FOOD INFLATION AND ITS IMPACT ON THE ECONOMY OF PAPUA NEW GUINEA

By

Stanis Hulahau

THESIS

Submitted to

KDI School of Public Policy and Management in partial fulfilment of the

requirements for the Degree of

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2016

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Professor Ji-hong KIM

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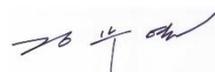
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ABSTRACT

FOOD INFLATION AND ITS IMPACT ON THE ECONOMY OF PAPUA NEW GUINEA (PNG)

By

Stanis Hulahau

This study examined the determinants of food price inflation and its impact on the economy of PNG from 2001 to 2011 (10 years) using time series data. Secondary data obtained from credible sources such as BPNG, ADB, WB, and IMF were analysed using various econometric test such as the Johansen Test for Cointergration, Augmented Dickey Fuller Test and the Vector Error Correction Model. The econometric tests revealed that there is a long run relationship (causality) between the variables real exchange rate and wheat price which significantly influenced food price inflation in PNG. There is a negative correlation between money supply and interest rate which negatively impacted food price inflation in the country. In the short run, real exchange rate, money supply, real interest rate and wheat price do not significantly affect food inflation as their corresponding p-values are greater than five percent (5%) critical value.

Alternatively, there is a long run relationship or causality between GDP, real exchange rate, real interest and food price inflation. However, food inflation has a negative correlation with Real GDP in the long run. Therefore the overall findings of the study concluded that food price inflation is caused by long run relationship among the study variables and food inflation has a long run relationship with real GDP. It is recommended that the government should focus attention on the agriculture sector (food security) at the strategic and sectoral level and work in alignment with the PNG Vision 2050, National Security Policy, Monetary and Fiscal Policy, Social Protection Policy, Transport Security Policy and other food policies in PNG in order to deal with high food inflation in the country.

Key Words: Headline Inflation, CPI, Food Inflation, VECM, ADF, GDP, Economy, PNG.

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DEDICATION

To my late brothers

Manley Hamarai Hulahau and Stafford Koibo Hulahau

My late sister

Maryanne Kwisil Hulahau

My Wife

Dominica Mai Hulahau

My Son

Marek Roiveng Hulahau

My Dad

John Ray Hulahau

My Mum

Helen Boikara Hulahau

My Brothers

Jeffard Piaromo Hulahau and Keith Wirr Hulahau

"I thank God for having you all in my life and for your moral, social and inspirational

support, I love you all".

ACKNOWLEDGEMENTS

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ADB: Asian Development Bank

ADF: Augmented Dickey Fuller

API: Agriculture Production Index

BPNG: Bank of Papua New Guinea

CPI: Consumer Price Index

FAO: Food and Agriculture Organisation

GDP: Gross Domestic Product

IMF: International Monetary Fund

LDCs: Least Developed Countries

LICs: Least Income Countries

MS Excel: Microsoft Office Excel

PIC: Pacific Island Countries

PNG: Papua New Guinea

PNGNPHC: Papua New Guinea National Population and Housing Census

PNGNSO: Papua New Guinea National Statistical Office

SPSS: Statistical Package for Social Science

STATA: Statistical Package for Professionals

UECM: Unrestricted Error Correction Model

UNDP: United Nations Development Program

VECM: Vector Error Correction Model

WB: World Bank

Chapter One – Introduction

1.1   Background and definition of Food Inflation

Every humans eat food. Therefore every person is affected by food inflation. This dilemma has constantly challenged consumers and governments across the world. Understanding food inflation and its impact on consumers and the economy are significant matters for governments and policy makers of developed and developing countries. With the impulsive nature of world commodity prices, especially with the volatile characteristics of food inflation, consumers across the world are left vulnerable to endure the impact of food inflation.

Despite an exponential growth in GDP since 2002 attributed to a favourable world market price of minerals and a stable economy, Papua New Guinea (PNG) has not been spared from the dreadful effect of food inflation. PNG as a member of the global community has experienced her fair share of food inflation episodes leading to several policy interventions by the Banking of PNG (Central Bank) with an attempt to manage inflation and ensure price stability.

Similarly various governments and development partners around the world have considered robust policy interventions to offset the negative impacts of food inflation on the poor masses in their respective countries (Joseph and Wodon, 2008). The impact of food inflation on citizens and economies around the world has generated interest from researchers and people to study and understand the underlying dynamics of hike in food prices.

Inflation is widely known as the general rise in the price of goods and services over a period of time, while reducing each unit of currency one holds to buy fewer goods and services. In the same vein, food inflation which is the focus of this paper

occurs when prices of food items rise, influenced by the increase in the aggregate quantity of food demanded which is greater than food supplied at a particular time, (World Bank, 2008).

This study examines food inflation and its impact on the economy of PNG, which is a small and open economy with an underdeveloped and disintegrated domestic food market.

The production and supply of staple food such as cassava, banana, sweet potatoes including animal products and sea food are inconsistent and usually supplied on a small scale. Production, preservation and distribution of food within the economy are conducted on an ad-hoc basis mostly by individual rural food supplying farmers with inadequate government support. Chand and Yala (2011) argued that food markets in PNG are highly fragmented as evidenced by large variations in the prices of similar goods across the country. There are various reasons for this variations but poor quality of transportation and communication infrastructure impedes the excess food supply from the rural areas to access the undersupplied urban food markets such as Port Moresby, which results in volatile staple food prices across the country. Furthermore, there is no economies of scale in food production and lack of organised food distribution points to effectively supply food to the market.

On the contrary, the demand for food has been increasing steadily in the rural and urban centres such as Port Moresby and Lae due to the increase in population, rapid urbanisation, increase in household incomes especially from the middle class, government fiscal spending and the increase in investments within the economy. According to the 2011 PNG National Population and Housing Census (PNGNPHC)

PNG's population has reached 7,275,324 people, an increase by 40 percent (40%) and at an average annual growth rate of 3.1 percent (3.1%) since the last National Census in 2000. Ormsby (2015) also revealed that a rise in the middle-class in PNG is seeing the emergence of a wider variety of food and beverages demanded, particularly in the urban centres such as Port Moresby.

The increase in the demand for staple and processed food with an ongoing scarcity in food supply in the economy has been a major challenge for PNG consumers, policy makers and the government. To manage this dilemma, the country has been consistently dependent on imported food hence becoming one of the leading net importer of food in the Asia Pacific Region, (UNDP, 1997, p. 178-9). The constant reliance on imported food has subsequently exposed PNG to the incantation of imported food inflation and other economic shocks transmitted from the volatile global commodity markets and from food producing countries apart from the domestic factors of inflation.

The graph below provides a synopsis of the level of inflation in the country using the CPI data from 2001 to 2011.

Consumer Price Index, 2001 - 2011

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CPI	9.3	11.8	14.7	2.2	1.8	2.4	0.9	10.8	6.9	6.0	8.4

Source: Author's collection based on data obtained from BPNG (2001-2011)

Figure 1: The Annual CPI for 2001 - 2011

As illustrated in Figure 1, the CPI rose markedly reaching its peak at 14.7 percent in 2003 and subsided to its lowest level in 2007 at 0.9 percent with a subsequent increase to 10.8 percent in 2008. The sharp increase in 2003 was due to a historical hike where the country was experiencing high inflation due to the depreciation of the kina[1] exchange rate in 1995-1996, 1998-2000 and 2001-2003 as a result of a change in the foreign exchange regime from a pegged regime to an independent float (IMF, 2008. p. 3-4). Lower inflation in 2004, 2005, 2006 and 2007 was due to the appreciation of the exchange rate and the drop in government expenditure. The higher inflation rate of 2008 was partly due to the effects of global financial crisis and the subsequent effects of the global food and fuel prices.

Alternatively as a net importer of food, PNG's demand for imported food maintained consistency throughout the 2007-2008 global financial crisis. The preceding figures provide a synopsis of five main food imports in US$ per tonne.
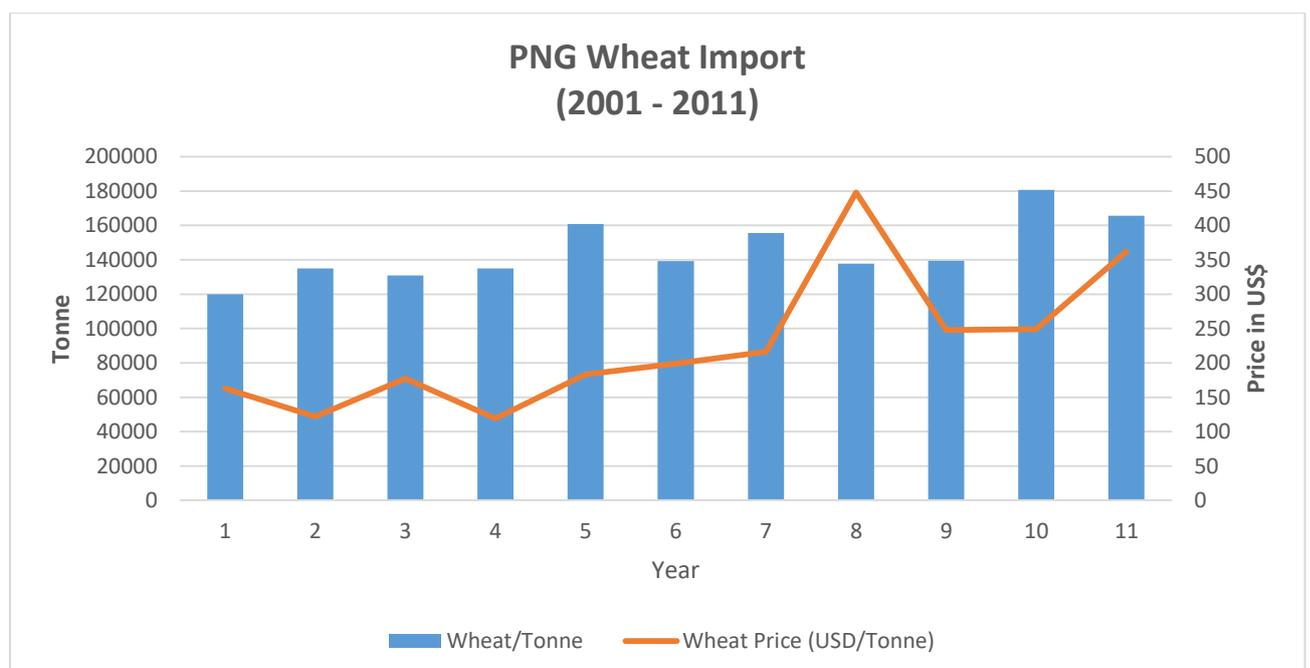
Source: Author's collection based on data obtained from FAO

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[1] Kina and Toea is the official currency of Papua New Guinea

Figure 2: PNG Wheat Import, Price/Tonne

**PNG Buckwheat Import
(2001 - 2011)**
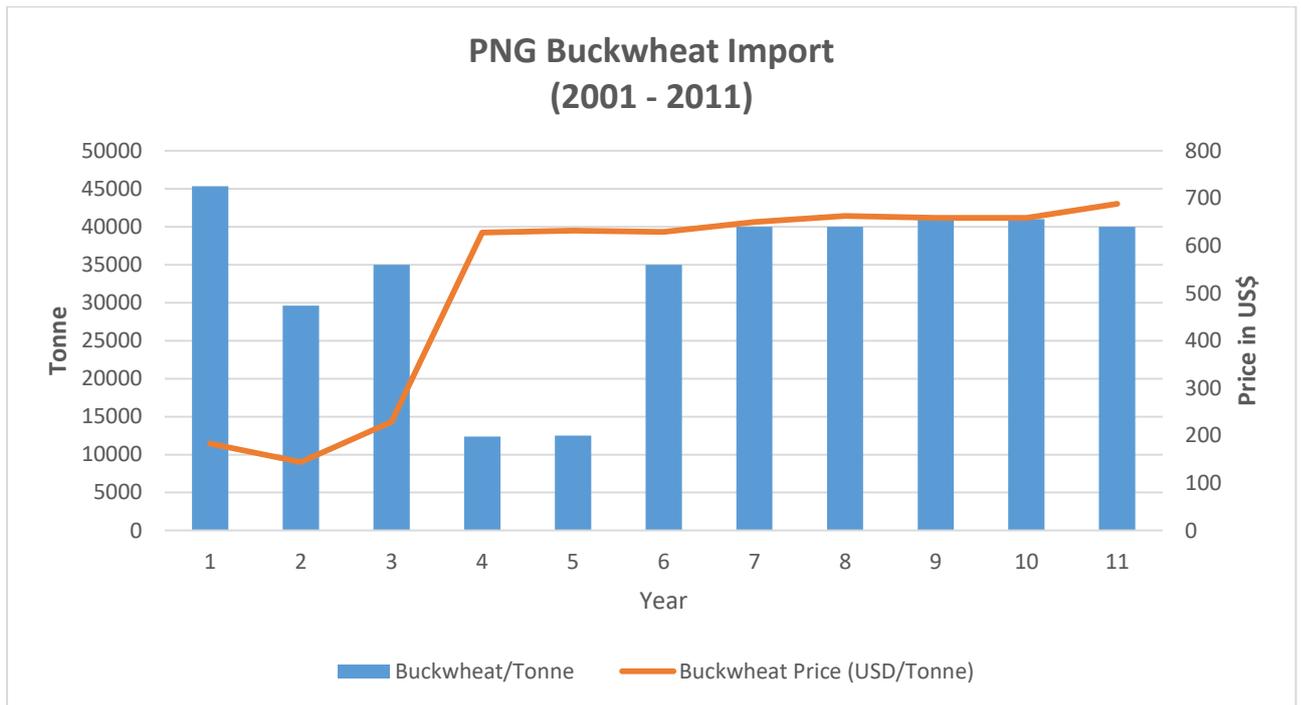
Source: Author's collection based on data obtained from FAO

Figure 3: PNG Buckwheat Import, Price/Tonne

**PNG Sorghum Import
(2001 - 2011)**
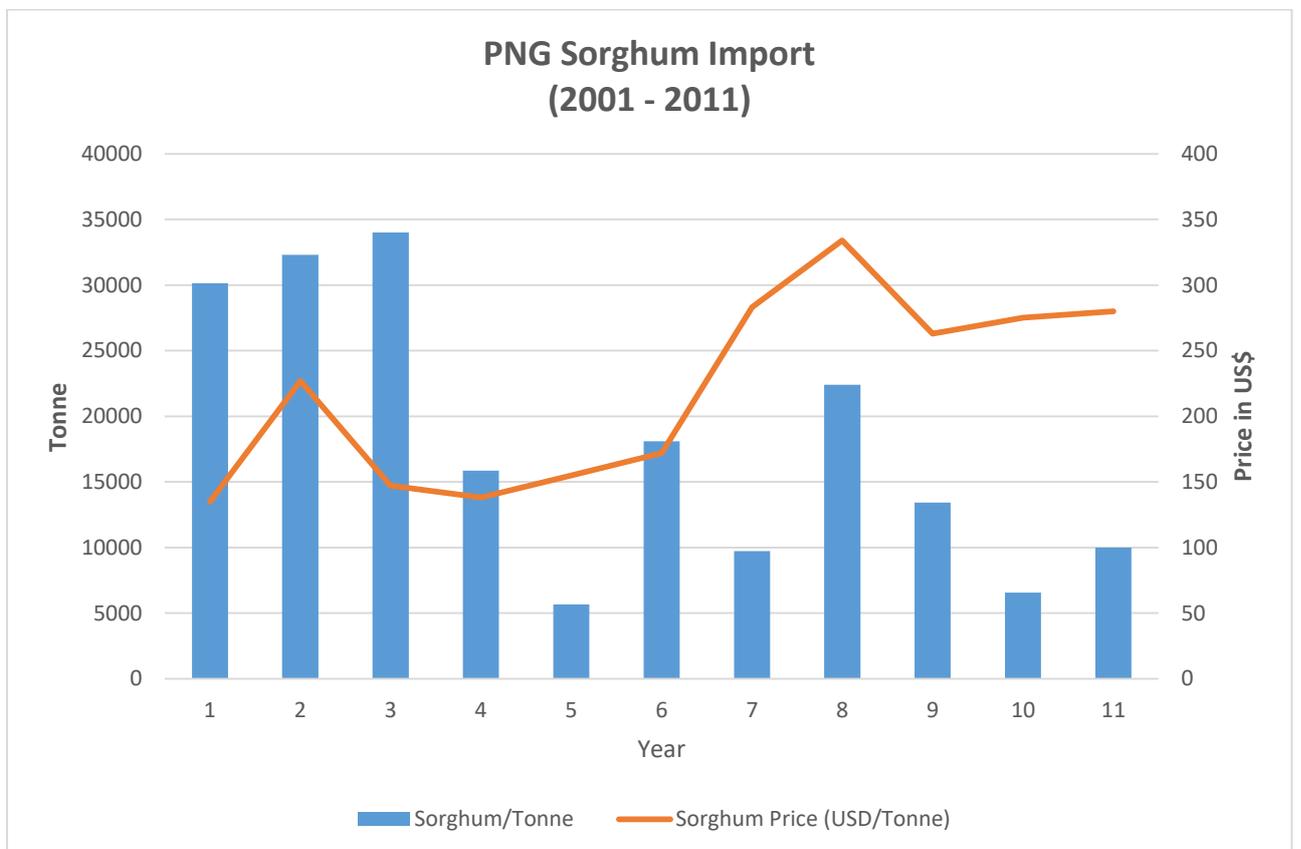
Source: Author's collection based on data obtained from FAO

Figure 4: PNG Sorghum Import, Price/Tonne

**PNG Sheepmeat Import
(2001 - 2011)**
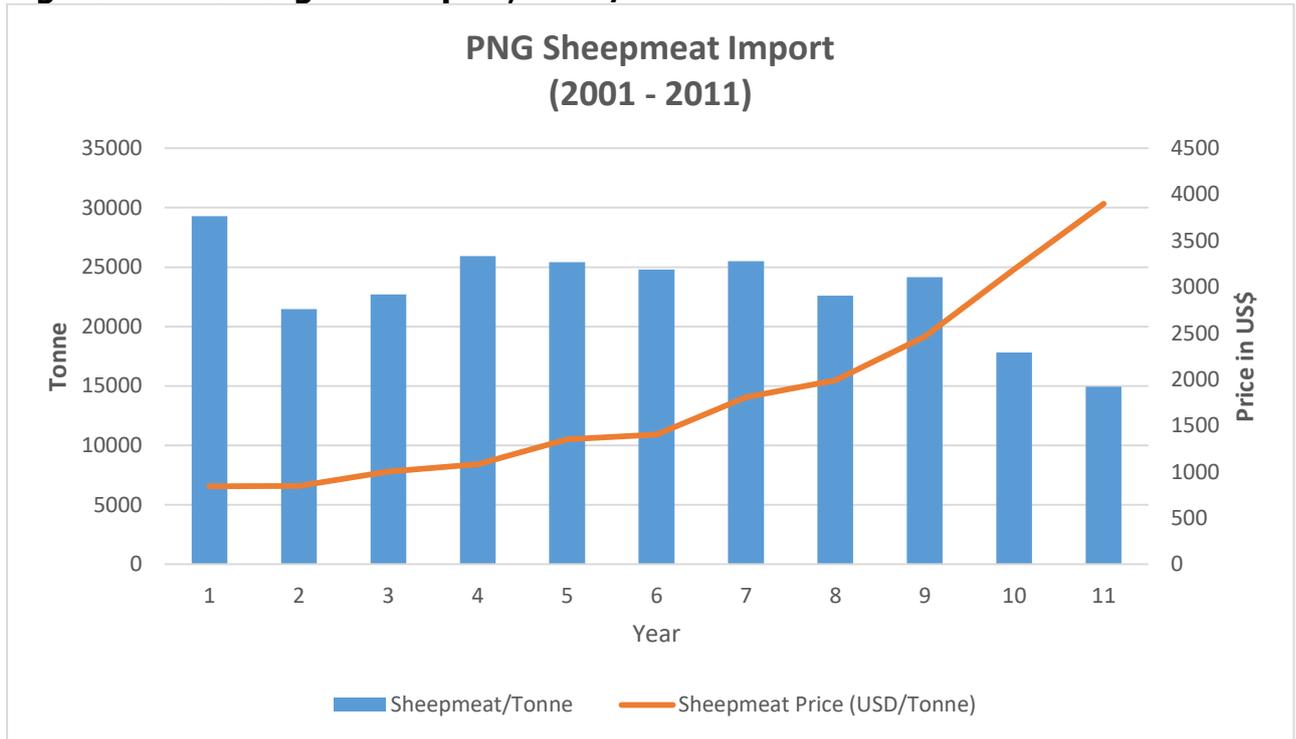
Source: Author's collection based on data obtained from FAO

Figure 5: PNG Sheepmeat Import, Price/Tonne

**PNG Mealmeat Import
(2001 - 2011)**
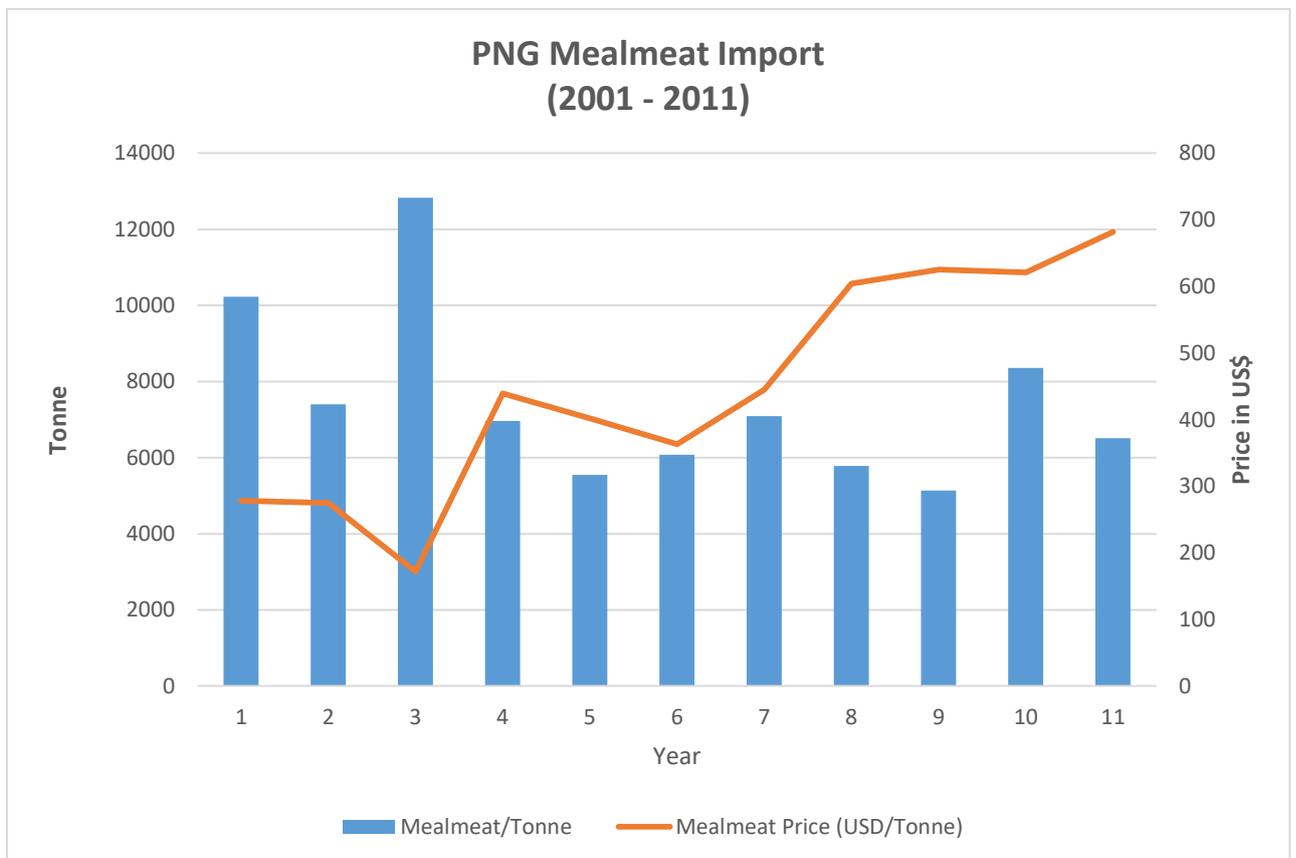
Source: Author's collection based on data obtained from FAO

Figure 6: PNG Mealmeat Import, Price/Tonne

The above figures depicted a scenario where any increase (decrease) in global food prices has a direct impact on PNG food tradeables. The corresponding demand for food is reflected in the volume of imports which were maintained at a fairly moderate level even though the respective food prices were high. Figure 2, 3 and 5 depicted the scenario where the demand for imported food is consistent in the height of a food price spike including the 2007-2008 global financial crisis.

1.2   Theoretical Aspect of Food Inflation

There are many causes and consequences of demand pull and supply induced food inflation which are discussed based on the macroeconomic theories such as the increase in household food consumption and spending, investment, expansionary and contractionary fiscal and monetary policy regimes, unemployment and exchange rate fluctuations.

Alternatively, food price inflation is caused by the other exogenous factors such as an increase in global oil price, increase in the price of fertilizers, speculation and an unfavourable environmental and weather conditions in food supplying regions leading to poor harvest yield and biofuel price. Food price inflation affects the households' ability to maintain the same standard of living and has the potential to push people at the lower end of the income bracket into poverty.

Food and non-food inflation is measured by the Consumer Price Index (CPI). The CPI measures the weighted average of prices of a basket of consumer goods and services, (PNG NSO, 2011) and it can also be viewed as a measure of the cost of living. When the CPI rises, a typical family has to spend more money (Kina) in

order to maintain the same standard of living. CPI varies from the developed and developing countries respectively.

1.3   Problem Statement and relevance of the study

According to UNDP (1997) PNG is one of the leading net importer of food in the Asia Pacific Region. The on-going challenge is that the production and supply of domestic food products such as cassava, banana, sweet potatoes including animal products and sea foods are inconsistent and usually supplied on a small scale, barely adequate to meet the households' growing demand for food. The current practice is that the domestic food are produced by individual rural farmers for their own households' consumption while selling the surplus randomly in the local food markets for extra cash.

There are no economies of scale in domestic food production, supply and distribution. PNG's domestic food industry is not well developed to cater for the rapid increase in food demand. Alternatively, semi processed foods such as animal and sea food products (tuna, beef, scrimps, prawns, et al) are processed and exported overseas hence contributing to the ongoing scarcity in food supply in the domestic food market. There is also lack of food substitutes such as backed, salted, dried and smoked food products that could be widey and promptly accessed by consumers to cushion the excess demand on certain food products. Coupled with that issue is the common practice where people live in tribal groupings both in the urban areas especially in urban settlements and rural villages and that encourages the proliferation of large family size and extended families living in the same household. PNGNPHC (2011) revealed that household size has increased throughout the country

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from 5.2 persons in the 2000 census to 5.3 persons in 2011. The proliferation of large family size promulgate increases in household food consumption and further increases share of household income spend on food at home.

Alternatively, certain regions and ethnic groups in PNG such as the Highlands region place special value on animal products such as pork, lamb and beef and use those products as part of their household food, ceremonial rituals and means for settling customary disputes (compensation) apart from cash. Other regions such as Momase, New Guinea Island and Southern Region place value on animal products, domestic and imported foods such as banana, cassava, rice, wheat, processed canned foods (fish and meat) et al for ceremonial rituals, means for tribal gifts and dispute resolution apart from using food for household consumption. The demand for "food at home" and "food away from home" (household food consumption) together with food used in ceremonial rituals and tribal compensation around the country on an annual basis has not been adequately researched in order to ascertain the annual quantity of food demanded.

However the prominent scenario around the country is the shortage of imported and locally produced food on a regular basis due to high demand. Currently there are no literature on household, ceremonial and tribal food demand, supply and consumption in PNG.

Therefore with these internal challenges and the effects of external challenges including the food price fluctuations in the volatile commodity market, there has been persistent hike in food prices in the country which has not been adequately documented. This study seeks to ascertain the vital determinants of food inflation and its impact on the economy of PNG.

1.4   Objective of the study and Hypothesis

The aim of this study is to examine the impact of food inflation on the economy of PNG using time series data from periods 2001 to 2011 (10 years). This period was selected based on two rationale, firstly PNG had economic stability as a result of high global commodity prices and political stability. Secondly, there was global financial crisis from 2007 to 2008 which has contributed drastically to the rise in global food prices. Therefore to achieve this objective, the paper examined yearly food consumer price index, real exchange rate, money supply, real interest rate and wheat price, factors contributing to food price inflation. The study then analyse the impact of food inflation on the economy of PNG by examining factors such as food consumer price index, real exchange rate, real interest rate and gross domestic product.

The following hypothesis were formulated to reach the objective of this research,

1. Null: Real Exchange Rate, Money supply, Real interest rate and Wheat price do significantly affect the yearly rate of Food CPI in PNG.

2. Alternative: Real Exchange Rate, Money supply, Real interest rate and Wheat price do not significantly affect the yearly rate of Food CPI in PNG.

3. Null: Food CPI, Exchange Rate and Interest Rate significantly impact Real GDP of Papua New Guinea

4. Alt: Food CPI, Exchange Rate and Interest Rate do not significantly impact Real GDP of Papua New Guinea

1.5   Organisation of the Paper

As outlined in the topic, this study investigates food inflation and its impact on the economy of PNG. To ensure unity, coherence and lucidity, the paper is organised into five chapters. Chapter one provides the introduction with various subsections including the brief background, definition of food inflation, theoretical aspect,

problem statement and the relevance of this study. The chapter also provides the objective of the study and the hypothesis that will be tested in this investigation. Chapter two contains the literature review which is again divided into subsections. Firstly, the chapter attempts to provide a scenario of global food inflation based on various studies conducted both in the perspective of developed and developing countries by other researchers and drawing the lessons and relevance of those studies as a guide in this study. Chapter two further provides an overview of PNG's economy and the food inflation trend. The chapter concludes with reviewing the determinants of Food Price Inflation in PNG.

Chapter three outlines the methodology of this investigation pertaining to the area of study, Macroeconomic model of food inflation, Data type, Sources, Variables and the Data Analytical Methods. Chapter four alternatively contain results and discussion which is divided into the results of the test statistic and the estimation of the error correction model. Chapter five provides the summary and conclusion together with policy recommendation and suggested area for further research.

CHAPTER TWO: LITERATURE REVIEW

2.1   Global Food Inflation

Food inflation is a global phenomenon which affects every countries across the world. According to Hochman et al. 2014, the food commodity price inflation beginning in 2001 and culminating in the food crisis of 2007/2008 had drastic effect on food prices. There are many literatures and research done on this subject. The

global food episode of 2008 led to substantial hike in the prices of agricultural commodities and food products. The food crisis attracted researchers and policy makers to critically study and analyse the dynamics of global food inflation. Abbott et al. 2008, Baltzer et al. 2008, Dewbre et al. 2008, Helbling et al. 2008, Schnep (2008), Trostle (2008), Von-Braun, (2008), Yang et al. 2008, in their empirical studies concluded that global food inflation was triggered by economic factors including low interest rates, escalating oil prices, hike in the demand for biofuel production, depreciation of major currencies, significant income growth in populated countries, low food stocks, high fertilizer prices, and domestic policies (export restrictions, embargoes and market structures) including weather shocks. According to OECD-FAO: 2008, food prices rise when markets get tight while production shortfall (shock) in itself is enough to send prices higher rather than the effects of monetary policy regimes.

However, there are myriad of factors that generate food inflation, some of which do not provide accurate explanation to causation effect. Makaiko (2010) also argued that the responses of domestic prices to some causal factors have not been strong enough in the presence of complexity in price transmission and the robust nature of the domestic economy.

A fascinating aspect of food inflation is the disparity in food prices and consumption pattern in the developed and the developing countries. In the well-developed and advanced economies of developed countries, food inflation is relatively lower than food price hike in the developing countries. In their study, Schnepf and Richardson (2011) revealed that the lowest 20 percent of US households' quintiles in 2009 spend 16.2 percent of their household income on food

while the food budget share decline across income quintiles until the wealthiest quantile, where households spend an average of 11.4 percent.

The status quo is further complicated when comparing food prices in developing countries who are well-developed emerging economies to those with underdeveloped and volatile economies. The food inflation in the volatile economies are higher, which reduces the real income of the most vulnerable people with serious nutritional and health implications. People in the lower to middle income brackets, who comprise bulk of the population in a developing country are mostly affected by food price inflation than those in the higher income level. "High food inflation has always penalized the poor people more than the rich because the poor are less able to protect themselves against the consequences and less able to hedge against the risks that food inflation poses" (G.I.Parvathamma, 2014). Average household in developing countries still spend almost half of their household income on food. Miskelly et al. 2011, in their study proved that the share of average household income spend on food in the Developing countries ranges from 35 to 40 percent (40%).

Food inflation is relatively high in developing countries as most of them rely on imported food. China's single most problem as a developing economy is food inflation. "About 75 percent of China's overall inflation rate is due to high food prices", (Matt Phillipps, 2010). The single most product that plays a significant role in China's high food inflation is pork which was estimated to account for 10 percent of China's overall inflation index measurement. Alternatively, Tang (2001) estimated Malaysia's inflation model using the unrestricted error correction model (UECM) by analysing the influence of bank lending. The model unveiled that the factors

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impacting Malaysia's inflation were import price and real-income variables. It subsequently concluded that concurrent fiscal policies had a significant effect on the depreciation of naira on inflation. Holod (2000) and Leheyda (2005) in their separate studies examined factors impacting food price hike in Ukraine and revealed that real output, exchange rate, money demand and supply and wages are key drivers impacting price hike in Ukraine. In India, there were three pivotal factors that impacted food inflation in the country. Gulati and Saini (2013) in their research concluded that the transmission of the global food inflation, ballooning/monetized fiscal deficit and the rising farm wages explained 98 percent of food variation in India's food inflation over the period of 1995 to 2012.

In Sub-Saharan Africa and the Middle East, various empirical research have been conducted to ascertain the determinants of inflation while few authors concentrated efforts on establishing the factors of food inflation in the region. Researchers studied the sources of inflation in the Sub-Saharan Africa by analysing the causal effects of inflation, output gap and real money gap by applying the heterogeneous panel co-integration estimation technique. Barnichon and Peiris (2008) concluded that both the output gap and the real money gap were instrumental in explaining the proliferation of inflation in Africa. Subsequent studies were conducted in Ghana, Tanzania, Swaziland and Kenya respectively to verify the factors of inflation. Dlamine et al. 2001, Durevall and Ndung'u (2001), Laryea and Sumaila (2001), Rutasitara (2004) and Ocran (2007) revealed that treasury bill, exchange rate, output, foreign prices, real wages, lagged inflation and the terms of trade had significant impact on inflation in those countries. Alternatively, a study conducted in Iran analysed the casual effects of food price and monetary policies

using the vector error correction model (VECM). Shahnoushi et al. 2009, revealed that food prices had long-run and short run granger causality with money supply. Another study was conducted in Ethiopia to establish the determinants of food inflation. According to Loening et al. 2008, the study unveiled that supply shocks and producer prices were significant drivers of food inflation in the country. Therefore, it is obvious that the demand side factors dictate the supply side in generating inflation in the region.

In the Asia Pacific region, various studies have been conducted on inflation and high food inflation. According to Min et al. 2006, the region encompasses developed economies, small and vulnerable economies with least developed countries (LDCs) and developing countries that are net food importers and net food exporters. The effects of high food inflation in 2008 financial crisis engulfed virtually all of developing Asia and Pacific, although the magnitude of the increase differed across countries. Rehman and Khan (2015) performed a study on the determinants of food inflation in Pakistan for the time period 1990 to 2013. They applied the Augmented Dickey Fuller, Vector Error Correction model and Johansen co-integration test which revealed that indirect taxes and food exports have positive impact on food inflation while government subsidy and GDP are negatively correlated with food price inflation in Pakistan. The Johansen co-integration test also shows long-run relation of indirect taxes, food export and subsidy with food price inflation. They concluded that the government should pay attention to the agriculture sector and also reduce taxes on food items. Carrasco and Mukhopadhyay (2012, p.15) examined the factors of food price inflation in South Asia based on panel estimates of three South Asian countries, Bangladesh, India and Sri Lanka from 1995 to 2009. The study utilised the

Wholesale Price Index (WPI) for food as dependent variable, per capita GDP and the Agriculture Production Index (API) as the two independent supply side and demand side variables respectively. The results concluded that demand and supply side factors are strong determinants of food inflation in South Asia, higher per capita income and declining agricultural output significantly push food price up in the region. In 2014, Reza, Firdaus and Novianti examined the factors that can affect rice, small red chillies and shallots prices using the Vector Error Correction Model and estimated the psychological prices at Indonesia's Rice Wholesale for periods 1999 to 2011. Rice is considered a strategic commodity that can influence economic, social and political stability of the country. Alternatively, chilies and shallots are horticultural products that Indonesians very much require for their daily meals and other requirements. The study concluded that the amount of supply and stock can decrease the commodity fluctuating prices while the fulfilment of small red chilies and shallots rely on import.

Alternatively, Pacific Island Countries (PIC) are net importers of staple and processed food (chicken meat, paddy rice, prepared beef, barley beer, pig meat, sugar, wheat flour, whole milk, mutton, lamb et al) and remain vulnerable to commodity price shocks. The vulnerability of PICs emanated from their isolated geographical locations, small and open economies, population size, limited arable land, frequent natural disasters and underdeveloped food production, distribution and supply mechanisms. According to FAO (2007), Pacific Island countries rely heavily on food imports with increases on annual rate of 20.3 percent in Cook Islands, 14.4 percent in Fiji, 7.7 percent in Kiribati, 16.7 percent in the Federated States of Micronesia, 16.4 percent in Niue, 2 percent in Papua New Guinea, 26.4

percent in Samoa, 23 percent in Solomon Island, 0.33 percent in Tonga and 8.6 percent in Vanuatu. "Food comprises approximately 45 percent of their consumer price index basket placing them overall in a position similar to Asian LICs and well above the average for emerging market economies", (IMF, 2011).

Few studies have been conducted on inflation and food price inflation in the sub-region. Paul, Tang and Bhatt (2014) examined the effects of exchange rates, international prices and the demand shocks on inflation in Fiji by analysing the annual data from 1975 to 2010. Unit root test, Multivariate cointegration test and Vector Error Correction (VEC) model reveals that changes in Fiji's CPI are Granger caused by the long-run trends in all other variables. Using Australia's CPI and devaluation-year dummies as exogenous variables and changes in the exchange rate and changes in demand shocks as independent variables in the VEC model, the study concluded that as a monetary policy instrument, the flexibility of the exchange rate is indispensable for Fiji to appropriately absorb the international supply and price shocks.

In summary, factors such as depreciation of major currencies, dwindling food stocks, hike in fertilizer prices, low interest rates, government policies such as export and import tariffs, production of bio fuel, money supply, rapid income growth in emerging economies, rising demand from middle class in developing countries and natural disasters (weather shocks) are key determinants of food and non-food inflation.

2.2   Overview of PNG Economy and Food Inflation Effects

PNG is categorised as a small and open economy with a GDP of 12.87 billion, (World Bank, 2011). The country is vulnerable to the global commodity price shocks

as it is one of the net importers of food and fuel, and food comprises approximately 45 percent of the consumption basket.

It is the largest island nation located in the Southwest Pacific and has a total population of 7, 275,324 people (PNG NSO, 2011) with a land mass of 462,840 km square. The country is endowed with abundant natural resources including gold, copper, silver, nickel, oil, gas, timber and fisheries.

Economic growth remained positive amidst the 2008 Global Financial Crisis spanning over a decade commencing from 2001 due to the strong demand for minerals and commodities such as gold and cocoa from the major trading countries coupled with the high commodity prices, effective bank liquidity position and active capital investments together with an internal stable political environment. The 2008 Global Financial Crisis had a docile effect on GDP growth. According to Baker (2012) GDP growth remained above 6 percent from 2007 through to 2009 when much of the world was entangled in the Global Financial Crisis and associated economic recession. The figure below depicts the GDP growth over the last decade.

GDP Real Growth Rates, Total and Non-Mining 2002-2016 (actual 2008-2010, thereafter Budget estimates, projections and revised Treasury projections)

Percentage of GDP by Economic Activity (source:NSO and Treasury forecast)
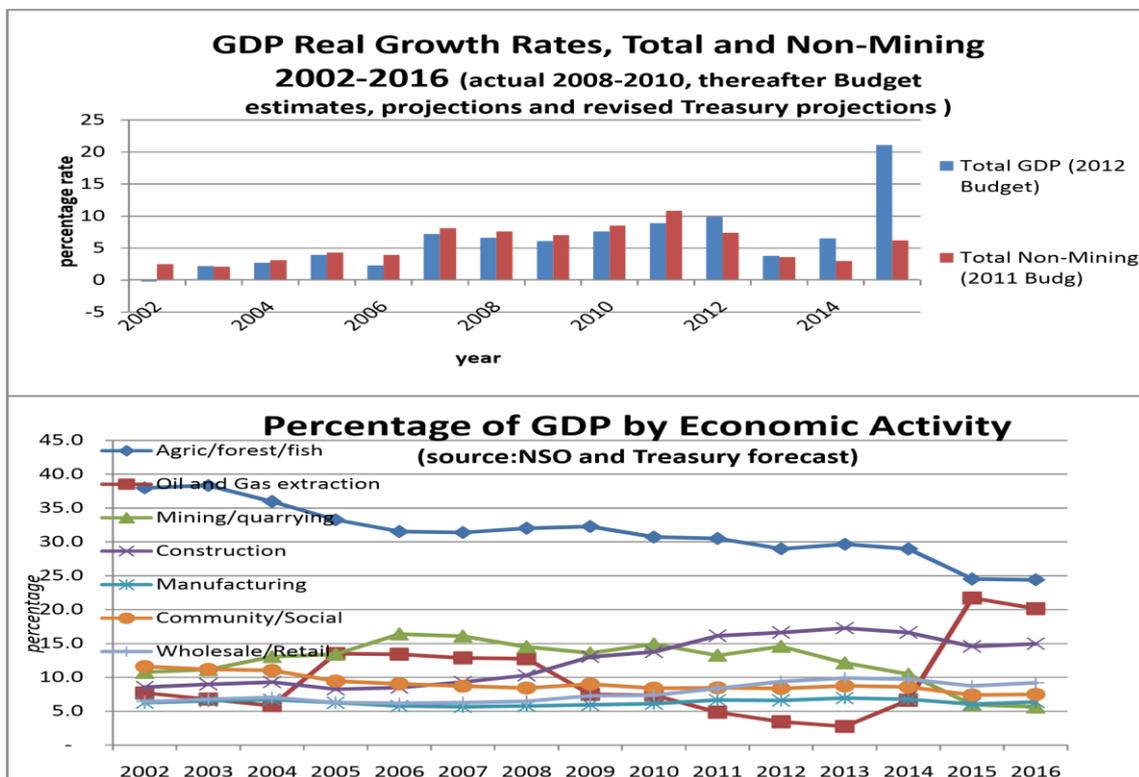
Source: INA, NSO and Treasury Forecast

Figure: 7 GDP Growth Rates and Economic Activities

Although there were diversification in economic activities by sectors, PNG according to World Bank (2014) is dominated economically by two major sectors, a small formal sector focussed primarily on the extractives and the export of renewable resources and an informal sector employing majority of the population. Rogers et.al (2011) revealed that eighty seven percent (87%) of people in PNG live in rural areas, which technically equates to the bulk of the population occupying the informal sector and engaging in subsistence agricultural and small holder cash crop farming to generate income opportunities and maintain their livelihood. While the formal sector is dominant in terms of export and revenue generation which accounts for two-thirds of the export earnings, the renewable resource sector GDP remains on par with the extractives (Baker, 2012).

The formal sector employment grew exponentially from 2004 to 2012 extending across sectors and regions within the country. Morobe and NCD experienced robust formal sector employment growth while the Highlands region had a sluggish growth rate. Agriculture/Forestry/Fisheries, Retail, Wholesale, Manufacturing, Building/Construction, Transport, Financial/Business and the Mineral sector all experienced reasonable share of employment growth.

However the informal sector employment growth rate cannot be established due to the unavailability of data and the technical nature of the informal economy but remain as the large sector providing income opportunities for those engaged in subsistence and small holder cash crop farming.
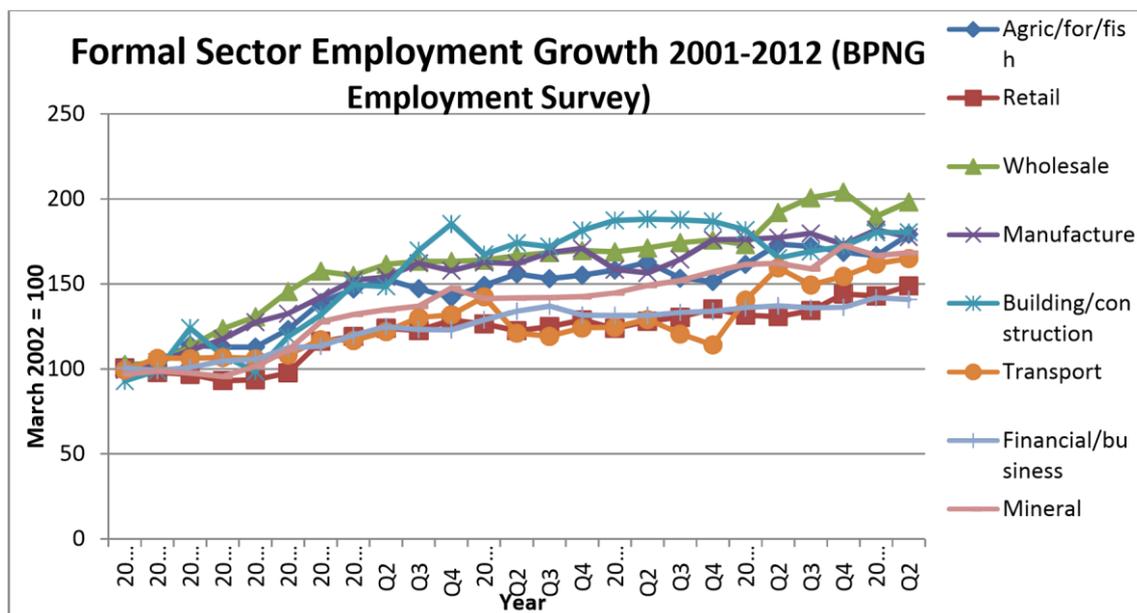
Source: INA, NSO and Treasury Forecast

Figure: 8 Formal Sector Employment Growth 2001 - 20012
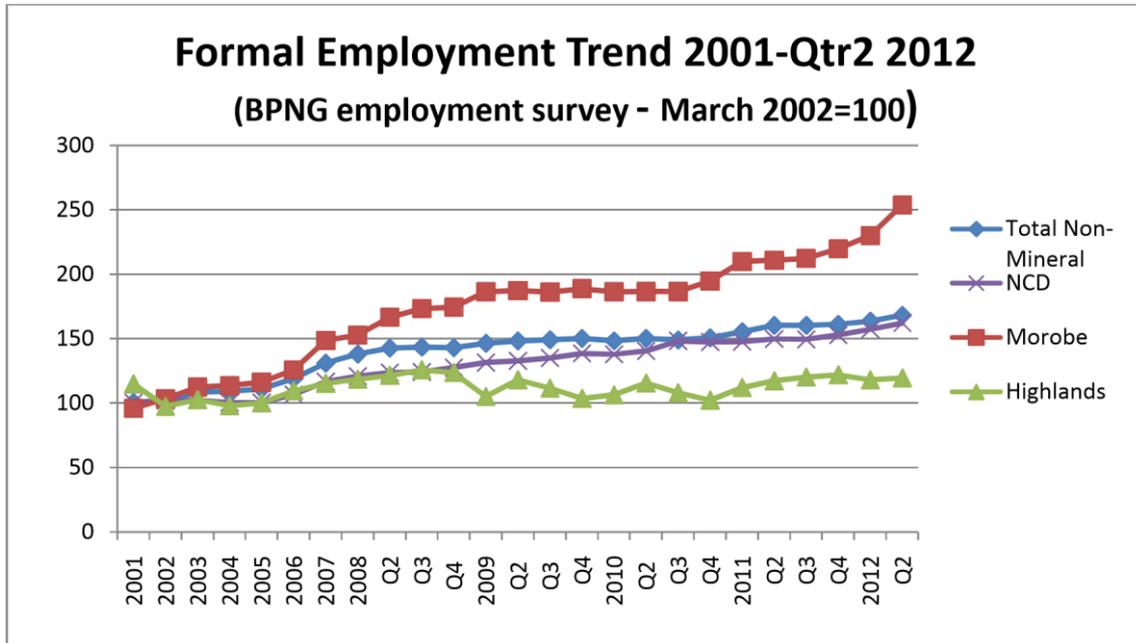
Source: *INA, NSO and Treasury Forecast*
Figure: 9 Formal Employment Trend 2001-Qtr2 2012

Despite the impressive employment growth demonstrated by the formal sector, it remains small compared to the informal sector and relatively inadequate to sustain the needs and expectations of the rapidly growing population.

Given the status quo and the lack of diversification and transformation in economic activities in order to hedge against global commodity price shocks, PNG's economy remains susceptible to the effects of food inflation. Various studies have been conducted briefly by World Bank, IMF and the ADB on inflation in the country and continuous efforts by the Central Bank has been geared towards taming the overall inflation with the objective of maintaining price stability in the economy.

There are no studies conducted specifically on examining the effects of food inflation on the economy of PNG even though it is a significant macroeconomic phenomenon posing threat to economic growth and food security. Food and fuel are considered as volatile items in the CPI calculations and most often are omitted when

determining core inflation. However, other developing countries have conducted extensive studies on the impact of food inflation on their economic growth. Ogbokor (2004) examined the effects of inflation on the economic growth of Namibia and concluded that economic growth effects of inflation can be detrimental if not controlled. Uaro (2007) revealed that food inflation, exports, imports, real interest rate and real exchange rate significantly influenced economic growth in Malawi.

The effect of high food prices in a country is the high Consumer Price Index (CPI) and it affects consumers differently in different economies. The effects tends to be greater for countries that are large net importers of food and where households spend a greater percentage of their income on food, meaning that they have a much larger weighting on food in their CPI basket (Holodny, 2015). This is synonymous with PNG and provides the impetus to examine the determinants of food inflation and its effects on economic growth as the country is a net importer of food with a large portion of household income spent on food.

According to IMF (2008) inflation historically has had a strong negative correlation with foreign exchange rate movement in PNG. The country encountered high inflation in 1995 to 1996 following the depreciation of kina exchange rate when the foreign exchange rate regime was changed from a pegged regime to an independent float. The high inflationary pressure prolonged until 2003 when the kina exchange rate appreciated against other major currencies due to a favourable hike in mineral and commodity prices and strong demand for minerals and commodities in the importing countries.

The figure below depicts the strong negative correlation with foreign exchange rate movement between 1980 and 2006.

Figure: 10 CPI and NEER (in percentage, y/y change)

The rate of Inflation in a country can have a major impact on the value of its currency and the rates of foreign exchange it has with the currencies of other nations (Investopedia, n.d., para. 1). Therefore given that PNG is a net importer of food, fluctuations in the exchange rate and global market price of food commodities can have a drastic impact on PNG's domestic food prices.

2.3   Determinants of Food Price Inflation in PNG

There are no previous studies conducted to examine the determinants of food inflation and its impact on the economy. However, IMF (2008) attempt to study the

movements of headline inflation in PNG explained by tradeable goods[2] which

accounts for seventy seven percent (77%) of the CPI basket and the non-tradeable

goods[3]. The study concluded that among the tradeable goods, food has been the

main determinant of underlying inflationary pressure in the country. The figure

below illustrated the impact of tradeable and non-tradeable goods on headline

inflation.
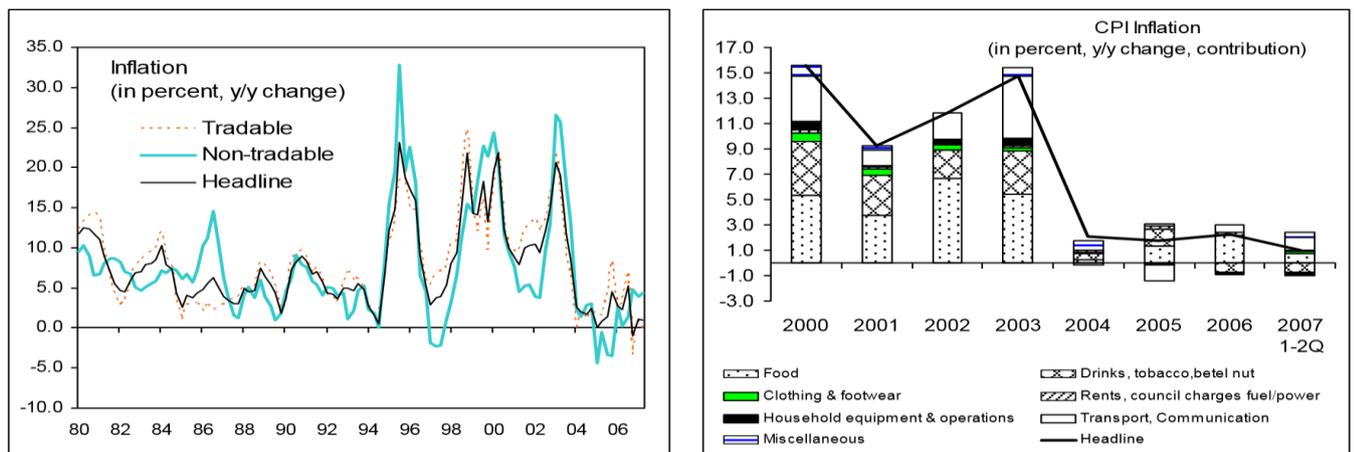
Source: IMF, BPNG 2008
Figure: 11 Inflation and CPI Inflation (in percentage, y/y contribution)

Figure 11 portrayed that underlying inflationary pressure generated from food

was high in 2000 through to 2003 with a decline in 2004 and a moderate rise in

2005 with fluctuations in 2006 and 2007. The general consensus is that food

inflation do have an impact on the CPI basket and headline inflation in the country.

This study contributes to the body of literature on food inflation especially in

the context of PNG. Brief studies have been conducted on core and headline inflation

but there are no studies on the determinants of food inflation including its impact on

the economy of PNG. This study will empirically analyse interest rate, exchange rate,

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[2] Tradeable goods include: food, drinks, tobacco and betel nut, clothing and footwear, household equipment and motor vehicles (IMF, 2008).
[3] Non-tradeable goods include: rents, council charges, and fuel/power, transport and communication and miscellaneous (IMF, 2008).

money supply and wheat prices as the determinants of food inflation. It will also analyse the impact of inflation on the economy of PNG and offer some policy advice.

2.4 Characteristics of Study Variables

Before analysing the variables, it is important to understand the behaviour and trends of the determinants of food inflation and their impact on the economy of PNG. The insights and the understanding gained from these study variables provide an important impetus in appreciating the results and outcome of the final statistical/econometrical analysis in chapter 4 and 5 of this study.

Interest rate declined in 2001 and remained low in 2002. However, the high inflation of 2003 and the appreciation of kina exchange rate due to the increase in demand for minerals and commodities coupled with the high world market prices for gold and cocoa, led to the PNG Central Bank tightening its monetary policy stance with a hike in interest rate at eight percent (8%) in order to absorb some of the excess liquidity in the economy and curb bank lending. Figure 12 below illustrates the Interest Rate and CPI trends from 2001 to 2011.
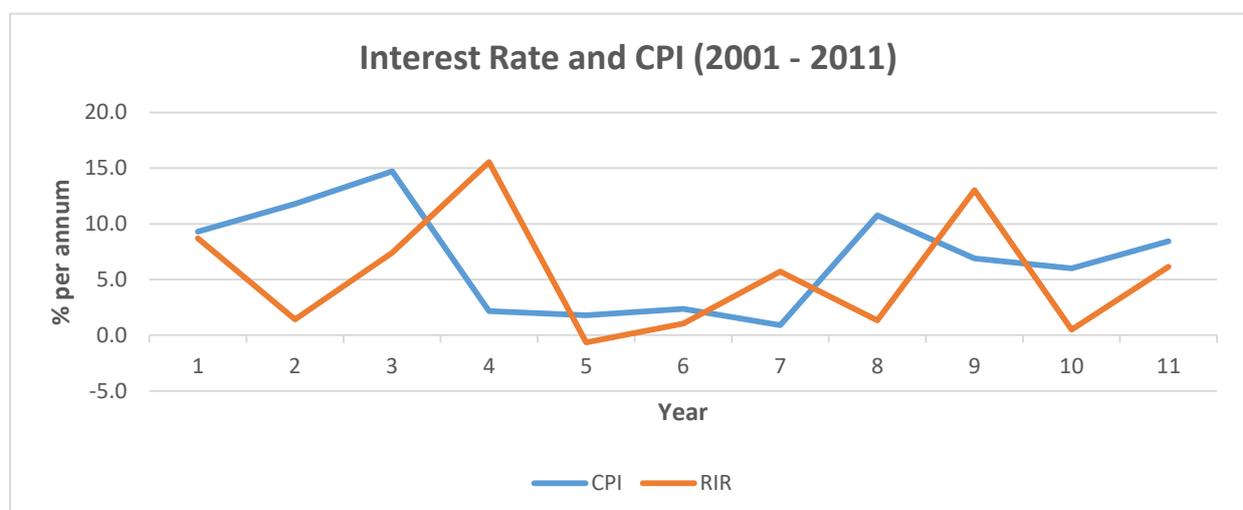
Source: Author's collection based on data obtained from BPNG and World Bank

Figure 12: Interest Rate and CPI

Kina Exchange Rates (against US$ and AU$)
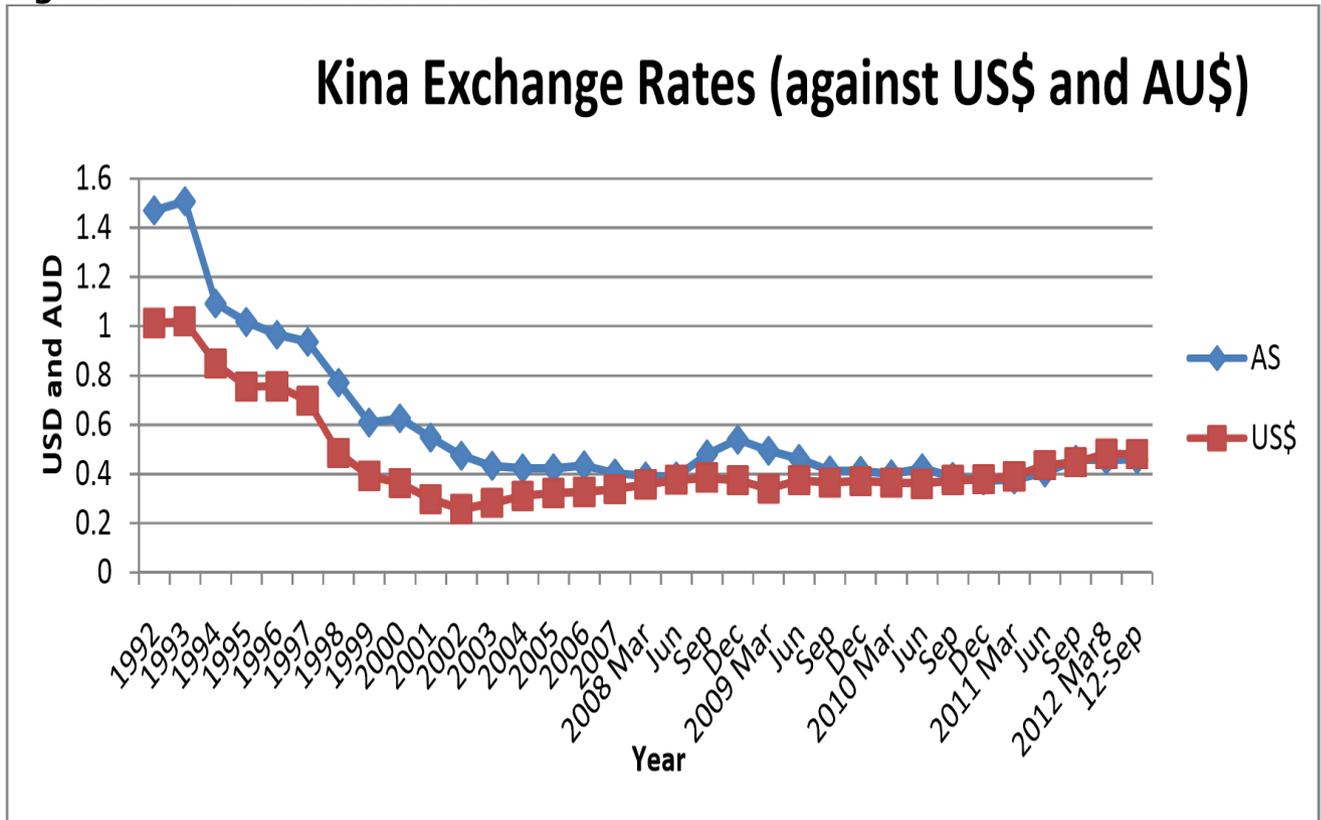
Source: INA, NSO and Treasury Forecast
Figure 13: Kina Exchange Rate

Kina exchange rate depreciated in the 1990s resulting in significant inflationary pressure but the high commodity prices in year 2000 appreciated the exchange rate moderately until 2008. The high commodity prices of 2008 further appreciated the kina exchange rate against both the US and Australian dollars including other major currencies by 8.9% through to 2011. The currency appreciation in 2011 and 2012 reflected a strong foreign exchange inflows together with high commodity prices and export earnings.

Constant intervention by the BPNG in the foreign exchange market assisted in cushioning excessive appreciation of PNG Kina against the US dollar. Between the periods January 2001 to June 2007 the central bank managed excess liquidity in the

economy by issuing central bank bills in order to sustain reserve liquidity within its target growth rate.
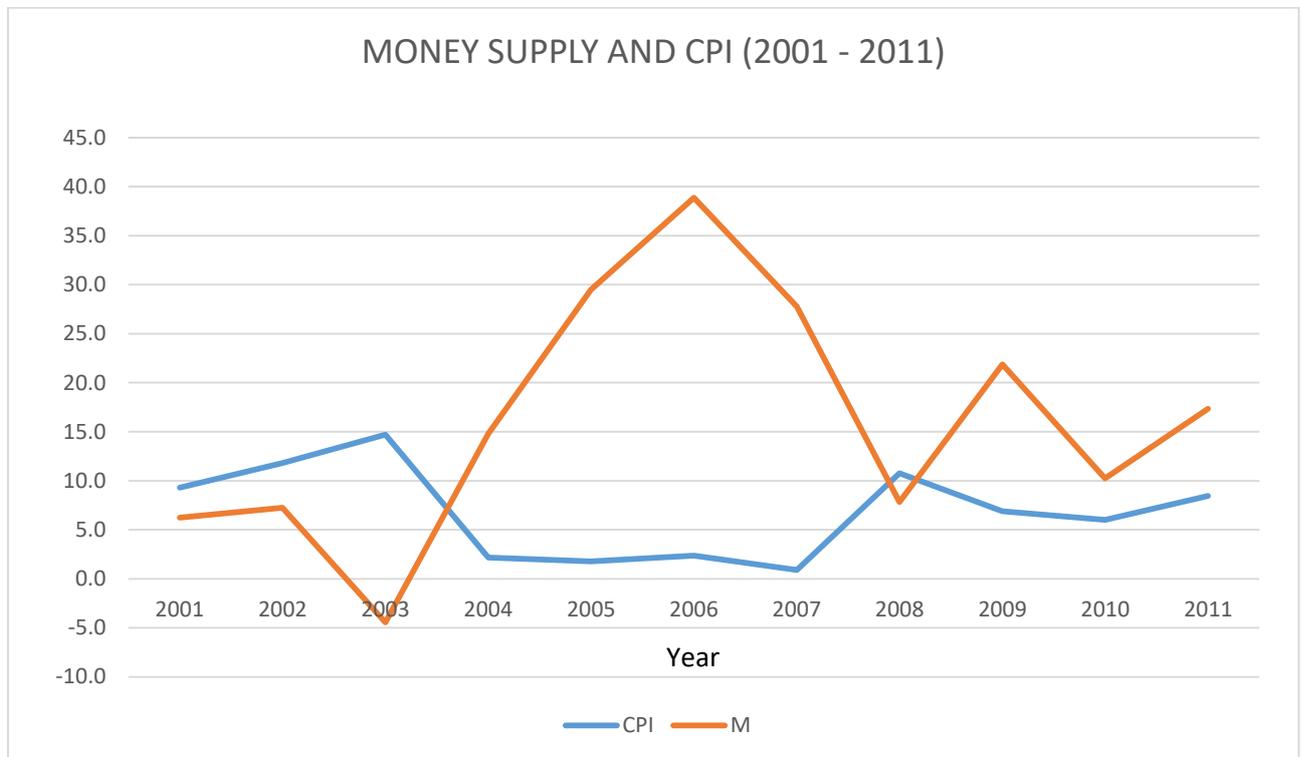
Source: Author's collection based on data obtained from BPNG and World Bank
Figure 14: Money Supply and CPI

Figure 14 above depicted the rate of money supply and consumer price index (CPI) from 2001 to 2011. The BPNG eased monetary policy in 2001 as a result of stability in exchange rates and a decline in inflation rate from 2000 to 2001. The level of money base increased by 12.9 percent between 2000 and 2001 due to the higher net foreign assets of the banking system (BPNG, 2002). In 2003, the monetary policy was tightened by the Central Bank in anticipation of a higher inflation which subsequently resulted in the significant decrease in total liquidity assets of the commercial banks to -4.4 percent. Following the decline in inflation towards the end of 2003, the Central Bank eased monetary policy and reduced the

Cash Reserve Requirement (CRR) from 5 percent to 3 percent which led to an increase in the money base to higher levels.

Money supply increased in 2004, 2005 and 2006 as a result of growth in the net domestic credit while inflation remained low due to stability in the exchange rate (BPNG, 2005). The total liquidity declined in 2007 as a result of the intervention by the Central Bank in the foreign exchange market but the money base remained high until a mild decline in 2008. The money base increased by 21.9 percent due to the growth in the private sector credit while the liquidity of the banking system increased in the same year as a result of the increase of the net government expenditure (BPNG, 2009). In anticipation of a strong domestic demand, weak kina exchange rate and draw down of government trust account balances, the Central Bank tightened monetary policy hence decreasing the money base to 10.2 percent in 2010 with an exponential increase in 2011. In summary the constant intervention by the BPNG in tightening or easing the monetary policy in response to inflation and other macroeconomic factors has assisted in managing the level of money supply in the economy.

Alternatively, global wheat prices fluctuated between 2001 to 2004 with a moderate hike in 2005 and 2006. In 2007 to 2009 due to the global financial crisis, the wheat price soared high as US$450/tonne impacting PNG's import for wheat. In 2010 there was a drop in price to US$250/tonne with a moderate increase to US$350/tonne. PNG's demand and import for wheat has maintained consistency throughout 2001 to 2011. Refer to Figure 2 above for graphical illustration.

CHAPTER THREE: METHODOLOGY

This study was conducted in PNG based on the yearly economic data collected from the time period 2001 to 2011 (11 years) for the entire country.

3.1 Data Type, Sources and Variables

The data used in this paper are secondary data and were collected from various credible and reliable organisations including the BPNG, PNGNSO, ADB, FAO and World Bank. The data include the Consumer Price Index (CPI), Real Interest Rate, Real Exchange Rate, Money Supply, Wheat Price and GDP.

The data were distilled, synthesized and codified to ensure accuracy, genuineness and completeness in order to be used in this paper. Alternatively, various statistical and econometric software were utilised including STATA, SPSS and MS Excel to analyse the data and test the hypothesis.

3.2 Data Analytical Methods

Various statistical techniques were used in this paper. To show the general trend in price and food price inflation in the country from 2001 to 2011, descriptive statistics was employed and the results were illustrated graphically in the figures throughout this paper. Next, Unit Root Test using the Augmented Dickey Fuller (ADF) method were employed to test the characteristics of the data. Economic variables in time series are often non-stationary and have unit root which implies that the data points have means, variance and covariances that change over time and behave in

cycles, trends, random walks or combination of the three. Non-stationary data are unpredictable and cannot be modelled or forecasted as it may indicate a relationship between two variables where one does not exist. Therefore the application of Johansen Cointergration Test and the ADF test are appropriate in this analysis. The corresponding results of the ADF unit root and stationarity test will further inform the use of cointegration analysis and error correction model in analysing economic time series data.

To examine the determinants of food price inflation in PNG, a parsimonious food inflation Error Correction Model (ECM) was employed. Based on the demand and supply side inflation model as food inflation and its determinants are cointegrated (Greene, 2012). ECM was also used to determine the effects of food price inflation on the economy of PNG.

In both ECM models, economic time series data were used which were nonstationary and has unit root hence appropriate tests were employed to differenced the variables in order to remove build-up of errors and obtain valid results.

3.3   Cointegration[4] and Error Correction Model

Test of Cointegration was used in this study to analyse whether the variables were integrated of the same order or have a linear combination and integrated of the same order or a lower order. Macroeconomic variables or economic time series data points tend to trend up or down in the short and long run hence the

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[4] Cointegration means the existence of long-run relationship between the dependent and its explanatory variables. That is if Y_t and X_t are cointegrated, the deviation from the long-run relationship is included as explanatory variable in an error correction model (Green, 2003; Psaradakis et al. 2004 and Reagle, 2002)

cointegration test will reveal whether there is a possibility for linear relationship among the set of variables used over long term periods.

If such a stationary I(0) or linear combination exists, the nonstationary (with a unit root), time series are said to be cointegrated and the stationary linear combination is interpreted as a long-run equilibrium relationship between the variables (Makaiko, 2008). Therefore the cointegration test offers a two dimensional approach of segregating the evolution of time series data into long-run equilibrium characteristics (the cointegrating vector) and the short run-run disequilibrium dynamics (Psaradkis et al 2004).

The Error Correction Model is mostly used in the multiple time series data analysis where variables have long-run stochastic trend or known as cointegration. ECM are useful for estimating both long-run and short-run effects of one time series on another and essentially estimates the speed a dependent variable returns to equilibrium after a change in the other variables. Therefore after the ADF and Johansen test were used to establish the existence of cointegration, ECM was ideal in this study to estimate both the long-run and short-run speed to which a dependent variable returns to equilibrium after a change in the other variables.

3.3.1 Factors Affecting Food Inflation in PNG

There are many contributing factors of inflation and food inflation (objective 1) in PNG. For the purpose of this study, an error correction model of food inflation combining both the demand and supply factors were employed. PNG is a small and open economy and a net importer of food hence is a price taker and spends almost half of its household income on food as discussed in chapter 2 of this study.

Basing on the fundamental theoretical notion of inflation in small open economies such as PNG, it is presumed that price level is determined by money demand and imported inflation (Ocran, 2007; Mankiw, 2003 and Moser, 1995). So PNG's economy can be categorised into tradeable and non-tradeable sectors (Mathisen, 2003, Abel et al. 1998). The price movements of non-tradeable food products reacts to fluctuations in exchange rate and money market. However, the price movements of tradeable food commodities react to the foreign prices (foreign inflation).

The work of IMF (2008), Makaiko (2010), Paul et al. 2014, Rehman (2015) and Wahab et al (2015) employed error correction model to analyse the determinants of inflation and food inflation in their various studies conducted for PNG, Malawi, Fiji, Pakistan and Malaysia respectively. There are many contributing factors impacting food inflation in developing countries and the context is different from country to country and also according to the size of their economy. Therefore, I compare and contrast the error correction models used in those respective studies alongside other variables and estimated a model suitable for this study basing on PNG's economic perspective and the variables used. Hence combining the study variables for food inflation in PNG gives the following Error Correction Model of Food Inflation;

$$P_t^{fd} = \alpha + \beta_1 rer_t + \beta_2 m_t^s + \beta_3 rir_t + \beta_5 P_t^{Wheat} + \in_t$$

VECM:

$$\Delta P_t^{fd} = \alpha + \sum_{i=0}^{n-1} \beta_{1,i} \Delta rer_{t-i} + \sum_{i=0}^{n-1} \beta_{2,i} \Delta m_{t-i}^s + \sum_{i=0}^{n-1} \beta_{3,i} \Delta rir_{t-i} + \sum_{i=0}^{n-1} \beta_{5,i} \Delta P_{t-i}^{Wheat} + \varphi_t$$

Where;

P_t^{fd} = $Consumer\ price\ index\ for\ food$

rer_t = $Real\ Exchange\ Rate\ (Value\ of\ PNG\ Kina\ equivalent\ to\ 1US\$$

m_t^S = $Money\ Supply\ in\ PNG\ Kina\ supplied\ by\ BPNG$

rir_t = $Real\ Interest\ Rate\ (\%)$

P_t^{Wheat} = $Wheat\ Price\ in\ US\$\ per\ tonne$

φ_t = $Denotes\ random\ error\ term$

Δ = $Denotes\ first\ difference\ operator$

According to the model above, the data used are based on yearly secondary data from 2001 to 2011. The dependent variable is the yearly consumer price index for food. The independent variables are real exchange rate, money supply, real interest rate and wheat price.

It is anticipated that the appreciation (depreciation) of kina exchange rate will either increase or decrease food inflation while an increase or decrease in the money supply will either increase or decrease food inflation, as almost half of PNG's household income is spend on food. Any interest rate policy shift up or down by the central bank will cause either a hike or a drop in food inflation rate. Wheat price is an exogenous variable. The price of exogenous variable is determined in the world market and any increase or decrease in wheat prices will have a corresponding negative or positive impact on domestic prices and food inflation as PNG is a net food importer and price taker.

3.3.2   Impact of Food Inflation on the Economy of PNG

To determine the impact of food inflation on PNG's economy, an Error Correction Model was employed and estimated according to the purpose of this

study (objective 2) by comparing and contrasting other models and variables used in other similar studies. The Economic time series data employed in the ECM are mostly non stationary and have unit root. Therefore the same method/approach employed in 3.3.1 was employed to differenced the variables in order to eliminate unit root and essentially exhibit stationarity of variables.

Granger causality test was also employed to determine the trend of relationship between food inflation and economic indicators. While the Johansen test was utilised to ascertain the long-run stochastic trend or cointegration.

The Vector Error Correction Model is as follows;

$$\Delta Y_t = \alpha + \sum_{i=0}^{n-1} \beta_{1,i}\,\Delta rer_{t-i} + \sum_{i=0}^{n-1} \beta_{3,i}\,\Delta rir_{t-i} + \sum_{i=0}^{n-1} \beta_{5,i}\,\Delta P_{t-i}^{fd} + \varphi_t$$

Where;

$Y_t = Real\ Gross\ Domestic\ Product\ in\ PNG\ Kina$

$rer_t = Real\ Exchange\ Rate$

$rir_t = Real\ Interest\ Rate\ (\%)$

$P_t^{fd} = Annual\ Rate\ of\ change\ in\ consumer\ price\ index\ for\ food$

$\varphi_t = Random\ error\ term$

$\Delta = Denotes\ first\ difference\ operator$

The secondary data used in the above model were based on yearly data from time periods 2001 to 2011. In the above model, the dependent variable is the real gross domestic product. The independent or explanatory variables are real exchange rate, real interest rate, and annual rate of change in consumer price index for food.

The real exchange rate would impact PNG's economic growth or output in two perspectives. One assumption is that any depreciation in exchange rate would result in high prices of tradeables especially imported semi-food products[5] and finished products. On the other end, it is assumed that the appreciation of the exchange rate renders domestic tradeables especially food products expensive and less competitive on the global markets and in response discourage international demand and lower domestic prices.

It is assumed that low interest rate *ceteris paribus* induces investment especially in the agriculture sector which then encourages agricultural production and reduces food price inflation. A high interest rate discourages investment in the agriculture sector which then reduces agricultural production and spark high food price inflation.

A high consumer price index for food induces high inflationary pressure on headline inflation and is detrimental to economic growth. Ogbokor (2004) revealed that high food inflation rate *ceteris paribus* significantly reduced economic growth of Namibia. Alternatively, high food price inflation can act as incentive for food producers who are net sellers of food hence inducing them to over produce and supply the food market. However in the case of PNG as discussed above, the country is a net importer of food which means that increase in food prices will surely induces inflationary pressure on the economy.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

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[5] Semi-food products refer to the import of commercial food ingredients such as wheat used in baking finished products such as breads, cakes, pies, et al.

In this chapter, various test results were presented. Firstly the result of the unit root test on each variables outlined the stationarity of the time series variables. The cointegration test proved the existence of long run relationship between the variables and finally, the vector error correction model will be used to estimate the impact of food inflation on the economy of PNG.

4.1 Results of Test Statistics.

4.1.1 Unit Root Test

In this section, the stationarity of each variable is tested using the Augmented Dickey-Fuller (ADF) test. The results of the test is illustrated in table 1 below. The test-statistics for each variable together with its corresponding p-values at level and first differenced at 5 percent (%) critical value is reflected below.

The null hypothesis in this test is that all variables have unit root and are non-stationary. While the alternative hypothesis is that the variables do not have unit root and are stationary. The number of lags were selected by Akaike Information Criterion.

Table 1: Unit Root Test Results for variables in Objective One – Factors affecting food inflation in PNG

Variable	Test Statistic		P-Value (5% critical value)		Order of Integration
	ADF^c	ADF^d	P-value^c	P-value^d	
Food CPI	-1.933	-3.452	-3.600	-3.600	I(1)
Exchange Rate	-4.352	-4.986	-3.600	-3.600	I(0)
Money Supply	-1.731	-2.860	-3.600	-3.600	I(1)
Interest Rate	-4.056	-4.835	-3.600	-3.600	I(0)
Wheat	-3.482	-4.093	-3.600	-3.600	I(1)

Note: ADF^c depicts unit root test in its level while ADF^d represents unit root test for differenced variables. The p-value^c for level at 5% crtitcal value is -3.600 and the p-value

The results for the unit root test above illustrated that the yearly exchange rate and interest rate variables do not have unit root at level and are stationary. The yearly food cpi, money supply and wheat are non-stationary and have unit root at level but when applying the first differencing, the variables are stationary and do not have unit root.

Table 2: Unit Root Test Results for variables in Objective Two – Factors impacting PNG economy

Variable	Test Statistic		P-Value (5% critical value)		Order of Integration
	ADF^R	ADF^S	P-value^R	P-value^S	
Real GDP	-2.939	-2.965	-3.600	-3.600	I(1)
Exchange Rate	-4.892	-3.609	-3.600	-3.600	I(0)
Interest Rate	-2.826	-3.310	-3.600	-3.600	I(1)
Food CPI	-1.584	-3.377	-3.600	-3.600	I(1)

Note: ADF^R depicts unit root test in its level while ADF^S represents unit root test for differenced variables. The p-value^c for level at 5% crtitcal value is -3.600 and the p-valued for differenced variables at 5% critical value is also -3.600. While the p-value for level and p-value for differenced variable at 1% critical value is -4.380

The results for the unit root test above illustrated that the yearly real gross domestic product, interest rate, and food consumer price index have unit root and were not stationary. When applying the first differencing, the variables were

stationary and do not have unit root. The exchange variable do not have unit root at

level and is stationary.

4.1.2 Test of Cointergration

Table 3: Johansen Test for Cointegration – Factors affecting food inflation in

PNG

Trend:	Constant				Number of Obs= 10
Sample:	2002-2011				Lag=1
maximum Rank	parms	LL	eigenvalue	trace statistics	5% critical value
0	6	-194.28548	-	1010.0055	94.15
1	17	-24.141733	1.00000	669.7180	68.52
2	26	143.44789	1.00000	334.5388	47.21
3	33	290.58918	1.00000	40.2562	29.68
4	38	306.21427	0.95606	9.0060	15.41
5	41	309.53187	0.48497	2.3708	3.76
6	42	310.71728	0.21107		
maximum Rank	parms	LL	eigenvalue	max statistic	5% critical value
0	6	-194.28548	-	340.2875	39.7
1	17	-24.141733	1.00000	335.1792	33.46
2	26	143.44789	1.00000	294.2826	27.07
3	33	290.58918	1.00000	31.2502	20.94
4	38	306.21427	0.95606	6.6352	14.07
5	41	309.53187	048419	2.3708	3.76
6	42	310.71728	0.21107		

Note: The result of the Johansen Test of Cointegration illustrated by the trace statistics and max statistics at 1010.0055 and 340.2875 respectively and at 5 percent critical value reflected that there is cointegration or association among the variables as the value of the trace statistics and max statistic are greater than the 5% critical value.

Therefore the above result in table 3 illustrated that the variables are

cointegrated so it is possible to conduct a Vector Error Correction Model to examine

the determinants of food inflation in PNG.

Test of Cointegration was also conducted on the variables that impact the economic growth of PNG to establish the association (causality) of the variables or the long run relationship.

Table 4: Johansen Test for Cointegration – Factors impacting PNG Economy

Trend:	Constant				Number of Obs= 10
Sample:	2002-2011				Lag=1
maximum Rank	parms	LL	eigenvalue	trace statistics	5% critical value
0	4	-88.790582	-	81.5977	47.21
1	11	-65.712235	0.99010	35.4410	29.68
2	16	-50.269222	0.95443	4.5550	15.41
3	19	-48.049428	0.35851	0.1154	3.76
4	20	-47.991724	0.01147		
maximum Rank	parms	LL	eigenvalue	max statistic	5% critical value
0	4	-88.790582	-	46.1567	27.07
1	11	-65.712235	0.99010	30.8860	20.97
2	16	-50.269222	0.95443	4.4396	14.07
3	19	-48.049428	0.35851	0.1154	3.76
4	20	-47.991724	0.01147		

Note: The result of the Johansen Test of Cointegration illustrated above by the trace statistics and max statistics at 81.5977 and 46.156 respectively and at 5 percent critical value reflected that there is cointegration or association among the variables as the value of the trace statistics and max statistic are greater than the 5% critical value.

The results in table 4 above indicated that the variables are cointegrated hence a Vector Error Correction Model can be employed to examine the factor impacting the economy of PNG.

The overall results for the two Johansen test of cointegration illustrated that the yearly rate of change in natural logarithm for consumer price index for food and each explanatory variables were cointegrated. Also the yearly rate of change in natural logarithm for economic growth and each explanatory variables were also cointegrated.

4.2   Estimation of Error Correction Model

The first Vector Error Correction Model (VECM) was employed to estimate the determinants of food inflation in PNG using STATA. Since PNG is a net importer of food and a price taker, the variables used in this model reflected the level and size of the economy from a macroeconomic perspective. The time series variables are consumer price index for food (CPI), real exchange rate (RER), money supply (MS), real interest rate (RIR) and international wheat price (WP). Apart from the endogenous variables, wheat price as an exogenous variable is determined outside of the country and any volatile price fluctuations will certainly have a corresponding and significant impact on food price inflation in PNG.

Table 5: Vector Error Correction Model – Factors affecting food inflation in PNG

Variable	Coefficient	z	P-value
Constant	1.727648	0.35	0.724
Food CPI	-1.141176	-0.69	0.490
Real Exchange Rate	25.9656	1.20	0.230
Money Supply	-0.243287	-0.82	0.411
Real Interest Rate	-0.1987773	-0.28	0.776
Wheat Price	0.0468249	0.71	0.477
Error Correction Term	-0.2466287	-0.29	0.773

According to the results, the coefficient of the error correction term is negative hence implying that there is a long run relationship (causality) between the variables real exchange rate and wheat price which significantly influenced food price inflation in PNG. There is a negative relationship between money supply and interest rate which negatively impacted food price inflation in the country.

In the short run, real exchange rate, money supply, real interest rate and wheat price do not significantly affect food inflation as their corresponding p-values are greater than five percent (5%) critical value.

Table 6: Vector Error Correction Model – Factors impacting the economy of PNG

Variable	Coefficient	z	P-value
Constant	1.752413	2.44	0.015
GDP	3.28779	1.19	0.234
Real Exchange Rate	11.30929	1.46	0.144
Real Interest Rate	0.0469842	0.56	0.575
Food CPI	-0.021296	-0.13	0.896
Error Correction Term	-7.554654	-1.45	0.146

According to the coefficient of the error correction term, there is a long run positive relationship or causality between GDP, real exchange rate, real interest and food price inflation. However, food inflation has a negative relationship with Real GDP in the long run.

Therefore the overall findings of the study using the vector error correction model estimates implied that food price inflation is caused by long run relationship among the study variables and food inflation has a long run relationship with real GDP.

4.3   Diagnostic Test

Various tests were conducted to ensure the validity of results and to verify the required statistical properties of data used in the models. Test of Normality using the Kolmogorov-Smimov and Shapiro-Wilk test, Heteroskedasticity using Hettest test,

test of specification of the models using the Ramsey RESET and test of multicollinearity. Firstly, diagnostic tests will be conducted for Model One (Factors affecting food inflation in PNG) and follow on with the diagnostic tests for Model Two (Factors impacting the Economy of PNG).

4.3.1 Model One – Error Correction Model (Factors affecting food inflation in PNG)

Test of normality is used to verify the normality of the variables using SPSS. The test evaluate the normality of the data using their Skewness and Kurtosis and calculating their respective z-values. It was noted that the z-values for each explanatory variables are within the -1.96 to 1.96 bound. Therefore it can be concluded that regarding the skewness and kurtosis, the data (RER, MS, RIR & WP) are little skewed and kurtotic but do not differ significantly from normality. Refer to Appendix A for detailed calculations of z-values and descriptive. Furthermore, using SPSS the Kolmogorov-Smimov and Shapiro-Wilk test were conducted and the result is illustrated in Table 7 below. The Null hypothesis for these tests is that the data are normally distributed. The Null hypothesis is rejected if the p-value is below 0.05. In the SPSS output, the p-value is labelled at "Sig". Hence in both tests the p-value for RER, MS, RIR and WP are above 0.05 p-value which means that the Null hypothesis is not rejected. So it can be concluded that the data are approximately normally distributed.

Table 7: Test of Normality (Factors affecting food inflation in PNG)

Note: Results from SPSS:

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
RER	.123	11	.200[*]	.980	11	.967
MS	.135	11	.200[*]	.974	11	.921
RIR	.229	11	.111	.904	11	.204
WP	.227	11	.117	.874	11	.086

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 15: Test of Heteroskedasticity (Factors affecting food inflation in PNG)

Note: Results from STATA:

- hettest rer ms rir wp

Breusch-Pagan / Cook-Weisberg test   for   heteroskedasticity

Ho: Constant variance

Variables: rer ms rir wp

chi2(4)   =   2.91

Prob > chi2 = 0.5727

The Breusch-Pagan test of heteroskedasticity above is a chi-squared test and it test the Null hypothesis of homoskedasticity. If the chi-squared value is significant with a p-value below 0.05, then the Null hypothesis of homoscedasticity is rejected and the model is assumed to have heteroscedasticity. In the case of this model, the p-value is 0.5727 which is above the threshold of 0.05, hence the Null hypothesis is accepted, meaning that there is no heteroskedasticity in the model.

Figure 16: Ramsey RESET Test (Factors affecting food inflation in PNG)

Note: Results from STATA:

- ovtest

Ramsey RESET test   using powers of the fitted   values   of   cpi

     Ho: model   has no omitted variables

        $F(3, 3) =$ 0.88

        Prob > F =   0.5404

The Ramsey RESET Test above is an F-test which is employed to test whether a multiple regression model suffers from functional form misspecification when it does not properly account for the relationship between the dependent and observed explanatory variables (Tastan, 2012). The Null hypothesis of RESET test is that the model is correctly specified. However if the p-value of the F-test is lower than 0.05

critical value, then the Null hypothesis is rejected meaning that the model is suffering from a functional form misspecification. The results from the RESET test for this model indicated that the Null hypothesis is accepted as the p-value of 0.5404 of the F-test is greater than the 0.05 critical value as illustrated above. Hence, it can be concluded that the model is correctly specified.

Table 8: Multicollinearity Test (Factors affecting food inflation in PNG)

Note: Results from SPSS:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.910^a	.827	.712	2.48021

a. Predictors: (Constant), WP, MS, RIR, RER

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-15.771	17.519		-.900	.403		
	RER	6.309	4.057	.596	1.555	.171	.196	5.111
	MS	-.226	.087	-.613	-2.589	.041	.514	1.946
	RIR	.018	.178	.021	.100	.924	.672	1.487
	WP	.030	.017	.650	1.752	.130	.209	4.790

a. Dependent Variable: CPI

The table 10 above test the model for multicollinearity to verify if two or more predictor variables in the model are highly correlated. The model has a large R Square value of 0.827 which means that it is nicely fitted and based on the coefficients output under the collinearity statistics, the VIF values for all independent variables (RER, MS, RIR and WP) is between 1 to 10. Therefore it can be concluded that the model is not suffering from multicollinearity symptoms.

4.3.2 Model Two – Error Correction Model (Factors impacting the Economy of PNG).

Similar to 4.3.1, diagnostic tests used in Model One is employed to ensure the validity of model two. Refer to table 11 below for the results of the test statistic.

Table 9: Diagnostic Test for Error Correction Model (Factors impacting the Economy of PNG

Test	Model Two			
Variables	Normality (Shapiro-Wilk test)	Heteroskedasticity (Breusch-Pagan test)	Model Specification (Ramsey RESET Test)	Multicollinearity
RER	Statistic: 0.977 p-value: 0.944	chi2(3): 1.00 p-value: 0.8013	F(3, 4): 0.25 p-value: 0.8583	VIF: 1.114
RIR	Statistic: 0.903 p-value: 0.198	One result for all Variables (as above)	One result for all Variables (as above)	VIF: 1.002
CPI	Statistic: 0.938 p-value: 0.501	One result for all Variables (as above)	One result for all Variables (as above)	VIF: 1.114

In summary, the diagnostic test results for the two models respectively indicated that the models were stable with normal distribution and no heteroscedasticity. The models do not suffer from functional form misspecification which imply that the models were correctly specified, the error term had constant variance and there is no indication of multicollinearity conditions.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1   Summary and Conclusion.

This paper analysed the determinants of food inflation in PNG using various statistical techniques with secondary data obtained from BPNG, World Bank, FAO, ADB and IMF. An estimated error correction model was employed and revealed that real exchange rate and wheat price significantly influenced food price inflation in PNG. As PNG is a net food importer and a price taker, any appreciation or depreciation in the Kina exchange rate will have drastic effect on food prices as most food products are tradeables hence there is high tendency of food price transmission to the domestic economy. Moreover, wheat prices including prices of other food products are exogenous variables and are determined outside of PNG. Any commodity price shift such as an increase in the global market price for wheat will certainly affect food price inflation in PNG.

Food inflation has a long run relationship or causality with real GDP of PNG. According to the study, GDP is affected by various variables including food inflation. It is now obvious that food inflation is the main determinant that exerted underlying inflationary pressure on headline inflation during the time periods 2001 to 2011. Now and into the foreseeable future, PNG's inflation rate will be subjected to constant underlying inflationary pressure emanating from food inflation as food and food products are tradeables and are susceptible to global commodity price fluctuations. PNG's economic growth (real GDP) is certainly affected by food price inflation as the economy is a price taker and is dependent on food imports. Food price inflation has the potential to derail future economic growth through its

underlying inflationary pressure on headline inflation and the overall consumer price index.

5.2   Policy Recommendation

The study results revealed that food inflation is a significant determinant exerting underlying inflationary pressure on headline inflation in PNG. Food inflation is mostly caused by the appreciation (depreciation) of Kina exchange rate and imported food and food items as illustrated by the variables real exchange rate and wheat price.

Therefore at the strategic level, there is a need to review the Food Security Policy of PNG taking its alignment from the PNG Vision 2050, PNG National Security Policy, Monetary and Fiscal Policies, the Social Protection Policy, Transport Security Policy and other relevant policies on food in the country. At the sectoral level, the PNG government should consider reviving the Agricultural Extension Program which was vibrant in the early years of Independence (1975) which resulted in farmers producing quality food produce and cultivating cash crops for generating income hence ensuring food security in their respective household. Better and reliable communication platforms and improved road network around the country is vital for communication and transportation of food from the food producing regions (surplus food) to the main towns and cities (urban centres) where food is scarce and the demand for food is high.

At the macroeconomic level, the government should limit food imports and encourage PNG food manufacturing companies to mass produce food that are produce outside of the country which are on high demand in PNG. The role of the

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PNG Manufacturing Council should be enhanced with appropriate mandates and adequate resources and funding in order to provide leadership and oversight mechanism for food production in the country. Alternatively, prudent management of monetary and fiscal policy by BPNG and the PNG government is necessary to control headline inflation and subsequently curb international food price transmission in the domestic economy. Diversification of economic portfolios away from the traditional extractive sector is essential to cushion the economy from any global economic boom and bust situation and insulate the PNG economy.

5.3   Suggested Area of Further Research

The study revealed that food inflation and its impact on the economy is a cause for concern as PNG is a price taker and a net food importer. Further areas for studies should explore food diversification and high food prices in the domestic economy, the effects of economic food security on social protection and national security of PNG and effects of increasing population and living standards on food insecurity in PNG.

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Appendix

A. Descriptives (Factors affecting food inflation in PNG)

Descriptives

			Statistic	Std. Error
RER	Mean		3.0682	.13178
	95% Confidence Interval for Mean	Lower Bound	2.7745	
		Upper Bound	3.3618	
	5% Trimmed Mean		3.0608	
	Median		3.0600	
	Variance		.191	
	Std. Deviation		.43708	
	Minimum		2.37	
	Maximum		3.90	
	Range		1.53	
	Interquartile Range		.67	
	Skewness		.393	.661
	Kurtosis		-.006	1.279
MS	Mean		16.1200	3.77968
	95% Confidence Interval for Mean	Lower Bound	7.6984	
		Upper Bound	24.5416	
	5% Trimmed Mean		15.9983	
	Median		14.7900	
	Variance		157.146	
	Std. Deviation		12.53577	
	Minimum		-4.45	
	Maximum		38.88	
	Range		43.33	
	Interquartile Range		20.53	
	Skewness		.300	.661
	Kurtosis		-.302	1.279
RIR	Mean		5.4727	1.62019
	95% Confidence Interval for Mean	Lower Bound	1.8627	
		Upper Bound	9.0827	
	5% Trimmed Mean		5.2525	
	Median		5.7100	

	Variance	28.875	
	Std. Deviation	5.37357	
	Minimum	-.64	
	Maximum	15.55	
	Range	16.19	
	Interquartile Range	7.66	
	Skewness	.726	.661
	Kurtosis	-.501	1.279
WP	Mean	226.00	30.167
	95% Confidence Interval for Mean Lower Bound	158.78	
	Upper Bound	293.22	
	5% Trimmed Mean	219.61	
	Median	199.00	
	Variance	10010.600	
	Std. Deviation	100.053	
	Minimum	119	
	Maximum	448	
	Range	329	
	Interquartile Range	86	
	Skewness	1.301	.661
	Kurtosis	1.404	1.279

Note:

Consider the individual Skewness and Kurtosis of the data used. The z-values calculated for RER, MS, RIR and WP should be within the lower and upper bound of -1.96 to 1.96.

a) Calculate z-value for RER

Skewness = 0.393/0.661 = 0.594

Kurtosis = -0.006/1.279 = -0.0046

b) Calculate z-value for MS

Skewness = 0.300/0.661 = 0.453

Kurtosis = -0.302/1.279 = -0.236

c) Calculate z-value for RIR

Skewness = 0.726/0.661 = 1.098

d) Calculate z-value for WP

Skewness = 1.301/0.661 = 1.968

Kurtosis = 1.404/1.279 = 1.097

Kurtosis = -0.501/1.279 = -0.391

Therefore it can be concluded that regarding the skewness and kurtosis, the data (RER, MS, RIR & WP) are little skewed and kurtotic but do not differ significantly from normality.

B.   Descriptives (Factors impacting the Economy of PNG)

Descriptives

			Statistic	Std. Error
RER	Mean		3.082	.1313
	95% Confidence Interval for Mean	Lower Bound	2.789	
		Upper Bound	3.374	
	5% Trimmed Mean		3.074	
	Median		3.100	
	Variance		.190	
	Std. Deviation		.4355	
	Minimum		2.4	
	Maximum		3.9	
	Range		1.5	
	Interquartile Range		.7	
	Skewness		.399	.661
	Kurtosis		-.111	1.279
RIR	Mean		5.473	1.6224
	95% Confidence Interval for Mean	Lower Bound	1.858	
		Upper Bound	9.088	
	5% Trimmed Mean		5.247	
	Median		5.700	
	Variance		28.954	
	Std. Deviation		5.3809	
	Minimum		-.6	
	Maximum		15.6	
	Range		16.2	
	Interquartile Range		7.7	
	Skewness		.729	.661
	Kurtosis		-.492	1.279
CPI	Mean		6.836	1.3921
	95% Confidence Interval for Mean	Lower Bound	3.734	
		Upper Bound	9.938	

5% Trimmed Mean	6.729	
Median	6.900	
Variance	21.319	
Std. Deviation	4.6172	
Minimum	.9	
Maximum	14.7	
Range	13.8	
Interquartile Range	8.6	
Skewness	.205	.661
Kurtosis	-1.159	1.279

Note:

Consider the individual Skewness and Kurtosis of the data used. The z-values calculated for RER, RIR and CPI should be within the lower and upper bound of -1.96 to 1.96.

    a) Calculate z-value for RER

       Skewness = 0.399/0.661 = 0.603

       Kurtosis = -0.111/1.279 = -0.086

    b) Calculate z-value for RIR

       Skewness = 0.729/0.661 = 1.102

       Kurtosis = -0.492/1.279 = -0.384

    c) Calculate z-value for CPI

       Skewness = 0.205/0.661 = 0.310

       Kurtosis = -1.159/1.279 = -0.906

Therefore it can be concluded that regarding the skewness and kurtosis, the data (RER, RIR & CPI) are little skewed and kurtotic but do not differ significantly from normality.