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An empirical investigation on the determinants of inflation in Ghana

Jacqueline Darko Owusu

M.Sc. Economics

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ABSTRACT

Ghana uses an inflation target of 8% as a monetary policy objective to control against double-digit inflation. The main reason for controlling inflation is to reduce the cost of living, poverty levels, and to ensure macroeconomic stability in Ghana. However, to control inflation successfully, the government must rely on empirical findings for policy formulation. Therefore, this study was conducted based on three main objectives. Firstly, to investigate determinants of inflation using Granger causality approach. The second objective of this study was to determine the impulse reactions of government expenditure, exchange rate, population, broad money, and crude oil prices to inflationary shocks using impulse response analysis. Finally, the study sought to ascertain the proportion of variability in inflation that is caused by the independent variables using variance decomposition analysis. Data spanning 1990 to 2018 were used to run the autoregressive distributed lag (ARDL) model and the results were reported. The findings from Granger causality tests show that, population and government expenditure determine inflation in both the short-and long-run. Another finding from the impulse response analysis reveal that the exchange rate, broad money supply, and population react negatively to inflationary shocks in the long-term while government expenditure and crude oil prices react positively to inflationary shocks in the long-term. In addition, the variance decomposition analysis shows that inflation explains about 80% of the variability in itself and 20% is explained by government expenditure, the exchange rate, population, broad money, and crude oil prices. Based on these findings, the study recommends that in order to control inflation, government should pay attention to both population and government expenditure.

Keywords: determinants of inflation; Granger causality; inflationary shocks

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CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Inflation is a regular phenomenon that every economy experience, though its rate of growth, its causes and the nature of the inflation may differ from one country to the other. In most cases, developed economies make a concerted effort to maintain a low-level inflation, often with a rate targeted of around 2%. This is because inflation reduces the purchasing power in a country McBride (2019), and it encourages spending and capital investment while discouraging savings (Pacific Investment Management Company 2016, 2020). In addition, inflation raises the cost of living in an economy, reduces living standards and raises the cost of borrowing (Jacobs, Perera, & Williams, 2014). Inflation may render prices in the local industry less competitive relative to other countries thereby affecting export sectors and threatening the survival of local industries, Mohseni and Jouzaryan (2016); Madurapperuma (2016); Boel (2018). If not curtailed, it can lead to even higher inflation which might end up exceeding 100%, i.e., hyperinflation. This is a situation that no economy would wish to reach due to the many negative consequential effects that accelerated inflation it has on a domestic economy.

The most important concern, here, is what causes inflationary conditions? There have been many cases of economies suffering from inflation of which various reasons have been given by various authors. They attempt to explain what triggers inflation, but the causes of inflation may vary from economy to economy. In Ghana, there is a belief that inflation is affected by several macroeconomic variables, in particular, the exchange rate, broad money, oil prices, government spending, and population, Agyire-Tettey (2017); Weiseke (2019).

The causal relationship between inflation and macroeconomic variables depend on the type of variable and its significance to the economy. Hence, the nature and directions of the

relationships among such variables need to be studied, especially in Ghana where there is no abundance of empirical work on the determinants of inflation.

In Ghana, from 1990 to 2018, the annual inflation rate averaged 20%, ranging between 7.1% and 60%. Such high inflationary values are above the recent inflationary targets of eight percent set by the Bank of Ghana. The target of eight percent [8%] is very high compared to two percent [2%] in the USA and many European countries. Inflation has impacts on the cost of living and welfare level of Ghanaians. It also has negative consequences on all sectors of the economy such that when cost rises, prices become unbearable and many sectors become dormant or less productive. However, before inflation can be brought under control, Ghana must be able to identify all variables that significantly affect inflation in the Ghanaian economy. In this case, the current study helps to identify some key determinants of inflation using annual historical data from 1990 to 2018. The rising levels of inflation makes understanding the major determinants of inflation in Ghana of greater importance. Few studies have done that, but they used only a limited number of macroeconomic variables, so there is a need to explore further. In answering questions on inflation, Ali, Jan, & Khan (2015); Agalega & Antwi (2013); Sahnoun & Abdennadher (2019); Sasongko & Huruta (2019); explained the causes of inflation in several ways. They argue that inflation is caused by money supply, economic growth, currency depreciation and so on. They established a positive relationship between a number of macroeconomic variables and inflation but with some levels of contradictions. Such contradictions show that there has not been a consensus on the causal relationships between inflation and other economic variables. Hence, in order to know the determinants of inflation in economies, each economy should be studied differently.

This study develops a model to analyse the effect of inflation and other macroeconomic variables such as the cedi-dollar exchange rate, broad money, oil prices, government spending, and population growth in the case of Ghana. Knowing the causal relationship is relevant to help

propose policies that control inflation in Ghana. The study asks three research questions. The first question of the study is which of the macroeconomic variables (the exchange rate, broad money, oil prices, government spending, and population growth) determine inflation in Ghana? The study has set an objective to investigate determinants of inflation by knowing the causal relationship between inflation and the macro economy. This helps to determine whether it is fiscal or monetary macroeconomic policy variables that determine inflation in Ghana. The study uses autoregressive distributed lag model to investigate Granger causality among inflation and all the study variables. Achieving this objective helps to know how key variables determine inflation in Ghana. It also helps to ascertain how the variables affect inflation and vice versa. This allows for policy makers to implement national policies that help regulate inflation. The use of Granger causality helps to answer the first research question and objective by establishing whether there is a unidirectional, bi-directional or no causal effect among the variables. The presence of causality is determined by evidence of a directional relationship running from any of the study variables to inflation which confirms that such variables are determinants of inflation.

The second research question is how do the macroeconomic variables respond to innovations or inflationary shocks and impulses? Therefore, the study investigates the impulse reactions of the exchange rate, broad money, oil prices, government spending, and population growth to shocks or unexpected changes in inflation using a vector auto regressive (VAR) model to run impulse response analysis. The results of impulse response analysis help to know how the study variables respond to innovations or shocks in inflation. Finally, the third question of the study is what proportion of the variances in inflation is determined by the macroeconomic variables under study? To answer this research question, the study investigates the percentages of variability in inflation that is determined by each of the study variables. This is done using variance decomposition analysis as it helps to know the percentage of variability

in inflation that is attributed to the independent variables. All these findings are important to answer the third research question and objective. This is useful for both monetary-and fiscal policies and for investment decision making.

1.2 Organization of the study

The study is organized into six chapters. Chapter one is an introduction and it introduces the study providing information on what motivates the general and specific problem, the study objectives, the research questions and organization of the study. Chapter two is a background to the study. It discusses in detail, the specific problem, collects and reports data. Chapter three is a review of theories and related literature. The theories relate to the problems identified in chapter one and are used to help establish the economic cause effect relationships. Chapter four describes the method and data used in the study which includes both statistical and econometric methodologies. Chapter five is results of the data used for analysis and chapter six is summary and conclusion.

CHAPTER TWO

BACKGROUND

2.1 Ghana's Macroeconomic Developments (1990-2018)

During the early 1990s, Ghana had embarked on the UN Millennium Development Goals (MDGs) agenda of economic development planning. The main agenda for Ghana's economic development strategy was benchmarked on accelerated economic growth and wealth creation, macro-economic stability, trade liberalization, poverty reduction and a comfortable living standard for all as a prerequisite for a sustainable development (Government of Ghana, 2000). Ghana embarked on various long-term development plans known as the National Development Policy Framework (Ghana Vision 2020); Ghana Poverty Reduction Strategy (GPRS I) 2003-2006; GPRS II 2006-2009; and The Ghana Shared Growth and Development Agenda (Better Ghana Agenda) 2010-2013. Since 2003, inflation rate has been targeted at a ceiling of 8% every month. Ghana's significant discoveries of offshore oil announced in 2007 was expected to have good impact on prices of oil in the local market. In 1997, the central bank used monetary instruments to satisfy the government's monetary requirements by raising broad money supply by 41% (Quartey & Afful-Mensah, 2014). Thus, the average inflation rate was expected to decline after implementing monetary policy decisions. As part of the government's efforts to reduce inflation, the Ghana cedi was devaluated to new Ghana cedi in 2007 (Obuobi et al., 2020). During the currency devaluation, inflation rate was 10.7% but the central bank tried to improve the cedi's value while reducing the number of zeros in the currency.

The Ghana vision 2020, started under President Jerry John Rawlings, is a long-term vision of Ghana to become a middle-income country by year 2020. This was part of the National Development Policy Framework (NDPF). The long-term vision was targeted from 1996 to 2020. The medium-term target for Ghana Vision 2020 was set from 1996-2000. The Ghana Vision 2020 brought on board all stakeholders including government agencies, private

sector and NGOs (Government of Ghana, 2000). The main objective of this vision was to equip Ghana with fully developed human capital base, infrastructure, rural and urban development and enabling the use of modern technology to create a conducive atmosphere to boost economic growth. The main target was to increase GDP by at least 8% and per capita income of over US \$500 in year 2000 and beyond. The program was also targeted at strengthening industrialization and the service sector (Government of Ghana, 2000).

In this study, the period of assessing inflation in relation to each of the study variables has been divided into two in section 2.2, thus, a period before the central bank introduced inflationary target (1990-2001) and the second period analyses the macroeconomic performance after the introduction of inflationary target (2002-2018). This is to help monitor whether the use of inflationary targeting has been effective in controlling inflation in Ghana.

2.1.1 Economic development under various administration of government (1990-2018)

Jerry John Rawlings (1993-2000)

The administration of Jerry Rawlings saw several macroeconomic transformations. It was the period that Ghana became a democratic state. The main developmental activities focused on macroeconomic stabilization and structural reform (Kusi, 2018). The goal was to stimulate economic recovery and enhance a continuous and increasing growth of the national economy. Economic growth fell from 5% in 1993 to 3.3% in 1994 (Kusi, 2018). The fiscal deficit was affected as well and dropped from 7.4% of GDP in 1993 to 3.8% of GDP in 1994. At the same time, inflation was increasing, rising to 34.2% (English, 1999). The rate of depreciation improved from 64.3% in 1993 to 27.9% in 1994 and it was as a result of improvement Ghana's export in of cocoa, gold and other agricultural commodities (Kusi, 2018). At this point, the government resorted to a three-year (1995-1997) IMF-support program which sought to ensure macroeconomic stability, invest more into the economy to support high economic growth and reduce inflation.

John Agyekum Kuffour (2000-2008)

The government under John Kuffour aimed at restoring macroeconomic stability as a prerequisite to boost economic growth. The national development strategy was focused on developing the private sector, service debt, fight corruption, and invest in human development. The Ghana Poverty Reduction Strategy (GPRS I) was introduced (Kusi, 2018). Government joined the IMF Highly Indebted Poor Country (HIPC) debt relief program. HIPC was an economic recovery program under the auspices of International Monetary Fund (IMF) and The World Bank in 1996. In addition to the HIPC relief the IMF included Ghana in the Poverty Reduction and Growth Facility (PRGF) in 2003. During the same period, the World Bank supported the government with Poverty Reduction Support Credits (PRSCs) which was estimated at US\$125. Ghana used such benefits to expand infrastructure (Kusi, 2018). Under their administration, Ghana's GDP increased to more than four folds in nominal value which gave Ghana a lower-middle income status (Bawumia, 2017). During this period, Ghana's main focus was on debt reduction. This is when inflation declined from 40.5% in 2000 to 12.7% in 2007 and Ghana achieved a balance of payment surplus (Bawumia, 2017).

John Evans Atta Mills/John Dramani Mahama (2009-2016)

The government under the leadership of John Mills encountered many challenges such as high fiscal and balance of payment deficits that opposed a robust economic growth. Ghana sought for relief from the IMF for a three-year Poverty Reduction and Growth Facility (PRGF) arrangement (IMF, 2012). This was done to augment the efforts of government to improve macroeconomic stability and achieve a sustainable growth and poverty reduction. Through the rebasing (changing of the base year) of Ghana's GDP which took place in 2010, Ghana attained the status of in a lower middle-income country. However, this was also the period of Ghana's commencement of commercial oil production. Therefore, Ghana's economy was boosted as one of the fastest growing economies in Africa. These economic growth successes helped to

lower poverty levels. This was a period characterized by a sharp depreciation in exchange rate, and high inflationary rate which resulted in Ghana seeking for a three-year arrangement under the Extended Credit Facility (ECF) a bailout from the IMF to support the medium-term economic reform program. However, Ghana continued to suffer adverse macroeconomic crisis (Kusi, 2018).

Nana Addo Danquah Akufo-Addo (2017-2021)

The government inherited the IMF assisted economic bailout which was meant to end in 2018. There was a freeze on public sector employment as part of the IMF bailout conditions (Kusi, 2018). To minimize the impact of IMF bailout restrictions, the government initiated some programs dubbed: Program for Economic and Social Development Policies (2017-2024). In addition, the government implemented the Infrastructure for Poverty Eradication Program (IPEP) to help strengthen infrastructure at the local level. This is when the National Entrepreneurship and Innovation Plan (NEIP) emerged and it was geared towards creating support for start-ups and small businesses (Kusi, 2018).

2.1.2 The impact of economic development plan, post 1990

Ghana sought to achieve rapid growth using short-, medium- and long-term economic development strategies. This was supposed to eradicate extreme poverty and improve the living standard of all Ghanaians, especially the underprivileged. However, these objectives were not actualized due to unstable macroeconomic conditions. Table 2.1.2 presents the selected GDP indicators performance from 1990 to 2012. A sustained growth in real GDP makes it appear as if such growth targets were met though they were not. The average real GDP growth rates grew at 5% every year after 2003. After 2007, real GDP exceeded a 7% growth rate in each year, except in 2009. There were structural challenges as indicated by large fiscal and balance-of-trade deficits, but improvements were seen in the external debt expressed as a percent of GDP,

which fell below 100% since 2003 and has remained below 40% for every year since 2006, except in 2012.

Table 2.1.2 Selected GDP indicators.

	Real % chg GDP	Budget % of GDP	External debt as % of GDP	Reserves as % of total external debt	Trade balance (good + services)
1990	3.8	-2.3		8.3	
1995	4.0	-6.7		14.6	
2000	3.7	-9.7	157.3	4.9	-991
2001	4.2	-9.0	122.6	5.7	-1176
2002	4.5	-6.8	113.7	8.8	-758
2003	5.2	-4.6	107.5	18.6	-940
2004	5.8	-3.7	73.0	23.5	-1869
2005	5.8	-2.4	59.2	26.4	-2084
2006	6.4	-7.8	17.5	61.5	-3338
2007	6.0	-8.1	24.6	43.4	-3879
2008	8.4	-8.5	32.1	35.4	-3328
2009	4.0	-5.8	36.1	51.3	-1688
2010	8.0	-6.5	37.6	55.4	-2701
2011	14.4	-4.0	39.1	52.4	-3675
2012	7.3	-7.0	51.0		-4880

Source: Garcia, Adomako, & Mintah (2013)

2.1.3 GDP contributions by sector

Ghana's goal of achieving high economic performance and reaching middle income status was achieved by the contribution of three major sectors, services, agriculture and industry. Table 2.1.3 shows Ghana's GDP contributions by sector. From 1990 to 2005, the agricultural sector contributed most to GDP growth; the minimum contribution from the agricultural sector was 35% and the maximum is 46%. For the overall period, the average

contribution from agricultural sector was 32%. Services contributed a minimum of 26% and a maximum of 37.8% to GDP with an average contribution of 30%, prior to 2006. Industry contributed a minimum of 16.7% and a maximum of 25.7%. The average contribution from industry was 23%.

Table 2.1.3 GDP contribution by sector

	Services, value added (% of GDP)	Agriculture, forestry, and fishing, value added (% of GDP)	industry, value added (% of GDP)
1990	37.89	44.85	16.77
1991	37.42	45.51	16.96
1992	37.44	44.78	17.38
1993	27.53	36.93	24.82
1994	27.34	37.79	24.90
1995	27.75	38.78	24.28
1996	26.25	38.96	23.58
1997	27.89	35.78	25.67
1998	28.23	36.01	25.27
1999	28.41	35.78	25.41
2000	28.82	35.27	25.40
2001	29.16	35.24	25.22
2002	29.21	35.15	25.28
2003	29.07	36.55	25.21
2004	28.68	37.95	24.72
2005	28.91	37.45	25.13
2006	46.46	28.95	19.80
2007	47.17	27.29	19.49
2008	46.17	29.41	19.40
2009	47.94	30.99	18.51
2010	48.18	28.04	18.01
2011	45.84	23.66	23.86
2012	47.58	22.13	27.14
2013	39.15	20.45	34.86
2014	36.11	20.00	34.59
2015	39.54	20.25	31.68
2016	43.09	20.98	28.23
2017	42.35	19.70	30.78
2018	43.01	18.27	31.53

Source: WDI (2019)

From 2006 to 2018, agricultural sector lost its dominance to the services sector making the services sector the major contributor to GDP growth. On the average, the contribution from

services sector was 44%, the average contribution from agricultural sector was 24% and industry was 26%.

Ghana's inflation dynamics have been persistent since independence. It has been unstable and high in some periods. From 1990-2018, Ghana experienced an increasing level of inflation during periods of macroeconomic instability, featuring high poverty levels, unemployment, balance of payment deficits, cedi depreciation, and high interest rates (Kusi, 2018). These instabilities were caused by both poor internal economic management and external shocks as shown in Table 2.1.2. According to Ocran (2007), there were many occasions when Ghana's inflation percentage change had jumped above 100% during 1990-2019. Although policies were implemented at that time such as the tightening of the monetary policy rate (MPR) to target inflation, it did not have the desired effect on inflation. The rising levels of inflation increased the cost of living and reduced the purchasing power which affected production and employment. Unemployment also increased the dependency ratio of the working population with implications on living standards and raising the poverty level. A reduction in production with constant demand pushes prices upwards thereby creating higher inflation levels. The overall effect is rising poverty levels in Ghana coupled with higher interest rates.

Therefore, knowing the causal relationship between inflation and other key macroeconomic variables is important for policy making purposes. Most of the time, Ghana has experienced an unexpected rise in inflation, which have been triggered by its causal relation with macroeconomic variables such as low levels of production and high poverty levels that are not adequately monitored by government due to lack of effective policies during some periods. Several studies Agalega & Antwi (2013); Agbenorhevi (2016); Boel (2018); Ejembi, Adesina, & Maja (2015); Mohammed (2013); Mohseni & Jouzaryan (2016); and

Madurapperuma (2016) try to investigate such relationships but few of them were conducted on Ghana.

The country has faced several economic challenges which have implications on economic growth. All these have been influenced by fiscal policies, monetary policies, oil price fluctuations, exchange rate and population growths. In spite of the economic challenges, the Ghanaian economy has undergone a series of economic transformations which has impacted on its developmental agenda. It has been a top priority of government to embark on policies that reduce the cost of living, increase standard of living and alleviate poverty among citizens in Ghana.

But the early 1990s presented new difficulties such as currency devaluation and high cost of living that raised poverty levels in Ghana. In dealing with high poverty levels, Ghana resorted to IMF-initiated economic recovery and reform programs, which was aimed at diversifying exports, controlling public expenditure and privatizing a number of state-owned enterprises to curtail inflation. In addition, Ghana developed a short-to medium term development agenda called the Ghana Shared Growth and Development Agenda (GSGDA). The GSGDA was a policy framework implemented to achieve economic growth and development using available resources including natural resources, human capital development, science and technology to drive industrialization. In an effort to make the Ghanaian economy recover, Ghana signed an agreement to join the (HIPC) in 2002.

HIPC was launched to provide debt relief to the world's poorest and heavily indebted countries to help relief them of constraints of economic growth and increase poverty reduction. All of such efforts worked together to help Ghana attain a lower-middle income status in 2010. Nonetheless, there are still a significant fraction, about 56.9% of Ghanaians who still live in high poverty levels. The poverty situations in Ghana is partly explained by high annual levels of inflation which has consistently increased above 2% since 1990 and as high as 9.8% as at

2018. Due to the high levels of inflation, cost of living has risen rendering most Ghanaians incapable to afford basic human needs and necessities such as food, decent clothing and decent shelter Leite et al. (2000). But the government's ability to control inflation could increase purchasing power and reduce cost of living which will tend to improve living conditions. Achieving low inflation therefore helps to improve poverty conditions. But in an effort to tackle inflation, there must be efforts to know what determines inflation in Ghana, especially, by looking at periods where inflation rate was high. The rest of the section describes the background of Ghana's economy from 1990 to 2018 with interest in its inflation and the evolution of some variables that affect inflation rate.

2.2 Macroeconomic performance of the individual variables

The following sections discuss the individual performances of the macroeconomic variables used in the study from 1990 to 2018. A comparison has been made for two periods, thus, pre-inflation targeting period (1990-2001) and post-inflation targeting period (2002-2018). Table 2.2 gives details of each variable.

2.2.1 Inflation

Ghana recorded high levels of inflation from 1990 to 2018, averaging almost a 20% annual average and ranging from a high of 60% in 1995 to a low of 7% in 2012. These intermittently high rates (with the exception of 2011, 2012 and 2018 which recorded single digits) are indications that the cost of living has been very high for ordinary Ghanaians. To reduce the impact of high inflation of above 8% inflation targets in the Ghanaian economy government uses inflation targeting approach. The Central Bank's control of money supply has undergone a transformation by moving away from the use of exchange rate as inflation control target to the use of inflation targets. Ghana's monetary policy has evolved from the use of direct instruments to the market-based approach with money supply as the main target.

Before Ghana adopted inflation targeting policy (IT) in 2002, annual average rate of inflation from 1990 to 2001 was 27.9%. However, after Bank of Ghana adopted inflation targeting (IT) as a monetary policy tool to control inflation, from 2002 to 2018, the annual average inflation rate reduced to 13.9% with the minimum being 7.1%. This shows that there has been a moderate improvement in inflation after adopting IT as a monetary policy tool. However, such values are still substantial and hence needs further improvements.

2.2.2 Crude Oil Prices

Fluctuations in international oil prices contributes to the increase in the general price levels in Ghana. Before 2015, government used to subsidize oil prices to help reduce its impact on inflation. This strategy mostly occurred during periods of rising oil prices in the international market. However, since oil production began in December 2010, there has not been any improvement in the oil price situation in the local market. Ghana started oil production at a rate of 55,000 barrels a day and was at 99,000 barrels a day in 2013. In 2015 the country was set to become a major oil exporter. Ghana's discovery of oil has had a positive impact on Ghana's trade balance, its revenues and GDP as a whole.

Prior to Ghana's oil discovery, the average price of oil from 1990 to 2001 was \$19.64/barrel, with a minimum of \$12.72 and a maximum of \$28.31. Ghana had an oil price subsidy policy that helped to subsidize oil prices so that it becomes less expensive to the final consumer. This was geared towards shifting the oil price burdens from consumers to the government. It was a strategy that government was using to reduce the cost of living and inflation

In post oil discovery period, average prices of crude oil increased to \$109.19 (2002-2018) from \$19.64 (1990-2001). The minimum value increased from \$12.72 per barrel (1990-2001) to \$25 and the maximum increased from \$28.34 (1990-2001) to \$112.17. One main policy change within such period was the deregulation policy adopted by government in 2015

to bring an end to government subsidies on petroleum products and replacing it with the automatic price formulation which allows the market to set its own prices. Periods of persistent increase in oil prices put a lot of financial burden on government due to fuel price subsidies. However, the government found that such fuel price subsidies were not very efficient because it was rather benefiting the well-to-do in society instead of the poor (Acheampong & Ackah, 2015). This was realized after the government launched a poverty and social impact assessment (PSIA) for fuel, which brought all stakeholders together to investigate on fuel price subsidies.

2.2.3 Exchange rate

The exchange rate is formally used to represent an authorized rate by a country or a regulated market of currency exchange. It is derived from annual averages calculated monthly using a ratio of local currencies (cedi) and the U.S dollars. The Ghana cedi exchange rate has been fluctuating at an increasing rate relative to major currencies such as the dollar, pound and euro.

From 1990 to 2001, the average exchange rate, cedi/\$, was 0.21, a minimum of 0.03 and a maximum of 0.72. From 2000 to 2018, the average rate increased to 1.99, the minimum and the maximum rates rose to 0.79 and 4.59, respectively.

2.2.4 Broad money

Economists define broad money as money in circulation in an economy which comprises of narrow, and less liquid money forms. In economics, the broad money is a measure of the amount of money, or money supply, in a national economy including both highly liquid "narrow money" and less liquid forms such as savings, and deposits. Broad money in the context of the study is as defined by the World Bank (2020), which is, "the sum of currency outside banks. Table 2.2 shows that from 2000 to 2018, the average rate increased to 24 billion, the minimum and the maximum amounts rose to 1.7 billion and 77.5 billion cedis respectively.

The bank of Ghana uses its monetary policy to control broad money supply to ensure price stability. This is subject to support the Government's economic objectives including those for growth. The central bank helps to achieve the government's inflation target by setting a monetary policy interest rate. The main objective of monetary policy is to consolidate and extend the progress made in reducing inflation.

2.2.5 Government spending

Government spending constitutes all public expenditure on goods and services, and forms a major component of the GDP, about 23.6% (IMF, 2020). Government spending policies may be in the form of setting up budget targets, adjusting taxation, increasing public expenditure and public works. These are very effective tools in influencing economic growth. Ghana has also adopted steps to improve the management of public expenditures under its Public Financial Management Reform Program which was launched in July 1995 and supported by the World Bank, the IMF, and donors. In the program, the medium-term expenditure framework (MTEF) was introduced as the basis for annual budgeting and a new computer-based budget and public expenditure management system. In studying the period of 1990 to 2018, Ghana's minimum expenditure was approximately GHC18 million and the maximum expenditure was GHC244 billion, averaging GHC45 billion.

The average government spending from 1990 to 2001 was 1.2 billion, the minimum and maximum amounts spent were 0.2 billion and 3.5 billion, respectively. From 2002 to 2018, the average government spending increased to 76 billion, of which the minimum was GHC4.5 billion and the maximum was GHC243.5 billion.

2.2.6 Population

The population composition of Ghana depicts that the population rises slowly but steadily from a minimum of 14.77 million in 1990 until it attains a maximum of 29.77 million in 2018.

Table 2.2 Macroeconomic indicators of Ghana from 1990-2018

	Inflation		Crude oil		Exchange rate		Broad money		Gov't spending		Population	
	Rate	% chg	\$/barrel	% chg	cedi/\$	% chg	cedi bn	% chg	cedi bn	% chg	Mln	% chg
1990	37.26		23.71		0.03		0.03		0.18		14.77	
1991	18.03	-51.61	19.98	-15.73	0.04	12.72	0.04	39.08	0.22	23.91	15.21	2.94
1992	10.06	-44.23	19.41	-2.84	0.04	18.83	0.06	52.28	0.28	23.01	15.65	2.93
1993	24.96	148.21	17.00	-12.45	0.06	48.50	0.08	33.50	0.36	31.44	16.11	2.90
1994	24.87	-0.36	15.83	-6.89	0.10	47.32	0.12	52.57	0.46	25.26	16.56	2.82
1995	59.46	139.09	17.06	7.77	0.12	25.47	0.17	43.17	0.69	50.40	17.01	2.73
1996	46.56	-21.70	20.45	19.92	0.16	36.39	0.23	39.20	0.98	43.58	17.46	2.64
1997	27.89	-40.11	19.12	-6.54	0.20	25.22	0.34	44.09	1.35	37.37	17.91	2.56
1998	14.62	-47.56	12.72	-33.46	0.23	12.88	0.40	17.49	1.55	14.84	18.36	2.50
1999	12.41	-15.15	17.70	39.15	0.27	15.35	0.50	25.42	1.99	28.00	18.81	2.48
2000	25.19	103.03	28.31	59.94	0.54	104.36	0.76	54.24	2.56	29.06	19.28	2.48
2001	32.91	30.61	24.41	-13.76	0.72	31.45	1.20	56.53	3.54	38.04	19.76	2.48
2002	14.82	-54.97	25.00	2.40	0.79	10.63	1.67	39.21	4.52	27.76	20.25	2.48
2003	26.67	80.04	28.84	15.39	0.87	9.38	2.05	23.24	6.15	36.03	20.75	2.49
2004	12.62	-52.67	38.28	32.71	0.90	3.78	2.61	27.28	7.40	20.36	21.27	2.52
2005	15.12	19.75	54.43	42.19	0.91	0.75	3.12	19.47	9.36	26.46	21.81	2.55
2006	10.92	-27.80	65.38	20.10	0.92	1.12	4.35	39.34	17.32	84.96	22.38	2.59
2007	10.73	-1.67	72.73	11.25	0.94	2.05	5.95	36.83	23.37	34.93	22.96	2.61
2008	16.52	53.94	97.57	34.15	1.06	13.11	8.29	39.18	31.07	32.98	23.56	2.61
2009	19.25	16.51	61.87	660.87	1.41	33.17	10.34	24.74	35.35	13.75	24.17	2.58
2010	10.71	-44.38	79.63	-89.27	1.43	1.58	13.64	31.92	46.36	31.15	24.78	2.52
2011	8.73	-18.50	111.08	39.49	1.51	5.65	18.27	33.99	59.58	28.53	25.39	2.45
2012	7.13	-18.34	112.17	0.98	1.80	18.78	22.87	25.14	71.91	20.69	26.00	2.40
2013	11.67	63.70	108.84	-2.97	1.95	8.81	27.33	19.50	103.26	43.58	26.61	2.35
2014	15.49	32.77	98.94	-9.10	2.90	48.40	37.52	37.29	124.09	20.18	27.22	2.32
2015	17.15	10.72	52.40	-47.04	3.67	26.49	47.11	25.57	143.38	15.55	27.85	2.29
2016	17.45	1.78	44.05	-15.94	3.91	6.59	57.71	22.50	163.05	13.72	28.48	2.27
2017	12.37	-29.12	53.51	21.48	4.35	11.28	66.98	16.07	202.82	24.39	29.12	2.25
2018	9.84	-20.49	71.07	32.82	4.59	5.43	77.54	15.76	243.51	20.06	29.77	2.22

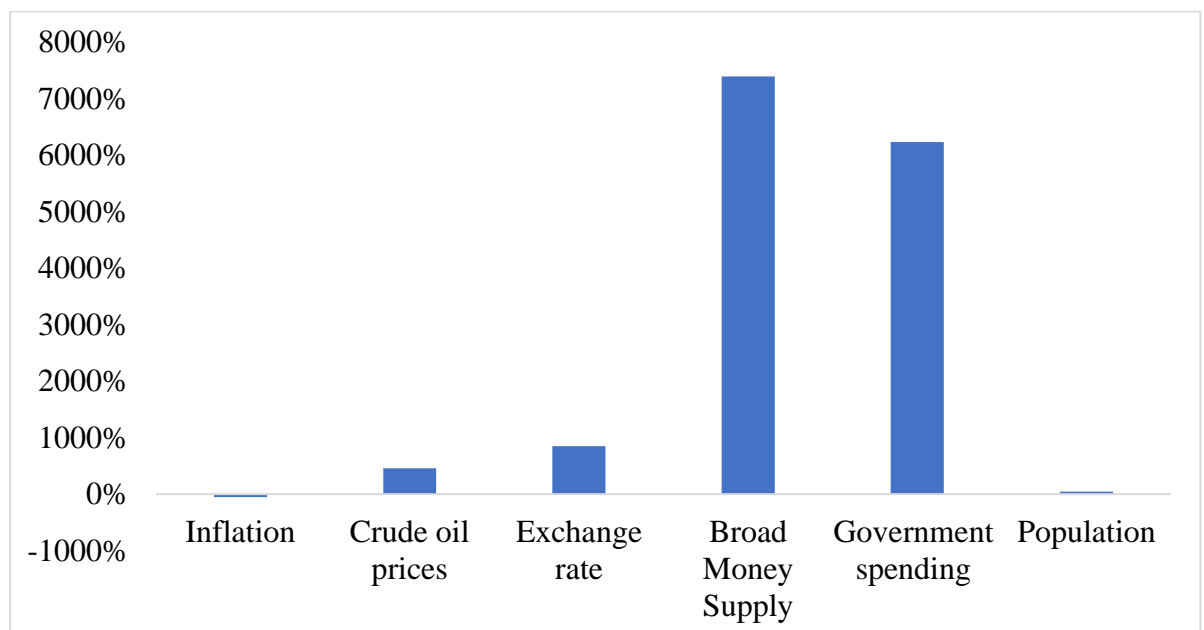
Sources: World Bank (2020)

The average population was recorded as 21.70 million during 2004 and 2005. During this period, 36.5% averaged under 15 years of age, 60% were between 15 and 64 years of age, and 3.6% were above 65 years. The average was 17.2 million people, the minimum was 14.8 million and the maximum was 19.8 million. From 2002 to 2018, Ghana's population was 24.8 million on average, with the minimum population recorded as 20.2 million, and the maximum was 29.8 million people. The annual average growth rate is +2% each year, but it affects inflation due to changes in demand. A change in population causes the demand curve to shift to the right which causes price to increase, *ceteris paribus*.

2.2.7 Comparing the averages of the various variables in 1990-2001 with 2001-2018

In Figure 2.2.7, macroeconomic variables are compared over two periods. The average rate of inflation from 1990 to 2001 reduced by 50% when compared with average inflation rate from 2002 to 2018.

Figure 2.2.7 Average annual % change of study variables from 1990-2001 to 2002-2018



Source: Writer's own construct, Data from World Bank (2020)

At the same time, average crude oil prices increased by 456%, exchange rate increased by 848%, broad money supply increased by 7400%, government spending increased by 6233%

and population increased by 44%. This comparison helps to know how each variable was affected after the implementation of inflation targeting policy in 2002.

Summary

Chapter two gave the background of the macroeconomic performance of Ghana with respect to monetary and fiscal policies. The study gives insight on the periodic programs and policies that necessitated such economic transformations under different administration of government since 1990. It is shown that the economic challenges that Ghana faced in the early 1990s prompted the government to use both monetary and fiscal policies to help reduce the impact of inflation which had positive effects on economic growth using inflation targeting as monetary policy and the implementation of economic growth programs. Also, it was discussed that the intervention of IMF and the World Bank was paramount for the economic recovery of Ghana which has enabled Ghana to transition into middle income status.

CHAPTER THREE

THEORY AND LITERATURE REVIEW

3.1 Theories of inflation

Inflation is defined as the general rise in the price level in a country (Cogoljević, Gavrilović, Roganović, Matić, & Piljan 2018). Similarly, Labonte (2012) defined inflation as a quantitative measure of the rate at which the average price level of a basket of selected goods and services in an economy increases over a period of time and this is often expressed in percentages. PIMCO (2020) posits that inflation may either be caused by demand pull factors or supply push factors.

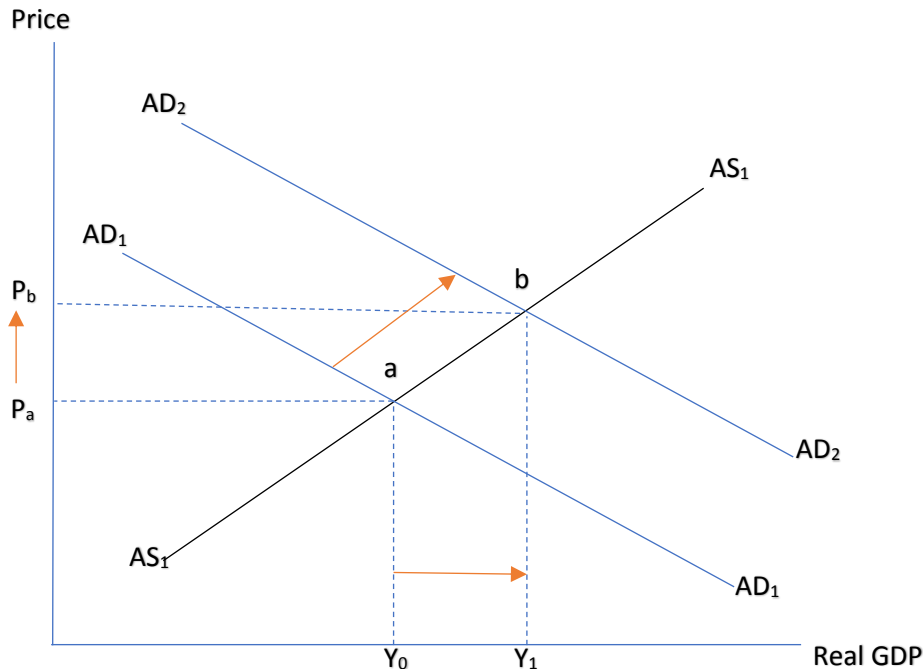
3.1.1 Demand-pull inflation

Demand pull inflation is the upward pressure on prices that leads to shortages in supply (Bresciani-Turroni & Savers (2013)). Thus, an increase in the income of consumers lead to more spending. The theory of demand-pull inflation was propounded by John Maynard Keynes. Proponents of Keynesian economics argue that aggregate demand increases as an economy gets closer to full employment. This leads to increase in the rate of economic growth since workers earn more income thereby giving them higher purchasing ability and consequently leads to inflation (Schwarzer 2018). According to Neri and Ropele (2019) demand pull inflation is mostly determined by household spending, business spending, government spending, and foreign investment all of which affect aggregate demand. When consumers feel confident, they spend more and take on more debt. This leads to a steady increase in demand, which means higher prices. Also, when government spends more freely, prices tend to go up. Inflation expectations can also cause companies to increase their prices (Neri & Ropele 2019).

In Figure 3.1.1, a change in income, causes a shift in the aggregate demand (AD) curve, from AD_1 to AD_2 . At the same level of aggregate supply (AS), the price increases from P_a to P_b

depicting inflation emanating from the demand side. This causes changes in equilibrium from a to b.

Figure 3.1.1 Demand-pull inflation



Source: Economist Online (2020)

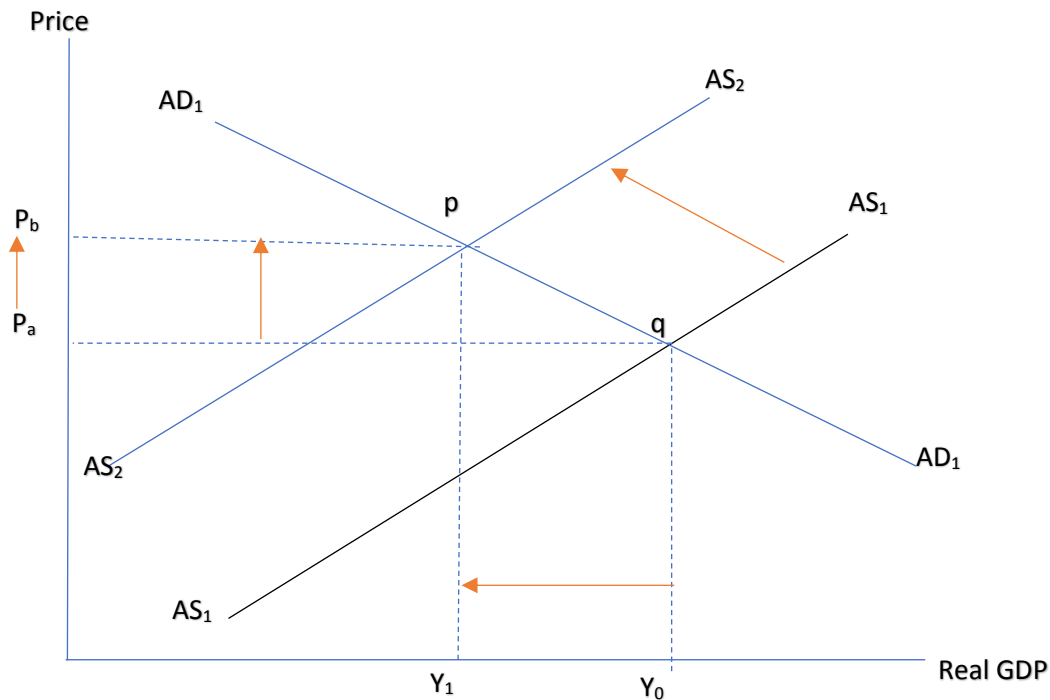
3.1.2 Cost-push inflation

Cost-push inflation occurs when there is an increase in production costs such as raw materials and wages (Bresciani-Turroni & Savers 2013). The effect of high cost in production is a reduction in aggregate supply and an increase in the price of final goods as a result of increase in wages, oil prices and fall in exchange rate. This led to cost being transferred to consumers in the form of higher prices for finished goods. The cost of production is affected by any or all of the factors of production, raw materials and taxes (Neri & Ropele 2019). Cost-push inflation occurs when demand for goods is constant or inelastic as supply of goods decrease.

In Figure 3.1.2, inflation is pushed up from the supply side. When the prices of the factors of production (cost of production) increases, it causes real GDP to fall from Y_0 to Y_1 , aggregate

supply falls from AS_1 to AS_2 . At the same level of aggregate demand, prices rise from P_a to P_b which depicts inflation from supply side. Also, there is a shift in equilibrium condition from q to p .

Figure 3.1.2 Cost-push inflation



Source: Economist Online (2020)

3.2 Empirical Review

After knowing the theoretical framework of inflation, it is important to know the empirical studies of inflation. Various studies Byanjankar (2020); Emerenini & Eke (2014); Gyebi (2013); Madito & Odhiambo (2018); Ubide (2016); Uddin, Chowdhury, & Hossain (2014) postulate that inflation is not affected by only one variable but several macroeconomic variables. But the nature and magnitude of inflation depends on the relevance of the variable and the nature of the economy under study. Some of these variables include oil prices broad money supply, GDP, unemployment, interest rate, exchange rate and so on. This section provides review of various empirical studies on inflation.

Sek, Teo, and Wong (2015) empirically analysed oil price changes as determinants of inflation in two groups of countries from 1980 to 2010. The first group was referred to as high oil dependency and the second group low oil dependency. They used autoregressive distributed lag (ARDL) model for their analysis and found that oil price changes have a direct effect on domestic inflation in low oil dependency group, but its impact is indirect on affecting the domestic inflation in the high oil dependency group. In their study, they conclude that variables such as the real exchange rate and production cost are key determinants of inflation. Their study is helpful to this research in two ways. First, it gives insights that the use of ARDL model is instrumental in investigating the determinants of inflation. Second, it exposes that their study was limited to the use of a few variables. Therefore, this study expounds on their approach by conducting impulse response and variance decomposition analysis.

Kibritçioğlu (2018) compared existing empirical studies on inflation in Turkey. He finds that most studies focused on the demand-side determinants of inflation which include variables on monetary growth and budget deficits. He argues that the supply determinants of inflation are the nominal exchange rate and oil prices. His study suggested that the “components, degree and effects of inflation inertia” must be looked at in detailed analysis. The findings and recommendations made by Kibritçioğlu (2018) guide the current study in selecting the determinants of inflation to include both demand- and supply-side determinants.

Phan (2014) used quarterly data spanning 1996 to 2012 to analyse determinants of Vietnam’s inflation by using vector autoregressive (VAR). The results show that monetary policy, interest rate and output prices are the key determinants of inflation in Vietnam while oil and rice prices seem not to have much impact on Vietnam’s inflation. Therefore, his study sheds some light on other determinants of inflation that are of relevance. This has justified the decision to include money supply as determinant of inflation in the current study to be

investigated in Ghana's case. The use of the VAR model, as in Phan (2014), is replicated as an approach in this study.

Nguyen (2015) investigated how fiscal deficits and broad money contributed to inflation in Asian countries. The selected countries were Bangladesh, Cambodia, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, and Vietnam. Their study used data spanning 1985-2012 to employ a pooled mean group (PMG) estimation-based error correction model and the panel differenced GMM (General Method of Moment) Arellano-Bond estimator. They observe that by using PMG estimation, broad money (M2) supply shows a significant positive impact on inflation while the fiscal deficit, government expenditure and interest rate, prove to be statistically significant determinants of inflation in both methods of estimation. This is important because it justifies the need for the inclusion of broad money and government expenditure as independent variables in this study.

Likukela (2007) used quarterly data spanning 1993 to 2003 on Namibia to investigate the major determinants of inflation. He emphasized the relationships that exist between the Namibian price level (dependent variable) and the real GDP, broad money supply, interest rate, and South African CPI as well as the United States price index (explanatory variables). He found that in the short run, domestic prices are influenced by the level of economic growth and foreign prices. However, in his methods, he did not analyze the causal relationships but rather, he uses regression model to make his findings which is not very effective way to determine causality.

Ramayah (2016) conducted a study to investigate the determinants of inflation in some selected South-East Asian countries, e.g., Singapore, Malaysia and Indonesia. The variables used were money supply (M2), oil prices and nominal exchange rate whereas inflation was used as the dependent variable. Their analysis was conducted using ordinary least squares (OLS) regression method. He/she found that money supply (M2) is a significant predictor for

inflation across all three studied countries. Oil prices were found to determine inflation only in Singapore and Indonesia but not Malaysia. Owing to the fact that Ghana is an oil producing country, it gives insights that oil production could be a major determinant of inflation. However, the nominal exchange rate did not prove to be a significant determinant of inflation. The insights given by Ramayah (2016) on the impact of oil prices and the exchange rate is relevant as it gives an idea of what previous studies have found as being relevant determinants of inflation which guides the focus of the current study.

Acquah-Sam (2017) conducted a study to explore some of the major triggers of inflation in Ghana from 1991 to 2011 using secondary data. His study used multiple linear regression analysis based on structural equation modelling through path analysis. He found that the interest rate is the only major variable that has a positive and significant effect on inflation in Ghana. However, he finds that the time of study has influence on what could possibly be a determinant of inflation. Interestingly, he discovered that GDP growth, market capitalization, gross fixed investment, and foreign direct investments do not have significant effect on inflation in Ghana. His findings indicate that there could be other variables that are determinants of inflation but are yet to be explored. Therefore, this study uses more recent data up to 2018 and adds more independent variables to extend his research.

El Baz (2014) studied the determinants of inflation in Egypt using annual data from 1991-2012. He analyzed the study data by use of VAR model. His results show that inflation rate has positive relationship with domestic liquidity, growth rate, output gap, exchange rate depreciation, and world food prices. The positive relationship of inflation and some macroeconomic variables in Egypt emphasizes that it is relevant to study each economic variable in the context of different economies because such relationships have impact on decision making.

Lim and Sek (2015) studied the determinants of inflation in both high and low inflation countries group and low inflation group using annual data spanning 1970 to 2011. Their analysis was done using an error correction model based on autoregressive distributed lag (ARDL) modelling. Their results suggest that GDP growth and imports of goods and services have a significant long-run impact on inflation in low-inflation countries. Also, money supply, national expenditure and GDP growth determine inflation and it has a long-run impact on inflation in high-inflation countries. They also observe that in the short run, none of the study variables had a significant impact (at 5% level of significance) on inflation in high-inflation countries. Nonetheless, they find that money supply, imports of goods and services and GDP growth has significant relationship with inflation in low-inflation countries. This study intends to use the ARDL approach used in Lim and Sek for the case of Ghana and extend it further with Impulse response and variance decomposition analysis to help study the implications of inflationary shocks on the macroeconomy. The current study has included variables such as exchange rate, broad money and government expenditure.

Madito and Odhiambo (2018) investigated the determinants of inflation in South Africa using quarterly data from 1970Q1 to 2015Q4. Their results reveal that inflation expectations, labor costs, government expenditure and import prices are positive determinants, while GDP and exchange rates are negative determinants of inflation. Their study concludes that for South Africa's government to achieve the macroeconomic policy objective of a stable and low inflation rate, more emphasis should be placed on anchoring inflation expectations, because it is highly significant in determining inflation.

Ubide (2016) assessed the main determinants of inflation in Azerbaijan during 2003-2015 years. They analyzed quarterly data on CPI, trade partner's CPI, nominal effective exchange rate (NEER), money supply (M2), real non-oil gross domestic product (NGDP) and credits. Their study used VAR analysis where impulse response and variance decomposition

analysis were made. They found that inflation is mostly explained by foreign inflation, fiscal policy, exchange rate and own shocks, whereas monetary policy and supply shocks do not play any essential role in explaining inflation. Among the determinants, they note that inflation expectations, foreign inflation and monetary policy (credit variable) have quick effect on domestic inflation, but the effect of the fiscal variable is relatively slower. They discussed that the appreciation of exchange rate has a deflationary effect on domestic inflation. In this study, in place of foreign inflation, crude oil prices is used because it seems to have more effect on inflation in Ghana.

Emerenini and Eke (2014) investigated the determinants of inflation in Nigeria using monthly data from January 2007 to August 2014. They employed OLS and found that expected inflation, exchange rate and money supply influenced inflation, but the annual treasury bill rate and the monetary policy rate did not influence Nigeria's inflation. Their result showed that all the explanatory variables used for the analysis accounted for 90% variation in explaining the direction of inflation as regards to increase or decrease inflation, the co-integration test showed a long-term relationship existing among the variables.

Their findings reaffirm that broad money proves to be an important variable that determines inflation in different countries. Therefore, it justifies the need to investigate whether it works in the case of Ghana while using different approach and different timeline. The case of Ghana and Nigeria are similar because both Ghana and Nigeria are developing countries with a similar macroeconomic profile.

Uddin et al. (2014) investigated the determinants of inflation from the perspective of Bangladesh, between 1977 and 2014. They explored both demand and supply-side factors that determine inflation and studied the long-term and short-term relationship between variables using co-integration and an ECM. They further investigated the causal relationships using a

Granger causality test, and they found that real GDP, money supply, imports, interest rate, remittances, and exchange rate significantly determine inflation.

Byanjankar (2020) examined the relationship between inflation and macroeconomic variables to see their effect on inflation during 1975 to 2018. Variables used include the CPI, government deficit, exchange rate, broad money supply, crude oil price, and real GDP. Their study was conducted using ARDL and the empirical results show that in the long run, the major determinants of inflation in Nepal are real income and the exchange rate. Also, in the short-run, exchange rate, and government deficit have significant effects on inflation.

Gyebi (2013) in a study, investigated macroeconomic factors responsible for inflation in Ghana for the period 1990 to 2009 using multiple regression method. His findings suggest that real output and money supply are the strongest forces exerting pressure on inflation in Ghana. His discovery portrays that there is a need to probe further to identify many other variables that have the potentials of determining inflation but have not been discovered by any empirical finding.

3.3 Impulse Response Analysis

Impulse response analysis is used to investigate how one or more variable(s) respond(s) to shocks in another variable (Lin, 2006). Therefore, this study investigates the impulse reaction of each of the study variables affecting inflation. A number of studies have used impulse response analysis.

Atilla & Özet (2017) investigated the effect of inflation on the stock market in South Africa from 1995 to 2017 using an impulse response function. They found a negative reaction of stock market dynamics on inflation in the short-run. Plescau (2017) used a VAR model, impulse response analysis and variance decomposition technique to capture the response of economic growth and inflation to shocks to the monetary policy. They found a negative relation between policy rates and economic growth. They found again that there is a positive relation

between interest rates and inflation, of which they interpret that a negative shock to interest rates leads to lower levels of inflation. Alnefaee (2018) investigated the determinants of inflation in Saudi Arabia for the period of 1987-2017. Through a VECM analysis, they found that inflation, in the long run, is positively influenced by the money supply, domestic demand, and oil prices and negatively influenced by the exchange rate. Their impulse response analysis illustrates that shocks associated with the money supply, domestic demand and oil prices have a positive impact on inflation. Cologni & Manera (2008) used a structural cointegrated VAR model to investigate the impulse reactions of oil price shocks in G-7 countries using quarterly data from 1980 to 2003. They found that oil price influences inflation and that shocks in inflation are responsive to the economy as it increases interest rates. Their impulse response analysis reveals that in most of the countries, there is a temporal response of oil price shocks on prices.

The various studies on impulse response analysis are relevant to the study as they provide empirical evidence that inflationary shocks cause various reactions to macroeconomic variables which are sometimes undesirable due to the negative and unexpected reactions they pose to the economy. Therefore, there is a need to take insights from these studies to foretell how inflationary shocks may alter both monetary and fiscal macroeconomic variables. This has significance in policy formulations, and it helps answer the second research question of this study which seeks to inquire on the impulse reactions of the study variables to shocks in inflation.

3.4 Variance Decomposition Analysis

Variance decomposition analysis is used to analyze the proportion of variability in one variable that is caused by another variable or the variable itself (Seymen, 2011). In this study, variance decomposition analysis has been used to determine the proportion of the variabilities in inflation that is attributed to each of the study variables. The impulse response approach

was used by Muhammad & Muhammad (2012) to examine external shocks impact on Pakistan's economy using a recursive vector autoregressive (RVAR) approach. They gathered monthly data 2001 to 2012 to test for shocks of oil price and foreign interest rate on the Pakistan economy using the inflation rate, output, interest rate, money supply and real effective exchange rate. Their result revealed that oil price shocks have inflationary pressure on Pakistan's economy. They conducted variance decomposition analysis which also confirmed that oil price shocks have an inflationary impact on Pakistan economy. The use of impulse response analysis makes it possible to satisfy the third research question which seeks to determine how each variable contributes to the levels of variability in inflation.

Table 3.4 provides a summary of empirical studies on the determinants of inflation. It gives indication of various findings, limitations and the contributions made by the current study. A thorough review of empirical studies has been helpful as it gives indications of the extent that previous studies have covered, identify their research gaps and justify the need to fill such gaps as providing a robust evidence on the causal relationships as well as the reactions of exchange rate, broad money, oil prices, government spending, and population to inflation in Ghana.

Table 3.4 Summary of Empirical literature on determinant of inflation

<i>Author(s)</i>	<i>Findings: Determinants of inflation</i>	<i>Limitation</i>
<i>Studies on causality</i>		
Mwanzia, (2014)	Oil prices, real exchange rate, production cost determine inflation	- did not include Ghana - no investigation on causality, (IR), or VDA
Kibritçioğlu, (2018)	Exchange rate, monetary growth, budget deficit, and oil prices	- did not include Ghana - no investigation on causality, VDA or IR - used data up to 2012 only
Phan (2014)	Monetary policy, interest rate and output prices	- did not include Ghana - data up to 2012 only - no investigation on causality, IR and VDA

Nguyen (2015)	Broad money (M2), government expenditure, fiscal deficit, and interest rate	- did not include recent data - did not include the case of Ghana - no investigation on causality, VDA, or IR and
Likukela, (2007)	Economic growth and foreign prices	- did not include the case of Ghana - only 4 variables used - no causality analysis
Ramayah (2016)	Money supply and oil prices	- no investigation on causality - did not include Ghana
Acquah-Sam (2017)	Interest rate	- no investigation on causality - only 5 variables used
Lim & Sek, (2015)	GDP growth, imports, money supply, and government expenditure	- did not include Ghana - data up to 2011
Madito & Odhiambo (2018)	Inflation expectations, labor cost, government expenditure, import prices	- no investigation on causality - the use of quarterly data
Ubide (2016)	Fiscal policy, exchange rate, inflation expectations, monetary policy and foreign inflation	-did not include Ghana
<i>Studies on impulse response</i>		
Atilla & Özet (2017)	Negative impulse reactions of stock market dynamics on inflation in the short-run	-the study does not reflect on Ghana -included only few variables
Plescau (2017)	Negative shocks between policy rates and economic growth, but a positive relation between interest rate and inflation	-the study does not reflect on Ghana -included only few variables
Alnefaee (2018)	Inflation react positively to money supply, and oil prices and negatively to exchange rate	-the study does not reflect on Ghana -did not investigate determinants
Cologni & Manera (2008)	Oil price influences inflation and shocks in inflation is responsive to the economy as it increases interest rates	-the study does not reflect on Ghana -did not use recent data
<i>Studies on Variance Decomposition</i>		
Muhammad & Muhammad (2012)	Both impulse response and variance decomposition analysis reveal that oil price shocks have inflationary pressure on Pakistan economy	-the study does not reflect on Ghana -no findings on determinants of inflation

Source: Writer's own construct (2020)

The extensive review of the literature has shown that oil prices, the real exchange rate, production cost, monetary policy, budget deficit, interest rate, prices of final goods, broad money (M2) supply, fiscal policies, GDP growth, and imports are potential determinants of

inflation in Ghana. However, each of the studies that found these determinants were conducted on different economies and in different time periods. As mentioned earlier, Akinsola and Odhiambo (2017) argue that the period of study and the country or place under study could affect how a particular macroeconomic variable is likely or unlikely to affect inflation. The review further shows that the extent to which a variable affects inflation in a particular country could not be the same in every country.

Only few of the studies were done on Ghana (Gyebi 2013; Acquah-Sam 2017). These studies on Ghana did not include very recent data on inflation. This study includes key macroeconomic variables such as exchange rate, oil prices, government spending, GDP and money growth to determine inflation in the case of Ghana. Moreover, this study investigates causality, IR (impulse response) and VDA (Variance Decomposition Analysis) which are very relevant to know due to their ability to understand the interactions of key macroeconomic variables that shock inflation and the types of policy needed to resolve inflationary challenges. Having an insight of future inflation helps to formulate policies that address inflation in a country.

Therefore, this study extends the works of Gyebi (2013); Acquah-Sam (2017) and contributes to literature in four ways. First, the study increases the number of variables by adding new variables. Adding new variables could help identify other variables that significantly affect inflation in Ghana, but which have not been included in other studies. To explore the effects of such variables on inflation, the study extends the number of variables to include exchange rate, oil prices, government spending, GDP and money growth. Secondly, the study advances on the works of Gyebi (2013) and Acquah-Sam (2017) by using a more recent data on Ghana, up to 2018. This will ensure that the current behavior of the economy is known and captured for policy purposes. Third, the current study goes further to investigate causality, using ARDL model, Sek, Teo, and Wong (2015), IR (impulse response), Atilla & Özet (2017); Plescau (2017); Alnefaee (2018) and VDA (Variance Decomposition Analysis)

Muhammad & Muhammad (2012), using the VAR model Cologni & Manera (2008). These analyses will give an idea of how sudden changes in inflation impacts on each macroeconomic variable.

CHAPTER FOUR

DATA, VARIABLES AND METHOD

The chapter discusses the data, sample and variables and study methodology. Also, the chapter gives details of both the relational and econometric models employed in the study. The details of unit root and stationarity test, cointegration test, Granger causality, VAR model, impulse response and variance decomposition methodologies are explained as well.

4.1 Sample, variables and data

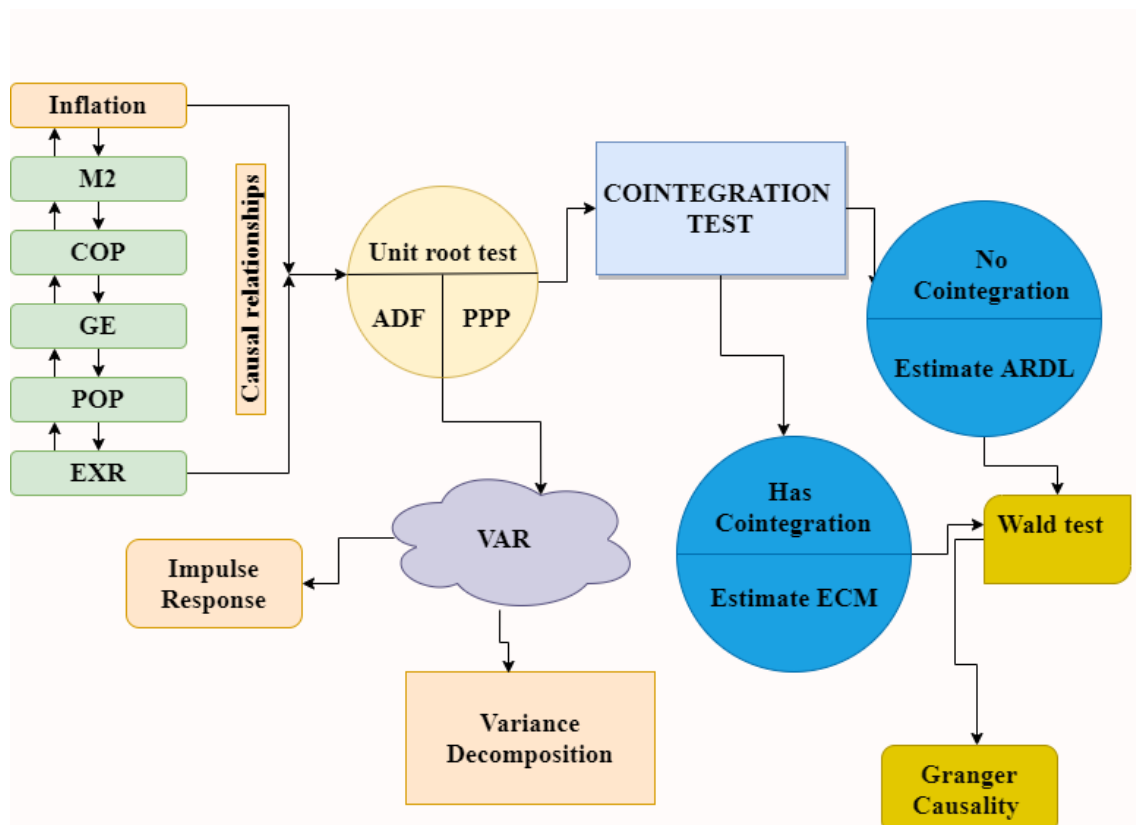
The study used annual data on the selected macroeconomic variables from 1990 to 2018. Data were extracted from the World Bank's Development Indicators (2020) and Knoema (2020). Five variables were used, and they include inflation, crude oil prices, exchange rate, broad money, government spending and population growth. Each of the study variables are relevant because they all are expected to be relatively important in explaining inflation. Inflation represents the percentage changes in the average price levels of the basket of goods calculated annually. The annual calculation is done by using the monthly inflation rates for each calendar year. The crude oil prices represent the annual crude oil price rate (in dollars) on the international market. The exchange rate variable is the cedis per unit rate of the dollar compared to the Ghana cedis expressed as a percentage ($E_{GHC/\$}$). The variable broad money refers to the M2 money supply as defined by Bank of Ghana. The values of broad money are recorded in local currency units. Government spending refers to the year-on-year expenditure of the central government as captured in the annual budget. The values of government spending are stated in local currency units. Population growth is a percentage growth of the number of people per million people per year. Instead of population growth, the study analysis is done using population head count because it gives accounts on how changes in population per head count affects inflation. This gives a clearer analysis than comparing with the percentage change.

GDP is another relevant variable that could have been included in the study, however, Acquah-Sam (2017) conducted a study on determinants of inflation of which he included GDP as part of his study variables but found that GDP does not have significant effect on inflation in Ghana. Therefore, including it in this study would be an unnecessary repetition because his study covered similar period as the current study, but the major difference is that in this study, more recent data was added to reach 2018. However, his work is very different from this study in terms of objective, methodology, variables, and findings. Also, macro-economic principles establish that in every economy, total income (GDP) equals total expenditure (Consumption) hence either expenditure or GDP must be used but not both. Based on such claims, using both GDP and government spending at the same time may be tautological. Therefore, GDP was not added as a study variable. It could be argued that population growth per annum (POP) is not an important indicator for inflation, especially in the short run. Nonetheless, the slightest change in population influences aggregate market demand and supply. Hence, the changes in population is expected to influence inflation.

4.2 Conceptual framework of study methodology

Figure 4.2 shows a conceptual diagram of the various approaches used for the study. To investigate the causal relationship among the study variables, the first step is to conduct a unit root test to satisfy the condition of stationarity. The stationarity variables are used to investigate long-term relationships using a cointegration test. The series that show cointegration are to be estimated using the autoregressive-distributed lag (ARDL) model while those without cointegration were estimated using an error correction model (ECM). A Wald test is estimated for both ARDL series and ECM series. The Chi-square values are then used to conclude whether there is Granger causality.

Figure 4.2 Flow chart of the research methodology



Source: Writer's own construct (2020)

A vector autoregressive (VAR) analysis is used to run the impulse response and variance decomposition to check the reactions of the dependent variables to inflationary shocks and the proportion of variability in inflation explained by the independent variables, respectively.

4.3 The relational models

The relational model shows how the variables are interrelated assuming each variable becomes the dependent variable. It is important to show how the causal relationships are established among the study variables. Each of the six variables has been assumed to act as a dependent variable and hence this results in six relational models. The main objective of this study was to investigate the causal relationship between the study variables. Therefore, the model establishes the link among the variables, which is specified as:

$$INF_t = f(M2_t, POP_t, GE_t, EXR_t, COP_t) \quad (1)$$

$$M2_t = f(INF_t, POP_t, GE_t, EXR_t, COP_t) \quad (2)$$

$$POP_t = f(M2_t, INF_t, GE_t, EXR_t, COP_t) \quad (3)$$

$$GE_t = f(M2_t, POP_t, INF_t, EXR_t, COP_t) \quad (4)$$

$$EXR_t = f(M2_t, POP_t, GE_t, INF_t, COP_t) \quad (5)$$

$$COP_t = f(M2_t, POP_t, GE_t, INF_t, EXR_t) \quad (6)$$

In each of the models in the equations to be regressed (1-6), INF denotes the inflation rate, M2 denotes the broad money supply, POP represents population, GE, EXR, and COP are government expenditure, exchange rate and crude oil prices respectively and subscript t refers to time period.

A description of the effects of each of the above-mentioned macroeconomic variables shows that the exchange rate is mostly inversely related to inflation such that when the value of a foreign currency increases relative to the cedi, prices of imported goods increase and vice versa. The exchange rate plays a major role in import and export of goods (both price and quantity) and it has greater chances in determining inflation in Ghana because merchandise trade as a percentage of GDP averages around 59% from 1990 to 2018 and most of the consumable goods are imported. Another potential macroeconomic variable that can determine inflation in Ghana is broad money. Broad money or liquidity increases people's demand and hence the basic demand theory postulates that prices increase when demand increases at the same level of supply. The rising demand due to high liquidity results in scarcity which may have a compounding effect on several variables in the economy. In the long run such effects will not be favourable as it may lead to increase poverty levels and increase cost of living if not properly addressed. Also, when oil prices rise, there is a likelihood of impacting on general price level because a change in oil prices affects production and distribution costs. This makes supply chain processes more expensive with a consequential effect on prices of final goods.

There is another claim that an increase in government spending may trigger inflation because government spending is a key component of aggregate demand. Government spending has a positive relationship with inflation, and it is caused by demand pull factors. The potential impact of population growth on inflation cannot be underestimated because an increase in population may lead to an increase in demand which also leads to increase in prices especially when aggregate supply remains constant and such effects are significant.

4.4 The econometric methodology for causality

To investigate the causal relationships of the study variables, a series of tests are to be conducted. Firstly, the unit root and stationarity test are conducted. This is because according to Nelson (1982) the trend or the presence of unit root in time series models could lead to model misspecification and, hence, the wrong results. Therefore, there is a need to ensure that there is no unit root in the time series data. This was followed by the ARDL bounds test for cointegration and the Granger causality test. The VAR model is then used to run impulse response and variance decomposition. All results are estimated using the e-views software, version 10 (enterprise edition).

4.4.1 Unit root test

The equation for the unit root test is specified as:

$$\Delta Y_t = \mu + \gamma Y_{t-1} + \sum_{j=1}^p \alpha_j \Delta Y_{t-j} + \beta t + \omega_t \quad (7)$$

where μ is the drift term, t denotes the time trend, and P is the largest lag length used. To determine stationarity, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are conducted. Under the ADF model, the Akaike Info Criterion (AIC) is selected. For the PP, the spectral estimation method used is the Bartlett kernel and Bandwidth selection option is the Newey-West Bandwidth.

4.4.2 Test of cointegration

Different types of cointegration models are used by various authors but most of them are not suitable for individual studies. The most commonly used test for individual studies is the Bounds cointegration test and Johanssen test. The former is used under conditions where data series achieve stationarity at different order and the latter is used when the series attain stationarity at same order.

Several studies Abbas, Bhowmik, Koju, & Wang, 2017; Ato & Yaaba, 2015; Batchu & Radha, 2015; El Alaoui (2015) found that the existence of cointegration among variables is an indication of one or more long-term causal relationship which could be unidirectional or bidirectional. The study uses the ARDL bounds testing approach to test for cointegration because the series did not attain stationarity at same order. The general ARDL model is specified as;

$$G_t = \gamma_{oi} + \sum_{i=1}^p \delta_i G_{t-i} + \sum_{i=0}^q \beta'_i A_{t-i} + \varepsilon_{it} \quad (8)$$

In equation (8), G_t is a vector which represents the respective dependent variables in the study models and (A_t) is the independent variable that are I(0) or I(1) or co-integrated; β and δ are the coefficients; γ is the constant; and the optimal lags are $I = 1, \dots, k$, where p and q are optimal lags; and ε_{it} is a vector of the error terms with unobservable zero mean white noise vector process.

The decision on whether or not there is cointegration is made with consideration to both the F- and T-statistics. For F-statistics, if the F-value is below the I(0) bound, then one does not reject the null hypothesis of no cointegration at the 5% or 1% level of significance. However, if the F-value is higher than the I(1) bound, one rejects the null hypothesis of no cointegration. For t-statistics, if the absolute value of the t-statistic is lower than the I(0) bound, then the null hypothesis is not rejected. However, if the absolute value is higher than the I(1) bound, the null hypothesis is rejected. For causality purposes, the error correction model (ECM) is used to

estimate causal effect of the independent variable on the dependent variable for models that achieve cointegration. ECM is used as a time series regression model to estimate the relationship of cointegrated series.

4.4.3 Granger causality test

The Granger causality test is used to depict the direction of causality between variables both in the short-and long-term. Even though there are several ways to investigate causal relationship, the use of Granger causality test is more advantageous due to its ability to depict both the short- and long-run relationships between variables (Bai et al., 2018; Damos, 2016). This study uses the auto-regressive distributed lag (ARDL) model and Engel-Granger technique to test for causal links in all relational models. To investigate the causal relationship among the study variables, it is required that a series of tests and conditions are satisfied as noted in Granger (1988). Such tests include unit root and stationarity tests as done in Rahman & Kashem (2017), and test for cointegration as done in Oppong, Jie, Acheampong, & Sakyi (2020). The short-term causality is determined by running the ARDL model for all series. Values of Chi-square are estimated using a Wald test. After conducting the Wald test, chi-square values with less than 5% p-value are considered as having Granger causality. Also, long-term causality is determined by estimating the ARDL model and using it to estimate the error correction form. The results are further estimated using the Wald test reported for two-way causality.

4.4.4 Vector autoregression Model (VAR)

VAR captures the interdependencies among multiple time series variables. The VAR is used in this study as the key reference model in estimating inflationary shocks and corresponding reaction. Results from the VAR model is used to estimate the possible shocks that could happen resulting from the sudden change in inflation. The optimal lag lengths necessary for running the VAR models are based on the AIC criteria. The VAR model is used

to run the impulse response and variance decomposition analysis for individual reactions of the independent variables and their contributions to inflation.

4.4.5 Impulse response and variance decomposition

The study uses impulse response analysis to describe how shocks in inflation affects itself and all the independent variables. Most often, a shock in the dependent variable affects itself and other independent variables. In addition, the variance decomposition analysis is used to show the proportion of the variability in inflation caused by each of the independent variable. The results of the various tests are reported and analyzed in the chapter that follows.

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1 Descriptive Analysis

This chapter opens with discussion of summary statistics of all the study variables included. Table 5.1 presents summary statistics and correlation results that were run using Gretl software (2019 version). The Jarque-Bera values show that all the data series, except POP and COP, follow the normal distribution. The skewness of the data series is, 1.67, 1.72, 0.19, 1.60, 1.29, and 0.70 for M2, INF, POP, GE, EXR, and COP respectively. The standard deviations show that M2, INF, POP, GE, EXR, and POP respectively deviate by 22.01, 11.99, 4.56, 67.86, 1.36, and 32.96 away from their means.

Table 5.1 Summary statistics

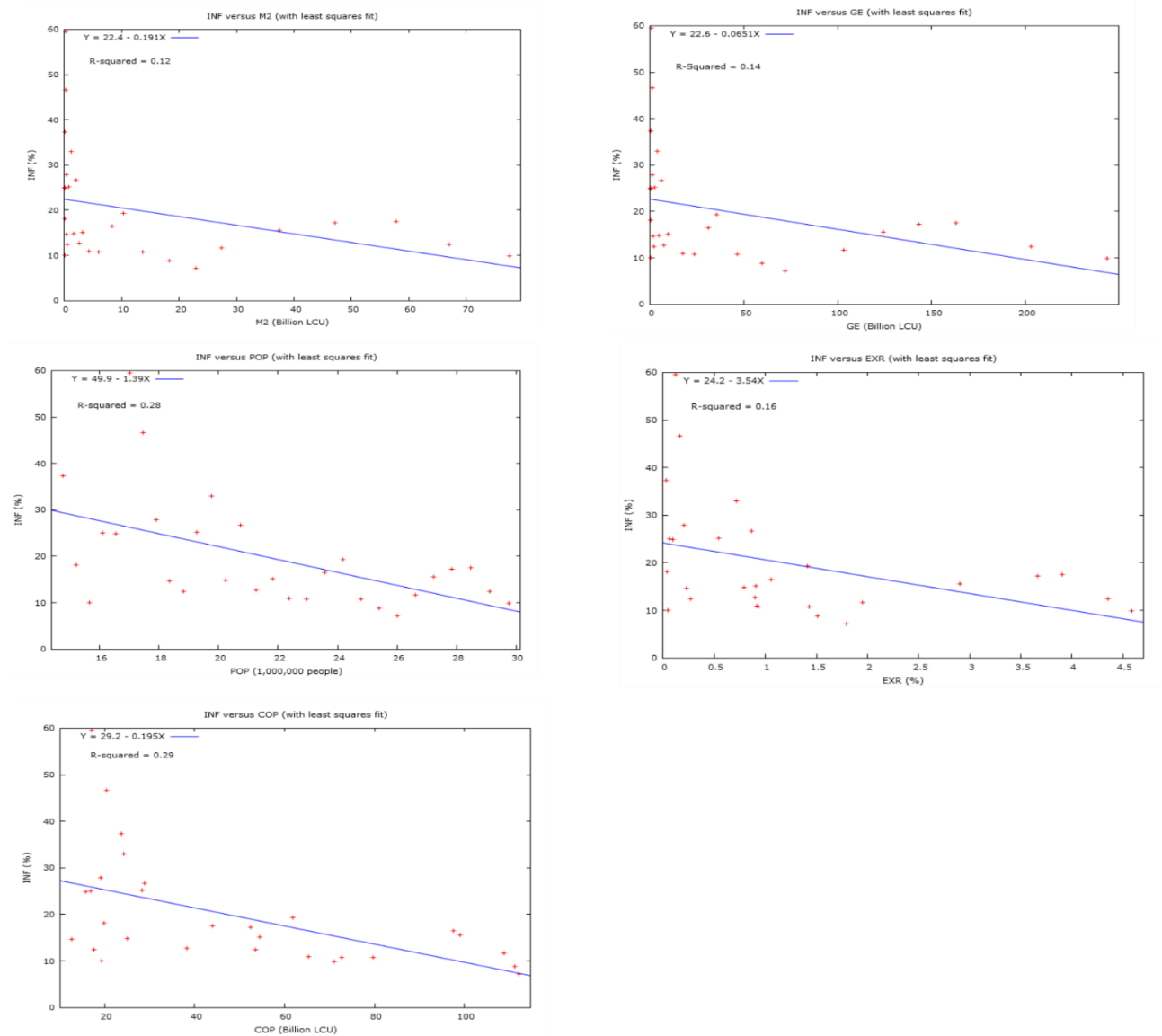
Statistics	M2	INF	POP	GE	EXR	COP
<i>Mean</i>	14.18	19.70	21.70	45.06	1.26	48.67
<i>Std dev</i>	22.01	11.99	4.56	67.86	1.36	32.96
<i>J-B</i>	16.47***	23.86***	1.85	15.03***	8.36**	3.27
<i>Sk</i>	1.67	1.72	0.19	1.60	1.29	0.70
<i>R-squared</i>	0.12	-	0.28	0.14	0.16	0.29
<i>n</i>	29	29	29	29	29	29

Note: Std dev represents standard deviation, J-B represents Jarque-Bera test, Sk is skewness and n is sample size. **, and *** are 5% and 1% levels of significance respectively.

Source: Writer's own construct

Figure 5.1 shows scatterplot of the correlation between INF, M2, POP, GE, EXR and POP. Each of the variables explain a relatively significant percentage of variability of inflation around its mean. This is indicated by R-squared values of 0.12, 0.14, 0.28, 0.16, and 0.29 for M2, GE, POP, EXR, and COP, respectively. All the variables have linear association with inflation but inversely related. The R-squared values indicate that each of the macroeconomic variables explain some percentage of the variability in inflation. COP explains the highest percentage followed by POP, EXR, GE and lastly M2.

Figure 5. 1 Correlation relationship



Source: Writer’s own construct, Data from World Bank (2020).

5.2 Diagnostic Tests

The chapter presents, analyses and interprets the results of unit root and cointegration tests, short-and long-term causality, impulse response and variance decomposition.

5.2.1 Unit root test result

The study performed a unit root test using the Augmented Dickey-Fuller (ADF) and Phillip Perron (PP) tests (Khraief, Shahbaz, Heshmati, & Azam, 2020). The test results as shown in Table 5.2.1 show that all variables, COP, EXR, INF, M2 and POP, were stationary

at either level and/or first difference except GE. Therefore, GE was log transformed as LGE. LGE achieved stationarity at the first difference. Therefore, all series satisfied the unit root and stationarity conditions.

Table 5.2.1 Unit Root test

Variable	ADF				PP			
	Level		First difference		Level		First difference	
	I	I&T	I	I&T	I	I&T	I	I&T
COP	-1.25	-1.92	-4.47***	-4.37***	-1.33	-1.92	-4.42***	-4.31**
EXR	1.37	0.48	1.15	-0.08	3.06	0.42	-2.77*	-3.68**
LGE	-1.25	-0.85	-4.48***	-4.71***	-1.44	-0.95	-4.48***	-4.69***
INF	-0.82	-2.41	-3.92***	-6.82***	-2.97*	-3.23*	-5.88***	-5.75***
M2	-3.17**	1.65	0.90	-1.58	11.79	6.16	0.86	-1.38
POP	3.01	-0.64	-1.12	-5.27***	9.96	-0.004	-0.24	-1.73

Note: *, **, *** indicates significance at the 10%, 5% and 1% level, respectively. ADF is the Augmented Dickey Fuller test, PP is the Phillip Perron test, and LGE is the log transformation of GE. I is the intercept and I&T is the intercept and trend.

Source: Writer's own construct

5.2.2 Cointegration test result

After satisfying the unit root and stationarity test condition, the test for cointegration was conducted. All variables were cointegrated, which means that they had a long-term relationship except for LGE. The error correction model was estimated for COP, EXR, INF, M2 and POP because they are cointegrated and the ARDL model is estimated for LGE which was not cointegrated. However, a short-term causal relationship was investigated for series with cointegration and those without cointegration, but a long-term relationship was investigated for only series which had cointegration. The results of the cointegration tests are reported in table 5.2.2. The null hypothesis of the cointegration test is based on the assumption that series are not cointegrated. The decision to accept or reject the null hypothesis is made at 5% level of significance. The results help to determine whether there is long-term relationship in each of the time series data. The data series which have cointegration have both short-and

long-run relationship while series without cointegration are related in the short-run only. Ho for F-Bounds test and t-Bounds test: There is no levels relationship.

Table 5.2.2 Cointegration results

	F-statistic		T- statistic		Co-integration	Model
	I(0)	I(1)	I(0)	I(1)		
COP	14.28***		-8.03***		YES	ECM
	3.41	4.68	-3.41	-4.79		
EXR	10.04***		1.12		YES	ECM
	3.41	4.68	-2.57	-3.86		
LGE	3.01**		-3.28**		NO	ARDL
	2.62	3.79	-2.86	-4.19		
INF	6.26***		-4.95**		YES	ECM
	3.41	4.68	-3.43	-4.79		
M2	21.16***		-3.09**		YES	ECM
	3.41	4.68	-2.86	-4.79		
POP	102.23***		0.72		YES	ECM
	3.41	4.68	-2.57	-3.86		

Note: *, **, *** represents significance at the 10%, 5% and 1% level, respectively.

Source: Writer's own construct

5.2.3 Granger Causality test results

Short-term Granger causality

The short-term Granger causality test result shows that when COP is used as the dependent variable, there is a causal relationship that runs to COP from EXR, M2 and POP. Such results are expected because in Ghana, crude oil price is determined at the international market and influenced by exchange rate of the dollar, the amount of money supplied to both individuals and firms and the population growth.

When EXR is used as the dependent variable, there is a causal relationship that runs through it from COP, LGE, INF, M2, and POP. Such relationship is expected because, such factors are strong determinants of international trade and currency exchange. If LGE is considered as the dependent variable, there is a causal relation running through it from EXR, INF and POP. This is not different from what was anticipated since all of these variables influence government expenditure. When INF becomes the dependent variable, there is a

causal relationship from LGE and POP. The causality running through INF from LGE and POP are common. However, same effect was expected to be seen among INF and COP, EXR, and M2 but it was realized that such relationships are indirect. Using M2 as the dependent variable will lead to a causal relationship running from COP, EXR, and POP. Finally, when POP is set as the dependent variable, there is a causality running from EXR, LGE, INF and M2 to POP.

Table 5.2.3a Short-term Granger causality

	COP	EXR	LGE	INF	M2	POP
COP	-	34.75***	4.33	0.67	12.44***	12.67***
EXR	11.79***	-	5.90**	8.34**	46.42***	21.73***
LGE	0.04	4.94**	-	13.69***	0.01	22.25***
INF	0.16	2.92*	7.26**	-	0.58	9.02**
M2	14.22***	20.86***	5.13	2.55	-	9.09**
POP	5.77*	45.35***	18.94***	36.12***	17.03***	-

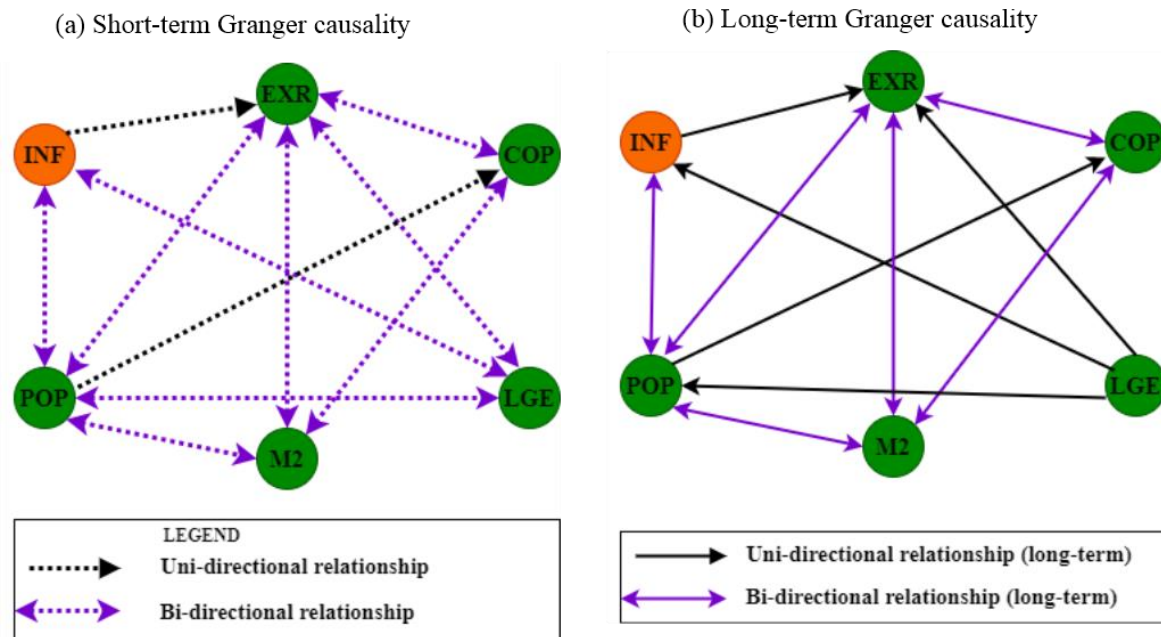
Note: *, **, *** are used to indicate significance at the 10%, 5% and 1% level, respectively.

Source: Writer's own construct

Figure 5.2.3a shows the short-term causality among the study variables. In the short term, there is uni-directional causality running from inflation to exchange rate. This means that inflation Granger causes changes in the exchange rate, but an exchange rate change does not Granger cause inflation. Also, there is a bi-directional causality between inflation and population and between inflation and government expenditure. Thus, inflation and government expenditure Granger cause each other, and inflation and population Granger cause each other. The result means that population and government expenditure are short-term determinants of inflation. Therefore, any short-term policy on population and government expenditure will have consequential effects on inflation. So, inflationary policies must be in line with population growth and government expenditure. Figure 5.2.3a reveals again that there is a uni-directional relationship running from population to crude oil prices which means that population is a determinant of crude oil prices. There are seven bi-directional relationships existing between population and exchange rate, population and broad money, population and government expenditure, exchange rate and broad money, crude oil prices and broad money, exchange rate

and government expenditure, and exchange rate and crude oil prices which implies that those pair of variables determine each other.

Figure 5.2.3 Short- and long-term Causal relationship



Source: Writer's own construct, Data from World Bank (2020)

Long-term Granger causality

Figure 5.2.3b shows the long-term Granger causality. In the long term, if COP becomes the dependent variable, there is a causal relationship running through it from EXR, M2 and POP. When EXR is used as the dependent variable, causality runs through from COP, LGE, INF, M2 and POP. Also, when INF is used as the dependent variable, causality runs from LGE and POP. If M2 is the dependent variable, causality runs from COP, EXR, and POP and if POP is used as the dependent variable, causality runs from EXR, LGE, INF and M2.

The interactions among the study variables lead to five long-term uni-directional causalities running from LGE to INF and EXR and POP, INF to EXR, and POP to COP. Additionally, there are six long-term bi-directional causalities recorded. These bi-directional causalities are

found between INF and POP, M2 and POP, POP and EXR, EXR and M2, EXR and COP, and M2 and COP. This shows that the study variables influence each other and so any policy implemented on one variable will have consequential effect on the others either directly or indirectly. When this happens, it makes it very complex to implement policies that will work effectively. This explains why Ghana finds it difficult to reach its inflationary targets.

Therefore, the results show that in the long-term, POP and LGE determine inflation. And there is a domino effect of EXR, COP and M2 on inflation. Thus, those variables have an indirect effect on inflation as they determine the variables that determine inflation.

Table 5.2.3b Long-term Granger causality

	COP	EXR	LGE	INF	M2	POP
COP	-	34.75***	4.33	0.67	12.44***	12.67***
EXR	11.79***	-	5.90**	8.34**	46.42***	21.73***
INF	0.16	2.92*	7.26**	-	0.58	9.02**
M2	14.22***	20.86***	5.13	2.55	-	9.09**
POP	5.77*	45.35***	18.94***	36.12***	17.03***	-

Note: *, **, *** are used to indicate 10%, 5% and 1% significance levels, respectively.
Source: Writer's own construct

5.2.4 Impulse response

Response of the study variables to one S.D shocks in inflation

Figure 5.2.4 shows results of the impulse response analysis. From period one to period three COP falls and attains a steady state from period four to period ten. EXR rises at period one, attains a maximum in period two where it begins to fall and becomes negative from period five as it keeps on falling from period five to period ten. GE will increase slowly from period one to period ten. M2 remains zero from period one to period three and becomes negative in period four as it continues to fall increasingly from period five to ten. POP remains steady at zero from period one to two, becomes negative in period three and falls increasingly from period three to ten. This gives insight that in the case of any inflationary shocks in Ghana, the macro economy will be destabilized. Hence, there should be radical measures to address such imbalances either through population control policies or government expenditure controls to

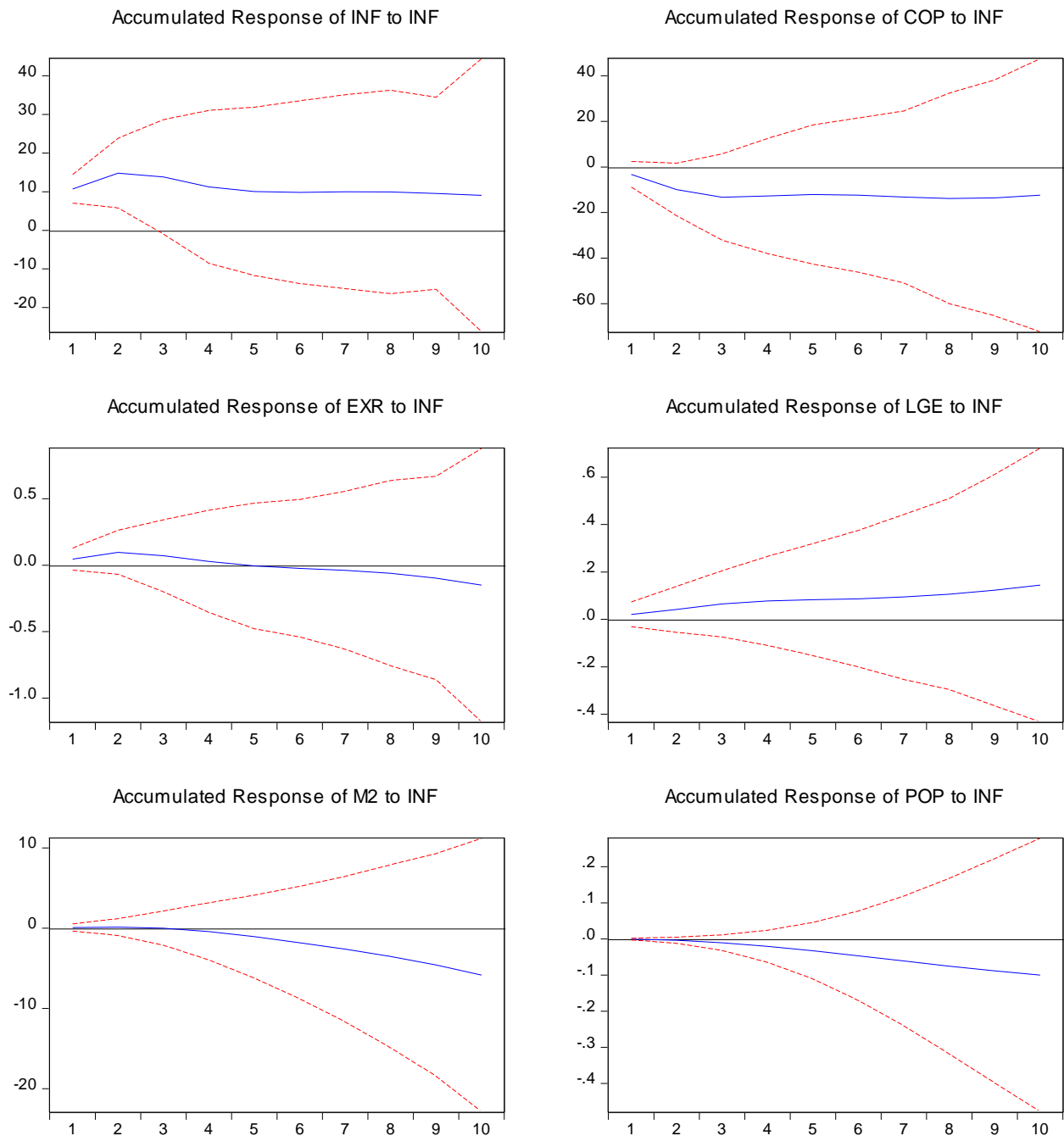
quicken the recovery process because the fall in most of the independent variables might have a negative influence on the macro economy if not addressed.

The results depict that the quest for government to decrease inflation by using policies that bring inflationary shocks will result in a falling exchange rate from the medium- to the long-term. Also, COP will assume a constant value, and there will be a slow increase in GE, falling M2, and decreasing population.

Already, the population of Ghana is low compared to most African countries and resources are under-utilized. Therefore, if a shock in inflation reduces the population and cause further macroeconomic disturbances, Ghana will lag behind in economic development in the long-term. Therefore, during inflationary shocks there is a need for radical policies that will bring back inflation to its minimum in the shortest time possible.

Figure 5.2.4 Impulse Response

Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.



Source: Writer's own construct, Data from World Bank (2020)

5.2.5 Variance decomposition

The response standard errors were done using Monte Carlo (100 repetitions). The study made use of Cholesky degree of freedom adjusted impulse definition. The proportion of variations in inflation has been estimated for 10-year periods and broken down into the short-term (period

1-3), the medium-term (period 4-6) and the long-term (period 7-10). In the short term, 100%, 93% and 87% of the variation in inflation is explained by itself in year 1, 2, and 3, respectively. This means that in the short term, the independent variables have less impact on changes in inflation. In the medium term, the impact of the independent variables on inflation increase because 87% of the variation in inflation is explained by LGEC itself in period 4, 86% in period 5 and 85% in period 6. The changes in inflation brought by each independent variable is important based on their percentages of contribution in the medium-term as it ranges from 1% to 6%. In the long term, 85% of the variations in inflation is explained by itself and approximately 15% is explained by the independent variables in period 7. In period 8, 84% of the variations in inflation is explained by itself and 16% is explained by the independent variables. In period 9, 84% of the variations in inflation is explained by itself and 16% is explained by the independent variables. Finally, in year 10, 83% of the variations in inflation is explained by itself and the independent variables explain 17% of the decompositions in inflation.

The insights gained from this analysis is that for government to implement any policy in addressing inflationary shocks, more attention should be given to inflation itself. There should be measures to create quick changes in existing inflation policies. Nonetheless, the independent variables must not be underestimated since their contribution to inflation is relevant.

Table 5.2.5 Variance decomposition

Period	S.E.	INF	COP	EXR	LGE	M2	POP
1	10.72	100.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
2	11.92	92.62 (12.19)	4.47 (8.14)	1.42 (7.57)	1.06 (6.31)	0.23 (2.93)	0.20 (0.28)
3	12.33	87.09 (14.83)	5.68 (9.34)	2.12 (7.93)	3.73 (9.41)	1.12 (3.70)	0.24 (0.42)
4	12.63	87.20 (15.70)	5.43 (8.57)	2.15 (9.15)	3.63 (9.53)	1.34 (3.78)	0.25 (0.50)
5	12.80	85.72 (16.33)	6.38 (9.12)	2.21 (9.46)	4.12 (10.12)	1.32 (4.11)	0.25 (0.51)
6	12.85	85.08 (17.08)	6.72 (9.73)	2.21 (10.11)	4.37 (11.66)	1.36 (4.04)	0.27 (0.57)
7	12.86	84.94 (17.54)	6.71 (9.63)	2.25 (10.60)	4.39 (12.69)	1.40 (3.84)	0.31 (0.57)
8	12.90	84.44 (17.45)	6.70 (10.13)	2.74 (10.73)	4.39 (13.60)	1.40 (3.76)	0.33 (0.63)
9	12.97	83.62 (17.92)	6.63 (9.91)	3.61 (11.61)	4.40 (14.45)	1.40 (3.88)	0.33 (0.66)
10	13.04	82.91 (18.24)	6.61 (10.66)	4.26 (11.84)	4.48 (14.39)	1.41 (4.02)	0.33 (0.62)

Cholesky Ordering: INF COP EXR LGE M2 POP
Standard Errors: Monte Carlo (100 repetitions)

Source: Writer's own construct

5.3 Empirical Results and Discussion

Based on the first research question of this study, which seeks to ascertain whether the exchange rate, broad money, oil prices, government spending, and population growths determine inflation in Ghana and determine the causal relationship among such variables. The study investigated determinants of inflation using Granger causality. It was found that population and government expenditure are short- and long-term determinants of inflation in Ghana. The findings correspond with Nguyen (2015) who found that government expenditure is a determinant of inflation and agrees with Lim and Sek (2015) whose results showed that national expenditure determines inflation having a long-run impact on inflation in high inflation countries. The finding is in line with Madito and Odhiambo (2018) who found

government expenditure to be a positive determinant of inflation. To regulate inflation, government must control its expenditure and population.

Already, Ghana has been battling with inflation control for a very long time which has been the cause of many economic challenges. The consistent increase in population growth has made it more difficult to control inflation to a single digit. Therefore, after gaining insights from the study that government expenditure and population determine inflation, government must address inflation concurrently with population and expenditure policies before Ghana can realize consistent single digit inflation. Any population policy and government expenditure policy can spike up inflation in Ghana. So, policy makers must make a thorough and careful assessment of this impact before enacting future policies on inflation, population and government expenditure.

The second research question concerns with how the macroeconomic variables respond to innovations or inflationary shocks and impulses. Therefore, the study checked the impulse reactions of the exchange rate, broad money, oil prices, government spending, and population to shocks or unexpected changes in inflation. The findings indicate that the exchange rate, broad money, crude oil prices and population have negative responses to shocks in inflation while government expenditure has a positive response. During inflationary shocks, government expenditure increases due to a fall in purchasing power. During such periods, the cost of living increases which affects expenditures. Also, during inflationary shocks broad money supply falls because the central bank uses monetary policy to reduce money in circulation. Further, population has a negative reaction because cost of living increases giving rise to high poverty levels, high mortality and lower life expectancy. During such periods people are not able to afford quality health care and basic necessities which decreases the population.

The study has revealed that, the macroeconomic cost to inflation is higher than the benefits and for that matter high inflation will not be helpful to Ghana either in the short-

medium- or long-term. This means that Ghana should continue to pursue efforts to keep inflation low and stable at all times by strengthening the monetary policy of the central bank.

The third question of the study is, what proportion of the variance in inflation is determined by the macroeconomic variables under study? The study found by the variance decomposition analysis that, shocks in inflation explain itself between 87 and 100% in the short-term, 85-87% in the-medium term and 82-84% in the long-term. However, the independent variables explain about 0-6% of the variability of shocks in inflation in the short-term, 0.2-6.7% in the medium term, and 0.3-6% in the long-term. Also, the findings indicate that during inflationary shocks, crude oil prices explain the largest proportion of the changes followed by exchange rate, government expenditure, and broad money supply. Population explains the least. This is in line with the a priori expectations because in Ghana, crude oil prices and the exchange rate are believed to be the major causes of inflation. All of these factors contribute to high cost of production inputs. This means that any government policy framework to tackle inflation must include pragmatic ways of stabilizing crude oil prices even if the international prices fluctuate. There must be a way to stabilize the Ghana cedi especially by reducing import and increasing export. The findings are accurate and reliable because they are based on historical data. The use of causality, impulse response and variance decomposition analysis has been proven and justified by several renowned economists (Roberts, 1995; Broom, 2019; Granger, 1988). As far as each of the variables contribute to some percentages of the variability in inflation during shocks, government must pay special attention to the other variables when addressing innovations in inflation.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Summary

The high levels of inflation in Ghana has contributed to a fall in living standard and a rising level of poverty. To improve the quality of life of Ghanaians, government has made numerous attempts to reduce the cost of living by using both fiscal and monetary policies. Nonetheless, inflation keeps on fluctuating and rates above 8% target rate. This depicts that government has not succeeded in meeting its inflationary targets. Achieving low inflation below the 8% target can be achieved if government is able to predict accurately the variables that determine inflation. Knowing the determinants of inflation helps government to formulate realistic policies that yield good results. Therefore, this study was conducted to ascertain the relevant variables that have causal relations with inflation. The study goes further to investigate how shocks in inflation causes changes in the independent variables and how each of the variables contribute changes in inflation.

The study employed the Granger causality analysis used purposely to determine the major variables that have statistical significance in determining inflation. The impulse response analysis was employed to detect the impulse response to shocks in inflation and the variance decomposition analysis was used to show how the independent variables contribute to changes in inflation. The findings revealed the following results:

- Population and government expenditure determine inflation in Ghana both in the short- and long-term
- The exchange rate, broad money supply, and population react negatively to inflationary shocks in the long-term while government expenditure and crude oil prices react positively to inflationary shocks in the long-term.

- The proportion of the variability in inflation explained by government expenditure, exchange rate, population, broad money, and crude oil prices range from 0-6% in the short-term and 0.2-6.7% in the long-term.
- Inflation explains about 80% of the variabilities in itself and the remaining 20% is explained by government expenditure, exchange rate, population, broad money, and crude oil prices

The findings indicate that any attempt made by government of Ghana to reduce inflation may fail if such actions do not include measures to control population growth and government expenditure. Also, for a more effective policy on inflation, government must give attention to exchange rate, crude oil prices, and broad money supply because they all have a domino effect on inflation. Therefore, for Ghana to succeed in controlling inflation, policies must be directed at population and government expenditure because they are direct determinants of inflation and exchange rate, crude oil prices, and money supply are indirect determinants of inflation.

6.2 Limitations of the study

The study could use more extensive data on the study variables spanning 1950 to 2020 to get a more general perspective but due to unavailability of the most recent data on the study variables, such periods were not covered. As a result, the findings could not be generalized to cover such periods because the findings could alter as the period changes. In addition, due to the limited time period to complete this study, variables such as taxation, import, export, market efficiency, and production efficiency were not included though they could be potential determinants of inflation in Ghana.

6.3 Suggestions for further research

Future studies could be done to include data beyond 1990. Also, variables such as taxation, import, exports, market efficiency, efficiency, and production efficiency are variables that are likely determinants of inflation, but no studies have investigated their effect in the case of

Ghana. Having an idea of how changes in the macroeconomic variables will cause changes in future inflation is ideal for planning and policy making. Therefore, future studies could base on historical data of the variables to forecast inflation both for long and short term.

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Norges miljø- og biovitenskapelige universitet
Noregs miljø- og biovitenskapelige universitet
Norwegian University of Life Sciences

Postboks 5003
NO-1432 Ås
Norway