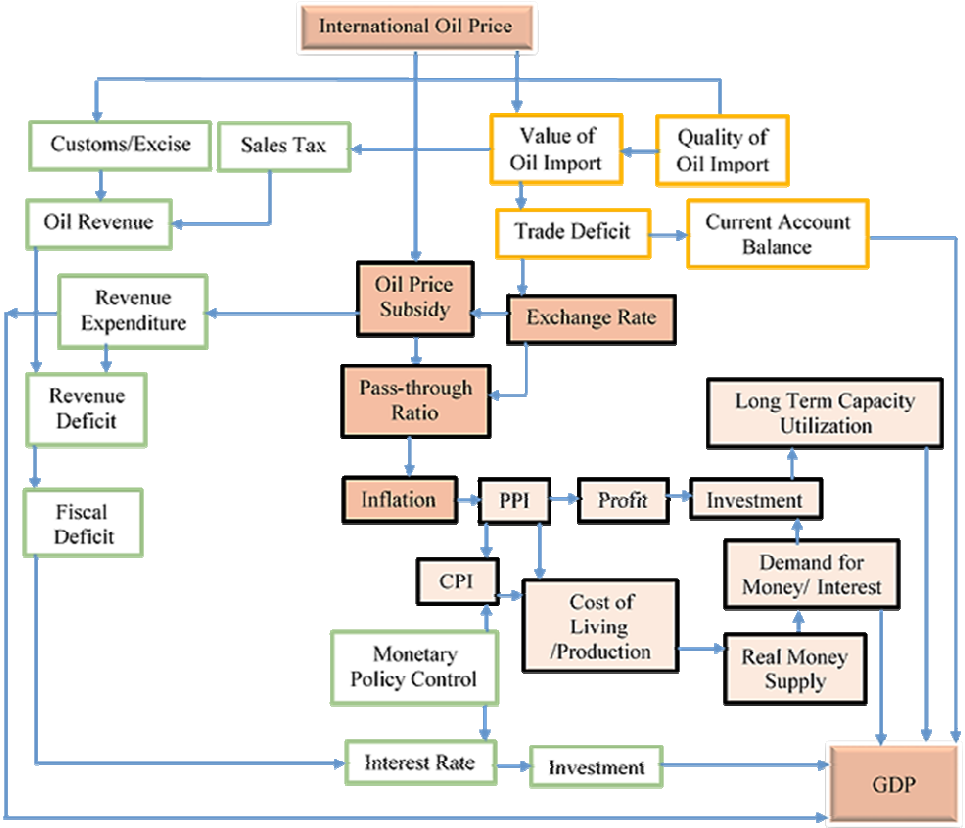

Figure 1: Transmission channels of oil price changes. Adapted from[32]

In the Assessment of Risks to the 2014 Inflation projections, Bank of Ghana Monetary Policy Report indicated that the possible removal of government subsidies on utility and petroleum products and subsequent upward adjustments in petroleum prices and its pass through effect on prices was likely to induce some inflationary pressures[5]. The report also cites domestic petroleum prices as a key microeconomic indicator in the assessment of inflationary outlook for 2015[6]. On the impact of petroleum and utility prices adjustments on inflation, the report was optimistic that the stabling international crude oil prices during the third quarter of 2014 will weigh down on domestic petroleum prices and possible downward effect on inflation[5].

Understanding the relationship between the world oil price and economic activity is important because oil price increases lead to a rise in prices of petroleum products which serve as a key production inputs and as an essential consumer goods[35][32]. These price increases are considerable enough that they normally become temporary rise in the general rate of inflation[35].

1.1.2 Political Elections and Inflation in Ghana

The Political Business Cycle (PBC) theory offers two distinct sets of political economy models to explain the economic effects of elections: (i) the opportunistic models, and (ii) the partisan models[26][40].

The Opportunistic PBC model predicts business cycles where incumbent governments try to manipulate fiscal and monetary policy instruments, as election period approaches, so as to increase their chances of being re-elected[26], [40], [41]. Tests of the opportunistic PBC theory look for cycles in spending, deficits, and money growth, and seigniorage rather than directly in inflation, unemployment, and growth[28], [41], [42]. This model has two important results[26]. The first is a prediction of an increase in growth and a moderate increase in inflation before the election period[26], [43]. The second is a permanent increase in inflation after the election period even with contractionary aggregate demand policies[26], [43].

The second model; the partisan approach, in contrast, identifies a ‘partisan’ cycle in which different parties, when in office, implement different policies[26], [40], [41][43]. For instance, the left-wing party tackles unemployment, and the right-wing party fights inflation. The theory predicts unemployment is permanently lower and inflation permanently higher during the tenure of left-wing governments as compared with right-wing governments[41], [43].That is to say, Incumbents keep growth high and unemployment low just before an election. This theory hereby predicts that a business cycle will be generated within the electoral cycle with austerity after election and a thriving before the elections.

Empirical evidence for the Organization for Economic Co-operation and Development (OECD) countries is rather consistent with the models of PBC theory[28]. Parallel studies found that, in developed countries, economic policy is relatively loose in election years (with low taxes and high spending)[27]. It has also been found that inflation tends to increase after elections (probably because of pre-electoral expansionary policies)[28].Furthermore, evidence have also been found for political manipulation of fiscal instruments, particularly transfers, only in some presidential elections. However, they report no electoral cycle in taxes and spending within a term in office[44].

A longitudinal research conducted in India reports that economic activity in India lost pace ominously over the past 30 years during a general election[45]. The report explains that Government spending went up in an average election year, which tended to fuel inflation rather than spur growth. The study found that, the average increase in nominal government spending during election years is 15.84% compared with 11.38% for non-election years. Average fiscal deficit for the election year is 5.87% compared with 5.08% for the non-election years. The average inflation during election years is 8.56% since 1980, compared with 7.55% for non-election years.

A few studies into political budget cycles for both developed and developing countries. have anticipated finding more pronounced cycles in developing countries[42]. The studies noted that less-consolidated democracies, have comparatively weaker institutions and fewer controls on executive power and leads to manipulation of macroeconomic steering around elections than in developed countries where structures are stronger and democracy is well-established[42]. Researchers find African political systems more fragile due to the major extensions of democracy[42][41]. A study using African data from the early 1980s and 1990s[41] reported that there is indeed averaging across African countries, a significant propensity for government fiscal deficit to be higher in the years before election and reduced thereafter. Other findings, similarly, show patterns of inflation to be correlated with political events, prior to election which to them erodes macroeconomic management and brings adverse effects to the economy at large[46]

The Opportunistic model seems to be the more relevant branch of the PBC theory for Africa, given the characterization and the discourse in the preceding paragraphs[41]. Furthermore, a study on Political Business Cycles, democratization and economic reform in Africa, concluded that electoral and partisan incentives influence the structure of economic policy making by governments[41]. This interaction between political and macroeconomic variables in the election of new governments as the study explains, results in expenditures and halting of policies that results in cycles of economic expansion and contraction that affect the economic wellbeing of the people[41].

The International Monetary Fund (IMF), reported that the 1992 general elections in Ghana that restored representative democracy to Ghana also encouraged the government to spend excessively[47]. According to the report, concerned about the elections, the government granted large salary increases, which worsened macroeconomic imbalances and rekindled inflation[47]. The fiscal balance turned from a surplus of 1.8 percent of GDP in 1991 to a deficit of 4.9 percent in 1992, financed by the banking system[47].

The Bank of Ghana praised the resilience of the Ghana economy in withstanding the 2004 election pressures, which in the past led to significant macroeconomic instability[7]. It also cited a surge in government expenditure in the run-up to the national elections as one of the key factors causing high inflation.[7], [8]. A similar trend was also reported after the 2012 general elections[9].

However opportunistic the African context may seem, a study has equally shown that pre-election boost of the economy may or may not serve a useful political purpose for all incumbents[48]. This is known to largely depend on whether the incumbent is a “dominant party” or has potentially opposing political opponents (strong opposition). With the issue of Ghana, this study conjecture that a pre-economic boost becomes necessary since the slightest chance may end the power of the incumbent[49].

1.1.3 Exchange Rates on Inflation in Ghana

1.1.3.1 Trend in Exchange rates and inflation in developing countries

Exchange rates volatility have been identified as a major determinant of inflationary pressures especially in developing economies[50]–[53]. A study on sources of inflation in Developing Countries, reported that monetary growth and exchange rate are the typical factors that relate to fiscal influences[18]. The report further explains that the impact of these factors on the economies of developing countries depends largely on whether the exchange rate regime is floating or fixed[18]. A related research on an assessment of exchange rate regimes, inflation and growth in developing countries, equally show some form of association between exchange rate regimes and inflation[54].

The findings of a study on output, inflation, and exchange rate in developing countries: an application to Nigeria, show mixed results on the impact of the exchange rate depreciation

on the output[55]. Whereas the impulse response functions exerted an expansionary impact of the exchange rate depreciation on the output in both medium and long terms, the opposite was, however, observed for the short term horizon[55]. Other studies have also confirmed the empirical relationship between the level of the real exchange rate and the rate of consumer price inflation for Asia, Latin America and selected industrialized countries[35] [36].

The Global Economic Prospects (GEP) report of the World Bank analyzes the link between currency and inflation patterns across developing economies, based on estimates of the size and timing of the exchange rate pass -through in 45 middle and low income countries including Ghana[53]. The analysis concludes that currency-related price pressures are mainly concentrated in a few large middle income economies, including Ghana[53]. The report cites Ghana as one the countries that has seen the largest currency depreciations since 2012.This trend is depicted in Figure 2[53].

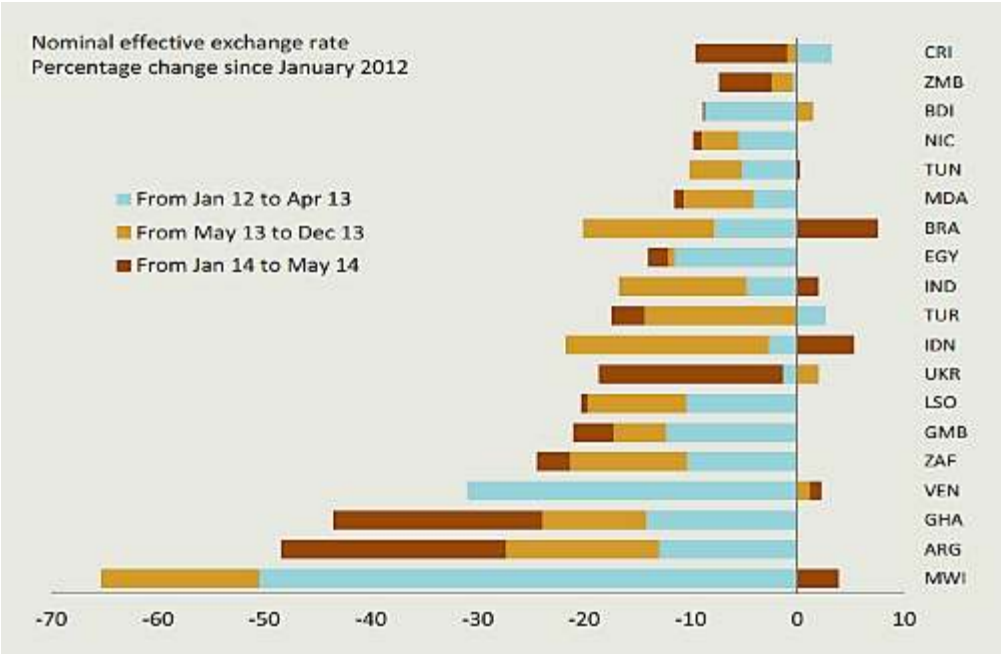

Figure 2: Countries having seen the largest currency depreciations since 2012[53]

In terms of annual average inflation, World Bank indicated that pressures resulting from past currency developments were still expected to build in 2014 in most regions (when compared with 2013[53].This is shown in Figure 3[53].

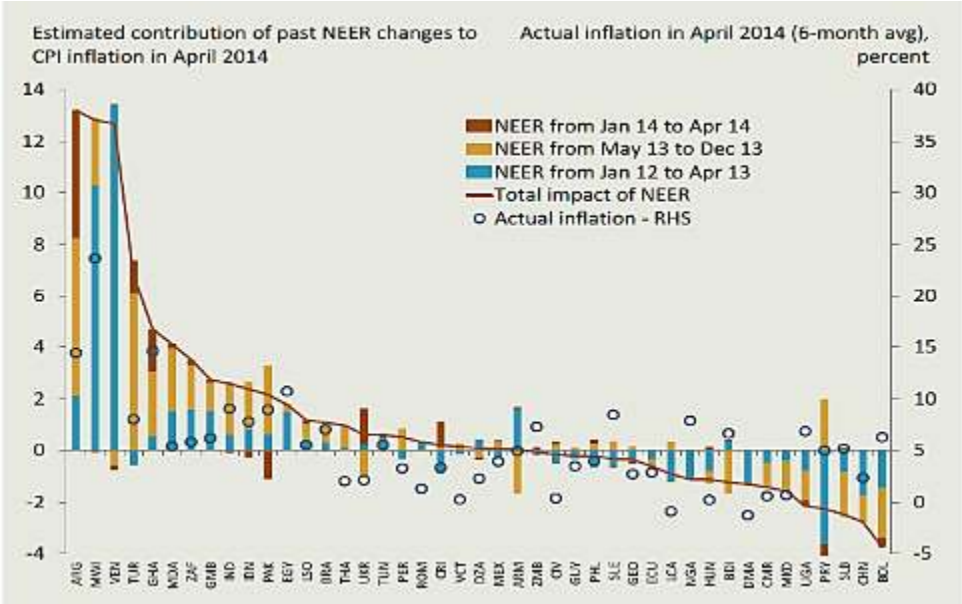

Figure 3: Exchange rate impact on current inflation (April 2014) across developing countries [53]

1.1.3.2 Trends in exchange rate and inflation in Ghana.

Obviously, Ghana has experienced unfavorable exchange rate trends over the years. This situation has not changed in recent times as the country continues to battle with the rapid depreciating of its currency. Figure 4 depicts an upward trend in the depreciation of the Ghana cedi against all the major currencies. The US dollar however showed a sharp upward trend from January 2012.

Figure 4: Trend in exchange rate in Ghana from 2000 to 2012[9]

Bank of Ghana reports a close relation between inflation and exchange rate[9]. Figure 5 shows the relationship between inflation and exchange rate movement. The pass through from depreciation to inflation is obvious over the years.

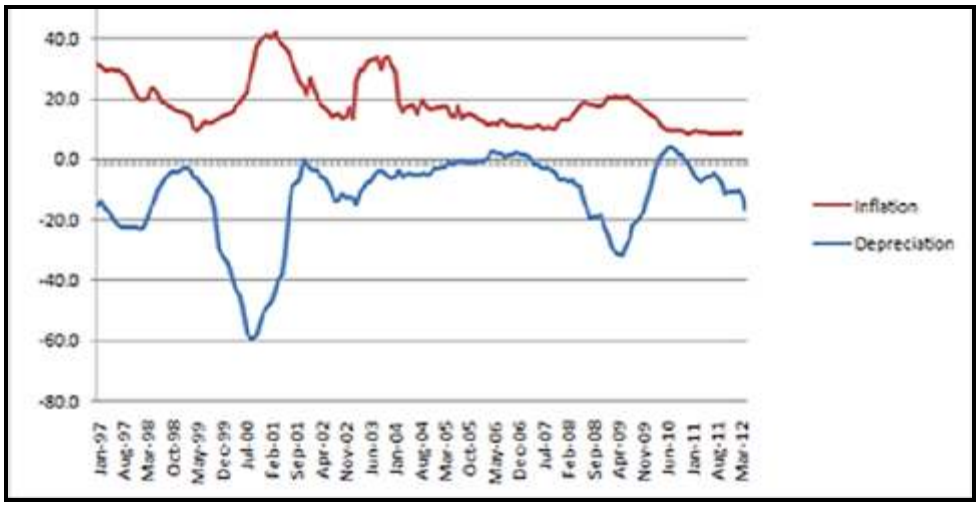

Figure 5: Inflation and Exchange rate(y/y),[9]

1.1.3.3 The impact of exchange rate on Inflation in Ghana.

Exchange rate has been one of the most debatable effects of inflation in Ghana over the years. An increasingly high inflation rate in Ghana has been attributed to major devaluations of the official exchange rate[15]. The results of an empirical analysis conducted confirm the fact that not only does monetary growth affect inflation but also exchange rate in a number of the Sub-Saharan African countries including Ghana[58]. The study concluded that both monetary growth and exchange rate impacted on inflation in Ghana with monetary policy having a higher impact. Moreover, a number study also indicated that, even though monetary policies has influenced the fluctuations in inflation of Ghana more than the exchange rate, policies that have the goal of stabilizing inflation must center on the stabilization of both the exchange rate and monetary policies[59]. Several other studies have concluded that indeed exchange rates have impacts on inflation in Ghana but have been sharply divided over the timing of the impact – whether long-term or short-term[50], [60], [61][62].

2. RESEARCH METHODOLOGY

2.1 Method of Estimation

The study uses Ordinary Least Squares (OLS) estimator to find the effects of the exchange rate, crude oil price and ESQE on inflation in Ghana. The OLS is preferred because it is the Best Linear Unbiased Estimator (BLUE); in the midst of unbiased linear estimators OLS has the minimum variance, efficient and consistent[63]. However, before the OLS estimation, the Augmented Dickey-Fuller (ADF) test is performed on the variables to check for stationarity since the data is a time series data[63], [64].

2.2 Model Specification

Economic theory identifies a number of variables that lead to inflation and also measure inflation using different variables. This paper uses growth rate of the Consumer Price Index (CPI) as a proxy for inflation and it is the dependent variable. CPI is preferred because it has a wider basket of goods and services than the Producer Price Index (PPI) or Gross Domestic Product (GDP) deflator[65]. The independent variables are the exchange rate, crude oil price at the world market (per barrel) and ESQE. Other factors such as money

supply, fiscal deficit, external debt, government expenditure, etc on Ghana were not used in this study because data on such variables are only available quarterly, semi-annually or annually. Taking a quarterly data and dividing it by three, or a semi-annually data and dividing it by six, or annually data and diving it by twelve may lead to misleading results[63].

The general model using the aforementioned variables is:

$\psi_t = f(R_t, E_t, C_t, \varepsilon_t)$ ……..(1)

Where:

ψ = *rate of inflation;*

R = *exchange rate (GHC to US$);*

C = *crude oil price per barrel (in UD$);*

E = *a measure of ESQE;*

ε = *the stochastic term which represent other relevant variables that were not included in the equation;*

t = *time (from January 2000 to December 2014)*

The unit of measurement is unique for each variable in the model. To normalise the differences in the elements of each variable the natural log is used. Taking the natural log of variables bridges the gap between and among variables and make them relatively uniform and to reduce the possibility of Heteroskedasticity[63]. The variables: ψ, R and C were each stationary at the first difference. Hence, the first difference (of ψ, R and C) are used in the analysis[63], [64].

From the year 2000 to 2014, Ghana has had four (4) democratic elections: 2000, 2004, and 2008 and 2012. Pioneers of the opportunistic PBC theory have indicated a permanent increase in inflation after the election period even with contractionary aggregate demand policies[26]. A similar study equally found that inflation tends to increase after elections (probably because of pre-electoral expansionary policies)[28]. This study therefore considers the after effects of elections on inflation in what is termed Electioneering Spillover Quaternary Effects (ESQE) in Ghana. The first quarter of the post-election year in Ghana is therefore considered in this study for the variable ESQE.

In order to estimate the overall effect of ESQE on inflation, a new dummy variable defined as:

Ƀ = *1 if it is a first quarter of the post-election years (January to March of 2001, 2005, 2009, 2013)*

0 otherwise

Incorporating the new variable into the general model (equation (1)) gives the specific model below:

$ln\psi_t = \Omega_1 + \Omega_2\, lnR_t + \Omega_3 lnC_t + \Omega_4 Ƀ + \varepsilon_t$ ..... (2)

Where:

Ω_1 *measures the expected value (average) of inflation in non-election years irrespective of the level of exchange rate and crude oil price;*

Ω_2 *measures the unique effect of exchange rate on inflation;*

Ω_3 measures the unique effect of crude oil price on inflation;

Ω_4 measures the extent by which the expected value (average) of inflation in post-election years (January to March of 2001, 2005, 2009, and 2013) differs from that of the control group (non-election years).

Since from 2000 to 2014, Ghana has had four (4) elections (2000, 2004, 2008 and 2012), in order to introduce this effect into the model and to escape dummy variable trap, a total of three dummy variables were added to the general model in equation (1) above. These dummies are defined as:

Let D_{2001} *= 1 if January 2001 to March 2001*

0 otherwise

D_{2005} *= 1 if January 2005 to March 2005*

0 otherwise

D_{2009} *= 1 if January 2009 to March 2009*

0 otherwise

The last post-election year first quarter (January 2013 to March 2013) is used as the control group.

Adding the three dummies to the general model gives the following specific models:

$$ln\psi_t = \Omega_1 + \Omega_2\, lnR_t + \Omega_3 lnC_t + \Omega_4 D_{2001} + \Omega_5 D_{2005} + \Omega_6 D_{2009} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots (3)$$

Where:

Ω_4 measures the extent by which the expected value (average) of inflation in the first quarter of 2001 post-election year differs from that of the control group (January 2013 to March 2013);

Ω_5 measures the extent by which the expected value (average) of inflation in the first quarter of 2005 post-election year differs from that of the control group (January 2013 to March 2013);

Ω_6 measures the extent by which the expected value (average) of inflation in the first quarter of 2009 post-election year differs from that of the control group (January 2013 to March 2013);

The Augmented Dickey-Fuller (ADF) test was used to test for stationarity of the data. The quarterly data was stationary but CPI (ψ), Crude Oil Price(C) and Exchange Rate(R) were all not stationary. However, the three variables (ψ, C, R) were stationary at the first-difference. In order not to violate the classical linear regression assumptions, multicollinearity, heteroskedasticity and first order autocorrelation were checked. The Variance Inflation Factor(VIF) was used to test for multicollinearity; Breusch–Pagan–Godfrey (BPG) test to test for the presence of heteroskedasticity; and the Breusch–Godfrey (BG) Test to test for first order autocorrelation. The BPG test was used because unlike the Goldfeld-Quandt test, the BPG does not depend on the number of central observations and the variable causing the heteroskedasticity[63].The BG test was used to test for first-order autocorrelation because unlike the Durbin-Watson tests, it allows for non-stochastic regressors and can also be used for higher order auto regressive schemes [AR (1), AR (2), etc.][63]. The Heteroskedasticity and autocorrelation were corrected using the Newey-West HAC (Heteroskedasticity and Autocorrelation Consistent) procedure. The Newey-West HAC procedure was used because it is strictly valid in large samples[63].

2.3 Prior expectations

It is expected that exchange rate, crude oil price and ESQE all have positive effect on inflation. As a country's currency deteriorate (larger values of exchange rate), it becomes expensive to import because importers need more of the local currency (Ghana Cedis) to exchange for the US dollar. All profit oriented importers will shift this high cost to the consumer by factoring the high import cost into the price they charge the final consumer; the higher the cost of import the higher the price of the commodity. This will make $\Omega_2 > 0$.

Crude oil has become an integral part of the Ghanaian economy.As the price of crude oil on the world market increase, it becomes expensive to produce goods and services because producers need to pay more to use the same level of oil it hitherto used. With profit as the ultimate aim of commercial companies, firms will shift this high cost to the ultimate consumer; the higher the cost of crude oil the higher the price of the commodity. This will make $\Omega_3 > 0$.

As indicated earlier, the pioneers of the Political Business Cycle (PBC) theory report an interaction between politics and microeconomic management during election years[26], [40]. Based on this model, the paper makes the following assumptions on the ESQE variable:

i. Political parties spend more during election years;
ii. The money they spend goes directly into people's pockets;
iii. The beneficiaries of the money pumped into the economy do not use it for income generating activities; they save it for transactionary purposes;
iv. The beneficiaries spend the money they received after they have finished voting.

More money in the hands of the public will increase aggregate demand; if aggregate supply is held constant – because it takes time to increase supply – the end result will be higher prices. It is therefore expected that $\Omega_4 > 0$.

2.4 Sources of data

This study used monthly data on all the variables. Although it is expensive – time and money – to get monthly data, it is better than a yearly data because monthly data are fast to compute, easier to model, easier to identify changes in trends, and is better for strategic long term forecasting[29]

All data used in this study were from secondary sources. Data on CPI were from Ghana Statistical Service (GSS)[33]. Data on exchange rate were extracted from Bank of Ghana (BoG) data bank[66]. Data on crude oil price per barrel were also extracted from US Energy Information Administration (EIA) databank[67].

2.5 Data analysis

To achieve the research objectives two general hypotheses were tested. First, the *t-test* was used to test individually three hypotheses that:

i. H_o: $\Omega_2 = 0$; *exchange rate has no significant effect on inflation;*
H_a: $\Omega_2 \neq 0$; *exchange rate has significant effect on inflation.*
ii. H_o: $\Omega_3 = 0$; *crude oil price has no significant effect on inflation;*
H_a: $\Omega_3 \neq 0$; *crude oil price has significant effect on inflation.*
iii. H_o: $\Omega_4 = 0$; *ESQE has no significant effect on inflation;*
H_a: $\Omega_4 \neq 0$; *ESQE has significant effect on inflation.*

Second, the *F test* was used to test for the overall effect of independent variables on inflation.

In all the tests, the *p-value* approach as well as the critical value approach were used in drawing conclusions. A 5% level of significance is used in the study.

3. RESULTS AND DISCUSSION

To ensure that the results do not violate the classical linear regression assumption, multicollinearity, heteroskedasticity, and autocorrelation (up to order one) were tested. Table 1 shows the results of the test of multicollinearity.

Table 1: Variance Inflation Factors (VIFs)

lnR_t	*2.506*
*ln*C	*2.542*
D_{2001}	1.037
D_{2005}	1.005
D_{2009}	1.025

Note: *VIF (j) = 1/ (1 - R (j) ^2), where R (j) is the multiple correlation coefficient between variable j and the other independent variables. Minimum possible value = 1.0. Values > 10.0 may indicate a multicollinearity problem*

The results from Table 1 show that none of the variables has a VIF of 10 or more and hence there is no problem of multicollinearity. Again, we tested for the presence of heteroskedasticity and autocorrelation. The Breusch-Pagan-Godfrey test for heteroskedasticity showed a test statistic of LM = 52.6315 with *P*-value = .0000. Using the *P*-value approach, a value of .0000 is statistically lower than the level of significance used in the study (α=0.05). Hence, the null hypothesis that 'Heteroskedasticity not present' must be rejected and therefore needs to be corrected.

The Breusch-Godfrey test for autocorrelation, AR (1) showed a test statistic of 929.643 with P-value =.0000. Again, using the P-value approach, a value of .0000 is statistically lower than the level of significance used in the study (α=0.05). Hence, the null hypothesis of 'No autocorrelation' must be rejected and therefore needs to be corrected.

To correct for heteroskedasticity and autocorrelation, the Newey-West HAC standard errors procedure was used. The regression results of the heteroskedasticity and autocorrelation corrected model is presented in Table 2. Although the Durbin-Watson statistic of 0.115213 is suggestive of positive autocorrelation, the HAC procedure takes that into account and has already corrected the OLS standard errors[63].

Table 2: Regression Results

	Coefficient(Ω_i)	***Std. Error***	***t-ratio***	***p-value***	
Constant	4.61672	0.17284	26.7110	<.00001	***
lnR_t	0.348227	0.0652584	5.3361	<.00001	***
lnC	0.188113	0.0421041	4.4678	.00001	***
D_{2001}	0.182444	0.0357776	5.0994	<.00001	***

D_{2005}	-0.17833	0.0191332	-9.3204	<.00001	***
D_{2009}	0.227487	0.0343405	6.6244	<.00001	***

R-squared	0.954028	Adjusted R-squared	0.952707
F(5, 174)	722.1870	P-value(F)	.000
		Durbin-Watson	0.115213

n = 180. Dependent variable: $ln\psi_t$. ****, ** and * denote significance at 1%, 5% & 10% respectively*

The regression results in Table 2 show that there is a positive relationship between exchange rate and inflation; this result conforms to the expected relationship. It is also consistent with the findings of other studies[50]–[52][18], [53], [58].The results show that a one percent point increase in the Cedi-Dollar exchange rate, cause inflation to increase by approximately 0.3482 percentage points, holding other factors constant. As the Ghanaian Cedi depreciates – when more Cedis are exchanged for a United States dollar – the general price level increases. The exchange rate is statistically significant at a 1% level.

The results from Table 2 also shows that there is a positive relationship between crude oil price per barrel at the world market and inflation in Ghana. Similar to the exchange rate, this result conform to the expected relationship. This is also consistent with the findings of other studies[32], [35], [36]. The results is indicative that for any one percent increase in the crude oil price at the world market, the general price level in Ghana increase by approximately 0.1881%, ceteris paribus. Although the magnitude of the effect that crude oil price has on inflation is less than that of exchange rate, the two variables are individually statistically significant at a 1% level.

Furthermore, Table 2 also shows that, all else equal, the average level of inflation in the first quarter of 2013 (the controlled year) was 4.61672. The expected value of inflation in the first quarters of 2001 and 2009 were all statistically and significantly higher (at 1% level) than that of 2013 by 0.18244 and 0.227487 respectively. The results also show that the expected value of inflation in the first quarter of 2005 was lower than that of 2013 by 0.17833 and the difference is statistically significant at 1% level.

Again, the regression results in Table 2 depicts a high R-squared of 0.952707. Thus jointly, exchange rate, crude oil price, and ESQE explain more than 95% of the variation in inflation. Not only is the R-squared high, the test of overall significance showed a test statistic value of 722.1870 with a *P*-value = .0000. This means that aside the R-squared being high, the three independent variables jointly have statistically significant effect on inflation in Ghana at 1% level.

Once the results are free from violating the classical linear regression assumptions, the next is to test for statistical significance of the ESQE variable. The result showed a t-test statistic of 36.6355 and a *P*-value = .00001. There is therefore enough grounds to reject the null hypothesis that 'ESQE has no significant effect on inflation' in Ghana.

4. CONCLUSION

The main objective of this paper was to identify the key determinants of inflation in Ghana using the most recent monthly data from January 2000 to December 2014(data period of 180 months). The study tests whether or not crude oil price at the world market, exchange rate, and Electioneering Spillover Quaternary Effects (ESQE) statistically affect inflation in Ghana either individually or jointly.

The study found that crude oil price at the world market, exchange rate, and Electioneering Spillover Quaternary Effects (ESQE) are key determinants of inflation in Ghana. The findings indicate a positive relationship between Crude Oil price at the world market and inflation,

Cedi-Dollar exchange rate and inflation as well as Elections and inflation. Each of the determinants: Crude Oil Price, Exchange rate and ESQE is statistically significant at 1%.

The study also showed a high R-squared of 0.952707. This means that jointly, exchange rate, crude oil price, and ESQE explain more than 95% of the variation in inflation in Ghana.

The findings of this study are novel, very insightful and relevant to fiscal policy direction in Ghana as well as in other developing countries. As indicated earlier, most studies on the determinants of inflation in Ghana have all concluded that inflation in the country is purely monetary phenomenon; money supply by the central bank is the main driving force of inflation in Ghana[3], [23], [24][25]

The findings of this study however is contrary to that assertion. Not only is the R-squared high in this study, but also indicative that the three independent variables jointly have statistically significant effect on inflation in Ghana at a 1% level.

This paper agrees with the findings of a previous study of the determinants of inflation across different countries, which found that the causes of inflation are numerous and vary from one country to the other; and that the forces that drive the inflationary process are country-specific[22]. The paper therefore recommends further study into this subject matter by considering many other potential determinants of inflation in Ghana and the developing world as a whole.

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