FOOD INFLATION IN INDIA: TRENDS AND DETERMINANTS

Dissertation Submitted to the Central University of Punjab

For the award of

Master of Philosophy

In

Economic Studies

By

Mumtaz Ahmed

Supervisor

Dr. Naresh Singla

Centre for Economic Studies
School of Social Sciences
Central University of Punjab, Bathinda

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CERTIFICATE

I declare that the dissertation entitled “FOOD INFLATION IN INDIA: TRENDS AND DETERMINANTS” has been prepared by me under the guidance of Dr. Naresh Singla, Assistant Professor, Centre for Economic Studies, School of Social Sciences, Central University of Punjab. No part of this dissertation has formed the basis for the award of any degree or fellowship previously.

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CERTIFICATE

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ABSTRACT

"Food Inflation in India: Trends and Determinants"

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Food Inflation has been persistently high in India during the past few years. Controlling food prices is one of the major tasks for the macroeconomic policy makers. The recent oil price hike and some natural calamities have increased food prices around the world. This study focuses on the identification of main determinants of food price inflation in India. Using the monthly data from January 2006 to December 2013, Johansen's cointegration technique has been applied to find out the long run relationships among food price inflation and its determinants like money supply, interest rate, exchange rate, crude oil, world food prices and rainfall. Empirical findings prove the long run relationships among food price inflation and its determinants. In the long run model, all determinants affect food inflation except the world food prices. Error correction model has also been used in order to comprehend the short run causality of food inflation determinants. The error correction term of error correction model turns out to be significant which further confirm the long run causality as well as the speed of convergence toward long run equilibrium, which has occurred due the short disturbance. In the short run only world food prices and crude oil coefficients and statistically significant at five percent level. Finally, the study suggests some policy implications such as reduced dependency of monsoon by improving the irrigation system, investment in agricultural inputs and shift of policy towards biofuel etc.

Mumtaz Ahmed Dr. Naresh Singla

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Mumtaz Ahmed

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LIST OF ABBREVIATIONS

S.No	Full form	Abbreviation
1.	Augmented Dicky Fuller	ADF
2.	Error Correction Model	ECM
3.	Error Correction Term	ECT
4.	Food and Agricultural Organisation	FAO
5.	Food Articles Price Indices	FAPI
6.	Gross Cropped Area	GCA
7.	Lagrange Multiplier	LM
8.	Broad Money	M3
9.	Mahatma Gandhi National Rural Employment Guarantee Scheme	MGNREGS
10.	National Sample Survey Organization	NSSO
11.	Nominal Effective Exchange Rate	NEER
12.	Ordinary Least Square	OLS
13.	Public Distribution System	PDS
14.	Purchasing Power Parity	PPP
15.	Regression Specification Error Test	RESET
16.	Reserve Bank of India	RBI
17.	United Nations Development Programme	UNDP

Chapter 1
Introduction

1.1 Background

Since the last decade, the world has experienced a rapid and substantial rise in the commodity prices particularly food and energy. This shock posed complex challenges for policy makers. This surge in global commodity prices of the past few years has presented a tremendous development challenge for South Asian countries. The large loss of income from the terms of trade shock has worsened macroeconomic balances, fueled rapid inflation, and hurt growth (Ahmed, 2008). In India also, persistent and high food inflation over the last few years has emerged as a major policy distress as it can potentially threaten the collective target for a 'higher, inclusive and sustainable' growth. Besides, the record production of food grains, the country is still experiencing high food inflation during the recent past. The available literature suggests that there are no everlasting drivers of food inflation. Rather, the underlying drivers have changed over time, the influence of one has declined and some new sources of price pressures have emerged (Subbarao, 2011). The increase in food prices in India was much lower as compared to sharp increase in the food global prices due to various measures. For example, cereal prices in India increased only 23 per cent as compared to global price increase of 150 per cent during 2005 to 2008 (Dev, 2011).

Food inflation is a global problem and hurt poor more than the rich. In a developing country like India, inflation tolerance is very low and food inflation is least tolerated because its contribution is large in the consumption expenditure of poor. Various surveys in India have claimed that food inflation is the most important concern for the poor as well as middle class people. According to the 61st round of NSSO, share of food in total consumer expenditure is 55 percent in rural areas and 42 percent in urban areas. Food inflation is a serious challenge for Indian population as 32.7 per cent of the population live below the international poverty line of US$ 1.25 per day (PPP), while 68.7 per cent live on less than US$ 2 per day during 2010 (World Bank, 2010a; 2014). As per the latest data provided by United Nations Development Programme 29.8 per cent of the population live below the national poverty line during 2012 (UNDP, 2013). A steady rise in food

prices in India has greater impact on the living standard of the poor and fixed income groups of the society particularly in urban areas. Food prices have increased the living cost of household's especially in developing countries like India, which results in malnutrition and, therefore, productivity losses (Abdullah and Kalim, 2012).

Food inflation in Indian is a very intricate phenomenon of many factors explained by the various researches in the Indian context. Some causes of food inflation in India were similar to that cause global food inflation. One of the explanation for outstripping of food inflation globally as well as in India has been the supply shock due to drought (Heady and Fan, 2008; Chand, 2010; RBI 2010; World Bank 2010; Sharma *et al,* 2011). Food inflation is also considered as a purely monetary phenomenon in both developed as well in developing countries (Schuh, 1974; Chambers, 1984; Orden and Paul, 1989; Frankel, 1986; Saghaian *et. al.,* 2002; Siddiqui and Hye, 2010, 2010a; Khundrakpam and Das, 2011). These empirical researches have suggested that any change in monetary variables have real impact upon the agricultural prices, farmers' income and agricultural exports. Further, the responses of agricultural prices to a monetary shock are greater than the responses of non-agricultural prices. However, some domestic determinants of food inflation in India are quite different from the global food prices. Oil prices are also one of the most important determinants deriving the food inflation in India recently. Moreover, various institutional and structural factors are responsible for soaring food inflation such as inadequate storage infrastructure, constraints in importing, growing population and per capita income, changing dietary patterns, nature of the market etc. (Dev, 2011).

The identification of the sources of inflation is important for the conduct of monetary policy. When the inflationary pressure is dominated by adverse supply shocks, monetary policy could be less effective in containing price pressures (RBI, 2009). Food price inflation in India has been consistently higher than the non-food prices. Among the various reasons identified for the present inflationary situation in India, soaring food prices have received considerable national attention. Inflation in general and food price inflation in particular has been a persistent problem in India over the past few years. Price stability is crucial for sustainable growth as persistent inflation implies higher demand relative to supply. Food inflation in India has been a major challenge to policy makers, more so during recent years when it

has averaged 10 percent during 2008-09 to December 2012. Policymakers and administrators seem unable to bring food prices under control. Given the recent episodes of high inflation, it is important to investigate the primary drivers, (e.g. food, non-food etc) of inflation. From a policy perspective, to tackle inflation, it may, however not be sufficient to identify the sources only at a broad level, particularly in the context of a developing country like India. In India, both macro policies like monetary tightening by the RBI as well as commodity specific measures (e.g. trade policies and domestic interventions) are used to deal with inflation.

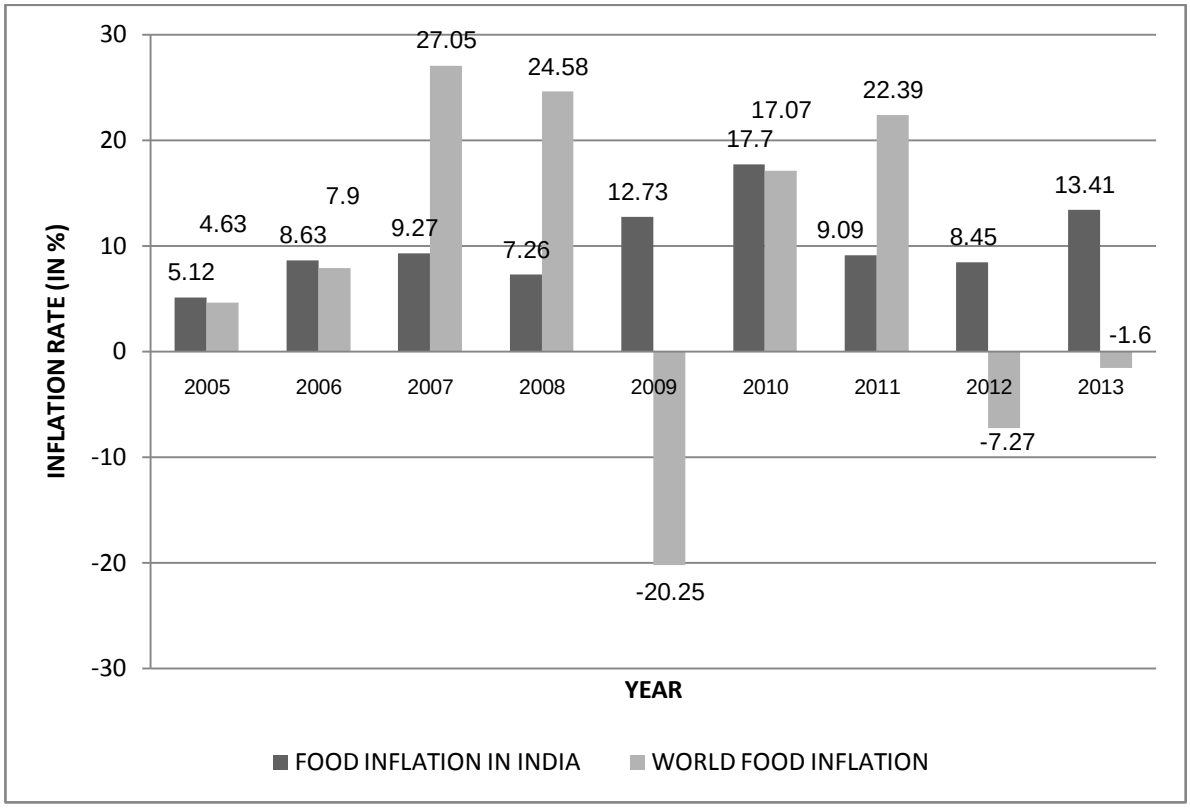
Understanding the nature and problems relating to food inflation in India is a complex task and warrants an in depth inquiry into the inter-linkages between various sectors and the related issues. Controlling food inflation is one of the foremost tasks for the policy makers as it is the major driver of the overall inflation in the Indian context (Chand, 2010; EPW Research Foundation, 2011; Nair, 2013).

1.2 Food inflation scenario: Global vs. Domestic

The global food prices have remained highly volatile during the last decade. Food prices in the global market recorded a dramatic increase in 2007 (25.33 percent) and then sharply declined in 2009 (-21.45 percent) amidst the global financial crisis. Again, the food prices started to increase in 2010 and crossed the 20 percent level in 2011 (Figure 1.1). During these years, south Asia also experienced relatively higher food inflation rate. Food inflation has been a major contributor to overall inflation in south Asia during past few years. For example during 2007-08, the average inflation in south Asia was 10 percent due to hike in food price (Carrasco and Mukhopadhyay, 2012). In India also, food prices are the major driver of overall inflation in the last few years. However, India's food inflation does not exactly follow global trend. Interestingly, when food inflation in India started creeping up from January 2008, food prices at the global level were already ruling high (Figure 1.1).

Figure 1.1

Food Inflation Scenario: Global vs. Domestic

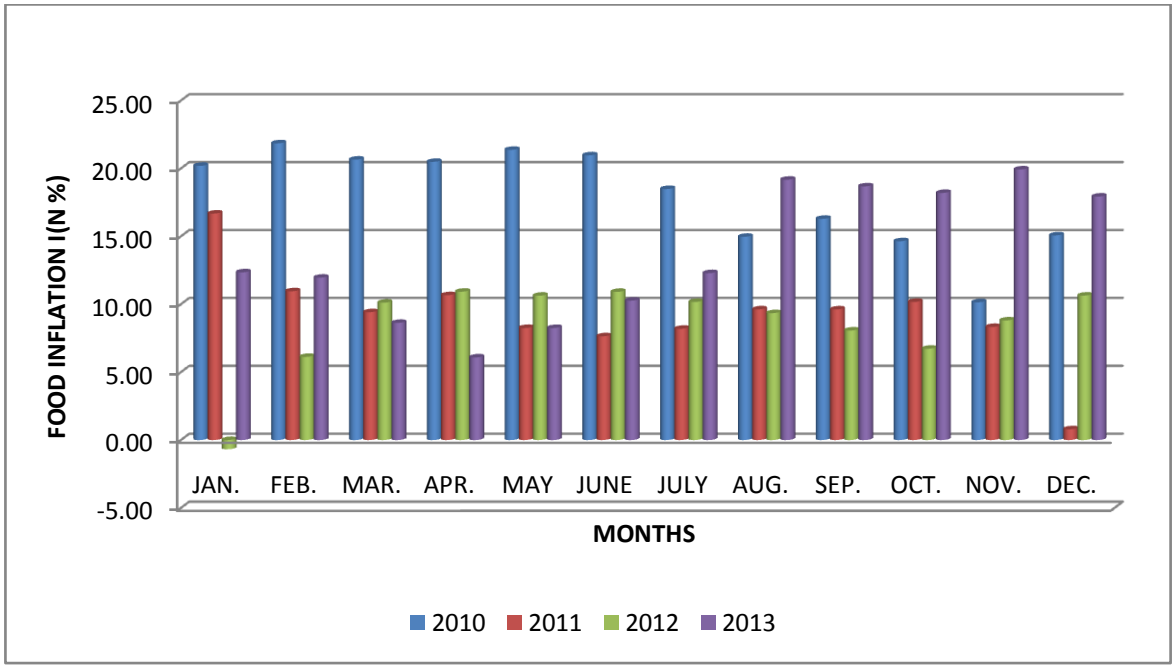


Source: Ministry of Commerce and Industry, 2014; FAO, 2014

Recently, India has also been struggling with high inflation in food items. Food (Primary) inflation in India started accelerating since 2006. During 2004-05, food inflation in India was at moderate level (around 5 percent). And it started accelerating since 2006 as it was 9.21 percent in January 2006 and crossed the double digits to 11.66 percent in January 2007 and further to 20.76 percent in December 2009. Annual average food inflation during the period 2006 to 2009 was more than 80 percent higher than inflation in non-food commodities. Inflation based on year-on-year wholesale price index (WPI) of primary food articles, is still ruling high at above 10 percent. Since the January 2010 up to December 2013, the monthly average food inflation was 12.19 percent which is higher than the level of moderate inflation (Figure1.2). At this rate of inflation, Indian consumer are required to spend about 12 percent more on food every month for the period of January 2010 to December 2013 (Figure 1.2). This consistently increase in food inflation is a serious challenge for the policy makers and administrators for a

developing country like India. The increase in prices is not restricted to a few commodities, and it is being experienced across the board (Chand, 2010).

Figure 1.2
Trend in Food Inflation from January 2010 to December 2013



Source: Ministry of Commerce and Industry, 2014

Current persistence episode of high food inflation beats all the past episodes of high persistence of 1970's, late 1970's to early 1980's and 1990's, during when average food inflation was stayed above 10 percent marks for 30 months, 26 months and 21 months respectively (Bandara, 2013). The recent spell of food inflation is larger in comparison of all that pales started increasing since 2006 and still ruling above 10 per cent (Figure 1.2). The Figure 1.2 shows the food inflation only for the four year, while the inflation since January 2006 has shown in the appendix A. From January 2006 to December 2013 the average food inflation was more than 10 percent level (Appendix A), despite the various steps (such as free import duties, ban on the export of pulses etc.) taken by the Government of India to control food inflation. But the growth in domestic agricultural production has stagnated around 3 per cent per annum that was a major constraint to control food inflation. Because the demand for food items has been persistently rising due to increasing population and the country is not still self-sufficient even in pulses and oilseed, although it has achieved sufficiency in food grains (Mohanty, 2013).

But recent hike is not restricted to food grains only, rather it hike due to demand for protein food. Protein-based items such as pulses, white milk, egg and meat and fruits have been contributing more to food inflation. Food articles, which include 55 commodities, have been showing fluctuation during the recent past. One item, however, whose price has never once dipped, keeps rising every year, is milk.

1.3 Justification of the study

The study covers for a period of 96 months starting from January 2006 to December 2013 to examine the major determinants of food inflation in India. Though there is enough literature available on the problem of food inflation in India and its causes and consequences, no research work has attempted to explain the simultaneously major determinants of food inflation. Further, the available literature on food inflation touches one or two aspects of food inflation problem, whereas the present study endeavors to study as many dimensions of food inflation as possible. The unique feature of the present work is that, in this study monthly data of all the variables has been used for the correct diagnosis of the problem. This study provides insights on economic determinants of food inflation and examines causality effects between food inflation rate and its determinants. The aim of this research is to investigate the determinants of food inflation in India by explicitly modeling food price index, applying error correction model.

1.4 Objectives

1. To examine the price trend of major commodities escalating food inflation in India.
2. To analyse the major factors that determine the food inflation in the long as well as short period in India.
3. To suggest suitable policy measures to overcome food inflation in India.

1.5 Hypotheses

To achieve the research objectives, the subsequent hypotheses formulated are:

1. Macroeconomic variables do not have any significant impact upon the food inflation in India.
2. Food inflation in India is adversely affected by hike in global food inflation.

1.6 Limitation of the study

The data set used in the analysis covered India only and as such, policy recommendations from the study results are only applicable to India. Limited number of variables were used in the analysis because of disaggregated secondary data were difficult to obtain. Food inflation in India is a very convoluted phenomenon and some of the structural factors, such as cold storage facility, nature of the market etc. also contribute to food inflation. Since it was very difficult to find the monthly data on structural factors for the analysis purpose these variables have been omitted from the study.

1.7 Organization of the study

This study comprises of five chapters including the introduction and conclusions of the study. The organization of the study is designed as follows: the background of food inflation in India, present scenario, significance and its effects on poverty are discussed in this chapter. The relevant literature on food price inflation at national and international level and its comparison with other emerging and developed countries is presented in the chapter two. Chapter three develops the econometric methodology used for its empirical estimation as well as the sources of data used for the purpose. Trends in food inflation and empirical results and their interpretation are discussed in the fourth chapter of the study. Summary and the main conclusions of the study are presented in the fifth chapter.

Chapter 2

Review of literature

A review of some of the important studies relating to the causes and determinants of food inflation is presented in this chapter. The review is grouped into four categories viz. (1) structural school of thought (2) monetarist school of thought (3) cross countries evidences regarding food inflation; and (4) country specific evidences of the determinants of food inflation. The effects of monetary determinants to food inflation were analyzed in the country-specific and multi-country studies.

2.1 Structural school of thought

One of the most competing schools is a 'structuralist school of thought'. This school emphasizes supply-side factors, such as food prices, administered prices, wages and import prices as determinants of inflation. It proposes that inflation in the long run can be explained by the differential rates in productivity growth, wages and elasticities of income and prices between the industrial and services sectors (Streeten, 1962; Olivera, 1964; and Baumol, 1967).

2.2 Monetarist school of thought

The monetarist school of thought has its theoretical foundations on the quantity theory of money, which is part of the classical economic theory, which explained that 'Inflation is always and everywhere a monetary phenomenon' is the famous statement of this theory. Monetarists refined this theory and restated increase in the money supply results in proportionate increases in the prices, and they assumed that economic agents were rational and output and real money balances were constant (Friedman 1968, 1970 and 1971; Schwartz, 1973).

2.3 Cross countries evidences regarding food inflation

Schuh (1974) analyzed the impact of exchange rate on agricultural prices in United States. The study found that overvaluation or undervaluation has real impact on the agricultural commodities. While linking the exchange rate with agricultural prices, the study explained when country currency was undervalued, it increased the external demand of the commodities resulting in increase in prices

and vice versa. It also impacted the rate at which new production technology was adopted as well as benefits of technical change between U.S. producers and consumers.

Frankel (1986) investigated the monetary determinants of commodities prices by employing the Dornbush's overshooting hypothesis. Dornbush in 1976 explained that monetary expansion overshoots the exchange rate and interest rate in short run. This study firstly expanded the Dornbush's hypothesis by including the third sector i.e. agricultural sector and then investigated the overshooting hypothesis. The result of this study explained that any decrease in the money supply would directly increase the interest rate which depressed the commodities prices. Further, the study concluded that the agricultural commodities were more flexible than industrial commodities. Agricultural commodities overshoot their long run equilibrium due to the increase in money supply.

Saghaian *et. al.,* (2002a) investigated the monetary impacts and overshoot hypothesis developed by Dornbusch by generalizing the Dornbush model to include agricultural sector. In the second step, Johansen cointegration test was employed to know long run cointegartion among macroeconomic variables. In addition, in the third and final step, vector error correction model was employed to investigate the overshooting of agricultural prices. The result of this empirical investigation showed that monetary policy had real impact on the price of commodities. Further, the result showed that the agricultural prices adjusted faster than the industrial prices to increase in money supply.

Saghaian *et. al.,* (2002) examined the impact of monetary policy on agricultural prices in four Asian economies. The study used the different econometrics approach to know the interaction among the money supply and agricultural prices. In the first step, the study used the Augmented Dickey Fuller Test to know the stationarity and in the second step, an application of Johansen Cointegration Test was made to know the long run relationship and finally, Vector Autoregressive Model was employed to know the interactive impact between monetary policy and agricultural prices. The result of the study claimed that out of four; in three Asian economies (Korea, Philippines, and Thailand except Indonesia), agricultural prices overshoot their long run equilibrium by the monetary expansion. Nevertheless, overshooting in these countries for agricultural prices was larger than the manufacturing prices. Furthermore, variance decomposition

was also employed which showed very strong relationship between agriculture and manufacturing prices in Thailand, whereas Indonesia and Philippines had minor relationship.

Bakucs and Ferto (2005) analyzed the monetary impacts and overshooting of agricultural prices in a transition economy. This study examined the overshooting hypothesis for the Hungarian agriculture employing a theoretical model developed by Shagaian *et. al.,* (2002). The study employed the Johansen cointegration technique and vector error correction model to determine the overshooting of agricultural prices. The result of the study indicated that agricultural prices were more flexible than industrial prices in the short run. However, the existence of three co-integration vectors amongst the Hungarian agricultural prices, industrial prices, exchange rate and money supply, proved the existence of a long-run equilibrium relationship between the variables.

Timmer (2008) studied the food inflation in the Asian economies for the period of 2000 to 2008. The result of this study diagnosed three major factors responsible for high food prices in developing countries. Firstly, rapid economic growth in China and India, put upward pressure on prices as demand simply outpaced supply. Secondly, sustained decline in the United States dollar since mid-decade added to the pressures on dollar-denominated international market prices. Finally, a combination of high and rising fuel prices coupled with legislative mandates to increase production of biofuels had established a firm link between petroleum prices and food prices.

Ali *et. al.,* (2010) identified the linkages between macroeconomic and agricultural variables using cointegration and correlation technique in Malaysian economy. In this study, a dynamics interaction was made among the agricultural export, gross domestic product, agricultural commodities prices, money supply, interest rate and exchange rate. The study found that the change in Malaysia's money supply and the interest rates had significant relationship to both agricultural income and exports. Further, the study found that the change in macroeconomic variables (particularly monetary variables) had significant impact on the agricultural sector.

Siddique and Hye (2010a) conducted an empirical study on money supply, exchange rate, industrial prices and agricultural product prices in case of Pakistan economy by employing Johansen cointegration technique and Vector error

correction model. The study found a long run relationship between money supply, exchange rate, industrial and agricultural product prices. The results of the Vector error correction model explained that there was greater variability in agricultural prices than the industrial prices due to the short run change in the money supply and exchange rate. Further, the study demonstrated that one percent increase in money supply caused to increase in 48 percent exchange rate, 59 percent industrial prices and 61 percent in agricultural product prices. The study also employed the rolling regression in order to find the impact of monetary variables in agricultural and industrial prices. The result of the rolling regression revealed that the depreciation of local currency was main reason to increase agricultural as well as industrial prices.

Apergis and Rezitis (2011) examined the food prices volatility and macroeconomics factors in case of Greece economy. The study concluded that there existed a positive effect between the deviations and food price volatility. An increase in price volatility implied greater uncertainty about future prices because the range in which prices might lie in future became wider. As a result, producers and consumers were affected by increased price volatility because it augmented the uncertainty and risk in the market. Increased food prices volatility could reduce the accuracy of producers and consumers' forecasts of future food prices, thereby causing welfare losses to both producers and consumers of food commodities.

Esmaeili and Shokoohi (2011) investigated the linkages of food prices and macroeconomic index of world food prices for the period of 1961 to 2005. The study used various techniques like principal component analysis, Scree test, proportion of variance method and correlation analysis in order to know the linkages of food prices and macroeconomic index especially the oil prices. The empirical results of the study found that the food production index had the greatest influence on the macroeconomic index and that the oil price index had an influence on the food production index. Consequently, crude oil prices had an indirect effect on food prices

Akinbobola (2012) conducted a study on the changing role of money supply, exchange rate and inflation on Nigerian economy. The study found that in short run, money supply led to inflation and where as it was not a case for long run, which implied that monetary policy had been the main causal factor to increase in prices in Nigeria. Exchange rate had no influence on inflation in

Nigerian economy. The evidence from the study showed that even the appreciation of exchange rate of Nigerian currency, the prices of both imported and domestic goods continued to rise. The study concluded that both monetary and fiscal policy must be well coordinated to prevent monetary expansion in Nigerian economy. Exchange rate had a little influence on inflation in Nigeria because it positively affected the inflation that is why exchange rate might not be the important factor of inflation determination in Nigeria. To attain the goal of price stability in Nigeria, study suggested reduced monetary growth as exchange rate depreciation and increase in money supply led to inflationary pressure.

Huh and Park (2013) examined the factors affecting food inflation in 11 Asian developing countries. The study specified the block autoregressive model and 10 variables classified into three blocks: world, region and country depending on their origin and nature. The regional block represented the Asian economy and included variables on Asian gross domestic product (GDP) and Asian food prices. The World comprised of oil prices, world GDP and world food prices. The country block comprised four domestic variables that could affect food price: (i) the exchange rate against the dollar, (ii) M1 money supply, (iii) real GDP per capita, and (iv) the domestic food price. Empirical evidence showed that the regional shock played a pivotal role in explaining the variations of domestic food prices, particularly at medium- to long-term horizons. Contrary to conventional belief, the World food price shock contributed little to the dynamics of domestic food prices.

2.4 Domestic evidences of food inflation

Sthanumoorthy (2008) conducted a study on nature of current inflation in food prices for the period of 1998 to 2008. The study used the tabulation analysis to explain nature and causes of food price inflation. The study revealed that out of various reasons, soaring food inflation was a major reason identified for the overall inflationary pressure. The study concluded that food products particularly manufactured food products were a major factor responsible for soaring food prices. The primary products (cereals, pulses) had little contribution in increasing food price inflation. Among the primary articles, non-food items caused more inflationary pressure than the food items. Further, the study also explained that among the manufactured products, oil cakes, edible oils and dairy products were

the major products responsible for soaring high food inflation in India. The major factor responsible for edible oil was high import in 2007 due to supply shock.

Chand (2010) made an attempt to understand the nature and causes of soaring food inflation by analyzing short and long run factors of food inflation. In the short run during 2009-10, food inflation was caused by supply shock, which in turn was due to the drought in 2009. In long run, food inflation was caused due to the slow growth of food items and increasing dependency on food. It was also found that due to high dependency on the food items, the average cost of food production had been consistently increasing in the long run. This suggested that food prices were controlled by the growth in food items. The study recommended some policy recommendations such as effective food management strategy, maintaining buffer stock, improvement in technologies for raising food production.

Dasgupta *et. al.,* (2011) examined the drivers of domestic wheat prices and its impact on food inflation in case of Indian economy for the period of 2000 to 2011. The study found that food prices started to ease after the drought in 2009. Reduced form model was used to estimate and forecast likely domestic wholesale wheat prices. The results of the study explained that the key role for wheat price soaring in India is the international price movement. although some domestic factors also have an important role in escalating the wheat and food prices, such as the level of physical wheat stocks in the Public distribution system (PDS), which indeed lowers market prices, and the effect of drought, which should raise domestic prices, as it indeed appears to.

Kumar *et. al.,* (2010) explained some structural and contingent factors of food inflation. The study found that the major factor that are responsible for increase in food inflation was declining per capita food availability due to decline in rainfall during the 2009 which not only caused a reduction in the net sown area, but also adversely affected yields. The study also identified some structural reasons for soaring food prices i.e. rising gap between per capita income and the resultant rise in demand for food products. The study recommended the urgent need for focused policy attention on improving the state of Indian agriculture. It also directed towards attracting more private investment, bringing in new technology and raising yields.

Sidique and Hye (2010) conducted a study on food prices and money supply in case of Indian economy for the period of 1971 to 2007 by using various

econometric techniques like Phillip-Perron unit root test, auto regressive distributed lag, cointegration technique and Granger causality test. The study adopted three steps to determine the direction of the causality. In the first step, order of integration was found by applying Phillip-Perron test. In the second step, cointegration technique confirmed the long run relationship between money supply and food prices. In the third step, empirical results of the Granger causality test showed bidirectional causality between money supply and food prices in the long run and unidirectional causality in case of short run from money supply to food prices.

Khundrakpam and Das (2011) investigated impact of monetary factors on food prices in India using various econometrics techniques. Relative response of food and manufacturing to changes in interest rate and money supply for the period of 2001Q1 to 2010Q2 were studied. The study employed the vector error correction model of five variables viz, food prices, manufactured prices, nominal effective exchange rates, weighted average call rate and money supply. The result of the vector error correction model explained that in the long run increase in the call rate (interest rate) led to increase in manufacturing prices only, while an increase in money supply led to increase in both the food as well as manufactured prices. However, in the short run monetary shock led to increase in both food as well as manufacturing prices. Further, the result of the study showed that food prices variability was greater than the manufactured prices to increase or decrease in monetary shock.

Sharma *et. al.,* (2011) analyzed the factors affecting the increase in prices of onion for the period of 2002 to 2010. This analysis showed different factors affecting the onion prices such as declining production of onion during 2009-10 due to bad weather conditions, resulting the increase in price. Although the time series trend showed significant increase in production of onion, but in 2009-10 and 2010-11, the production of onion declined due to the unseasonal rain in most of major onion producing states. However, this decline was partly recovered by marginally increase in other onion producing states and total arrival of the onion did not affect significantly in the all the major markets. But, after 2010, the increase in price of onion was due to hoarding of stock with the expectation of increase in prices.

Nair and Eapen (2012) analyzed causes of food price inflation in India for the period 2008 to 2010 by analyzing the commodity wise causal factors. The study revealed that the commodities such as pulses, fruits, vegetables, meat, fish, spices, tea, coffee and sugar had inflationary pressure due to the supply side constraint. Some other commodities such as milk and eggs exerted inflationary pressure due to the cost pull inflation. In addition, price escalation of rice was caused by the complex factors like hike in minimum support prices (MSP), surging buffer stock etc. The study found no evidence that the food inflation was caused by shift in consumption pattern toward the high-value agricultural products except the milk. The study also explained that the hike in world oil prices also caused the domestic food inflation. Further, the analysis examined that high cost of food import had a very little role in increasing in domestic food price inflation.

Bandara (2013) also carried out a study to know the causes behind soaring food inflation in India for the period of 2005 to 2012. The study analyzed the role of cyclical factors, structural factors, vitamin based product and distribution in food inflation. Among all the factors, increase in demand for vitamin-based products was identified as the major factor responsible for increase in food inflation. Increase in demand for vitamin based products was caused by the supply shock which in turn was caused by bad weather conditions.

Gulati and Saini (2013) examined the causes of increasing food inflation in India for the period of 2005 to 2012. The study found that demand pressures are building up fast on high value agri-products as consumption patterns shift from cereal based diets to fruits and vegetables and protein foods. It was also analyzed in this study that during 2005-06 to 2012-13, pressure on food articles price indices (FAPI) had mainly come from high value products, namely fruits and vegetables and protein products viz., milk, eggs, meat and fish. The cereal inflation was higher in initial years, but was subdued subsequently, only to re-emerge in 2012-13, purely because of sub-optimal food management. This structure of inflation during the last few years showed that with higher growth of the economy, demand pressures were building up fast on high value agro-products as consumption patterns shifted from cereal-based diets to fruits and vegetables and protein foods.

Kumari (2013) examined the food inflation scenario in India using tabular analysis for the period of January 2010 to March 2013. The study explained that in

many countries and regions, food price inflation was higher than aggregate inflation and contributed to inflationary pressures. It was also investigated that crisis of food inflation in 2011 was due to increase in global commodity prices and crude oil prices. To know causes of food inflation in India, the study argued that weakening dollars, domestic infrastructure and price stabilization policies were major causes to price escalation. The study suggested that import of food items and execution of open market sale by the government would help to reduce inflation not only by bridging the supply gap, but also by reducing speculative buffering.

Chapter 3
Data base and Methodology

3.1 Data Sources

The study is entirely based on secondary data. All the data are monthly in nature. All the relevant data have been collected from different secondary sources and utilized to test the hypotheses of the study. The data regarding monthly food prices index and crude oil index was culled out from official website of the Office of the Economic Adviser, Ministry of Commerce and Industry, Government of India for the period of January 2006 to December 2013. Data on nominal effective exchange rate, broad money and call rate was collected from the Handbook of Statistics on Indian Economy, Reserve Bank of India for the same period. Monthly world food prices index data was also used to cover impact of agricultural trade on food prices. This data was collected from Food and Agriculture Organization of United Nation for the same period. Finally, month-wise rainfall data were collected from the indiastat.com and Metrological Department.

3.2 Model Specification

The economic theory suggests that inflation is the results of the disequilibrium of market demand and supply conditions. The specification was assumed with the help of domestic as well as cross-countries evidences on food inflation which incorporates both demand and supply side determinants. The identified model consists of seven variables which hypothesize that food inflation is a function of money supply, interest rate, exchange rate, world food prices, oil prices and rainfall. However, correct diagnosis about the nature, structure and factors influencing food inflation, therefore, is critical for any rational policy decision.

Mathematically,

$$FI_t = F\ (CO_t, WFP_t, RF_t, M3_t, CR_t, ER_t)$$

Where, t shows the sample range which consists of 96 observations from January 2006 to December 2013. FI represents monthly food price index for the

period of 2006 to 2013, CO represents the oil price index, WFP represents the world food price index, RF is the monthly rainfall, M3 is broad money, CR is the interest rate on the short term loan and ER exchange rate.

3.3 Data Preparation and Analysis

Data collected from the different sources were edited, coded, entered into a computer and cleaned to ensure accuracy, consistency, uniformity and completeness. STATA, SPSS, E-views and Excel computer programs were used to analyze the data.

3.4 Analytical Methods

3.4.1 Unit root test

The general aim of the study is to apply cointegration and error correction regression among the time series in order to know the factors that derive food inflation in the long and short run respectively. Cointegration is most favored and widely used approach (Saghaian and Reed, 2002; Khundrakpam and Das, 2011). Before applying empirical cointegration tests, the Augmented Dicky Fuller (ADF) test was used to test the stationarity among the time series. Because Johansen cointegration regressions that have used in this study have some special properties, for example data must be integrated on the same order (Johansen, 1988). The main purpose of testing the unit root is to check the sufficiency of regression, for example if we treat the non-stationary time series with ordinary least square in the cointegration regression without converting it to the stationarity, the results will be insufficient for economic analysis (Philips, 1986). The model can lead to the problem of spurious regressions with very high R-squared (approximating unity) and significant t and F -statistics (Newbold and Granger, 1974).

Here advanced form of Dickey and Fuller test has been used to check the stationarity among the time series system. In the Dickey Fuller test, it was assumed that μ_t are uncorrelated. To avoid the problem that μ_t are correlated, Dickey and Fuller have developed another test known as “Augmented” Dickey Fuller test (ADF). This test is conducted by augmenting the preceding test by adding the lagged value of the dependent variable ΔY_t. The general framework of the ADF regression consists of the following equation (Gujarati, 2004).

$$\Delta Y_t = \beta_0 + \beta_1 t + \delta Y_{t-1} + \sum_{j=i}^{q} \beta_j \Delta Y_{t-j} + \varepsilon_t \quad \ldots (3.1.1)$$

Where,

$\Delta Y_t = Y_t - Y_{t-1}$

β_0 is the constant or drift

t is the time or trend variable

ε_t is the white error term

Where ε_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. The number of lagged difference terms to be include is often determined empirically, the idea being to include the enough terms so that the error term is serially uncorrelated so that we can obtain an unbiased estimate of δ, the coefficient of lagged Y_{t-1}.

The actual procedure of implementing the ADF test involves several decisions. In discussing the nature of the unit root process, we noted that a random walk process may have no drift, drift or both deterministic and stochastic trends. To allow for the various possibilities, the ADF test is estimated in three different forms, that is, under three different null hypotheses (Dickey and Fuller, 1981).

Model 1

Y_t is a random walk: $\Delta Y_t = \delta Y_{t-1} + \varepsilon_t \quad \ldots (3.1.2)$

If the time series fluctuates around a sample, average of zero we use the equation 3.1.2. The underlying study does not make use of this equation because the underlying series does not have mean zero.

Model 2

Y_t is a random walk with drift: $\Delta Y_t = \beta_0 + \delta Y_{t-1} + \sum_{j=1}^{q} \beta_j \Delta Y_{t-j} + \varepsilon_t \quad \ldots (3.1.3)$

If the time series fluctuates around a sample average that is non-zero, an application of equation 3.1.3 is appropriate. For example in our case, three variables viz. interest rate, exchange rate and rainfall fluctuates around a sample average, that is non-zero and the study made use of model two for all these three variables.

Model 3

Y_t is a random walk with drift around a stochastic trend:

$$\Delta Y_t = \beta_0 + \beta t_1 + \delta Y_{t-1} + \sum_{j=1}^{q} \beta_j \Delta Y_{t-j} + \varepsilon_t \qquad \ldots (3.1.4)$$

Similarly, if the time series fluctuates around a linear trend or if the trend is quadratic, then equation 3.1.4 is most appropriate. In order to achieve our objective, model three have been applied for four variables viz. food price index, crude oil index, world food index and money supply because they all fluctuate around a linear trend.

The existence of unit root for all the three equations is decided on the basis of following hypothesis:

H_0: $\delta = 0$ for non-stationary if $t_\delta \geq \tau$

H_a : $\delta < 0$ for stationarity if $t_\delta < \tau$

Where t_δ represents t statistic of δ and τ (tau) are critical values tabulated by Dickey and Fuller (1979).

There are several ways of choosing how many lags need to be added. The study used the ADF test via Eviews software which has property to include number of lags automatically. By interpretation, we compare test statistic with critical value, if the absolute value of t-statistic is less than the critical value, we accept the null hypothesis that series has unit root. On the other hand, if the test statistic is more than the critical value, we reject null hypothesis and accept the alternative hypothesis that series is stationary.

3.4.2 Johansen cointegration test (long run impacts)

The concept of cointegration was originated in the pioneering articles of the Granger 1981. Since then many have contributed to the development of theory and applications of cointegration (Engle and Granger, 1987; Johansen 1988; Johansen and Jesulis 1990). The Johansen cointegration is more popular and mostly useful technique than the other cointegration tests such as Engle and Granger, Autoregressive Distributed Lag techniques etc. One simple reason of its popularity is that it allows one to determine the number of cointegrated equations in case of multivariate system (Shahnoushi, *et.al,* 2009). In this study,

cointegration technique has been used as proposed by Johansen and Jesulius (1988, 1990) to find long run relationship among the concerned variables.

Johansen's methodology takes its starting point in the vector autoregression (VAR) of order p given by

$$Y_t = \mu + \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} + \ldots\ldots + \Pi_p Y_{t-p} + \varepsilon_t \qquad \ldots(3.2.1)$$

where Y_t is an nx1 vector (column vectors FI, CO, WFP, RF, M3, CR, ER) of variables that are integrated of order one commonly denoted I(1) and ε_t is an nx1 vector of innovations. While Π_1 through Π_p are n x n coefficient matrices.
The equation (3.2.1) contains the unit root and can be reparameterize that is subtracting Y_{t-1} on both sides, leads to

$$\Delta Y_t = \mu + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots\ldots + \Gamma_p \Delta Y_{t-p} - \Pi_p Y_{t-p} + \varepsilon_t \qquad \ldots(3.2.2)$$

Where, $\Gamma_1 = \Pi_1 - I$, $\Gamma_2 = \Pi_1 - \Gamma_1$, $\Gamma_3 = \Pi_2 - \Gamma_2$ and $\Pi = I - \Pi_1 - \Pi_2 - \ldots\ldots\ldots - \Pi_p$. The matrix Π determines the extent to which the system is cointegrated and is called the impact matrix. As all factors in this equation except Πy_{t-p} are clearly stationary if the variables are cointegrated, it means that also Πy_{t-p} must be stationary. Furthermore, every cointegration relationship has to appear in Π. Even more, their number is given by the rank of Π.

By allowing the trend term and rearranging the equation 3.2.2 leads to:

$$\Delta Y_t = \mu + \Pi_{t-p} Y_{t-p} + \sum_{i=1}^{m-1} \Gamma_i \Delta Y_{t-i} + \beta \mu_t + \varepsilon_t \qquad \ldots(3.2.3)$$

Where Y is a p-dimensional process and Π and the Γi's are p x p parameter matrices. μ_t contains deterministic terms such as a constant, a linear trend and seasonal dummies and β contains the parameters associated with μ_t, while ε_t is a p-dimensional vector of white noise components. The coefficients matrices $\Pi_{t-p} Y_{t-p}$ describe the long run dynamics of the vector Y_{t-p} while (i) Rank (Π) = n, i.e. the matrix Π has full rank, indicating that the vector process Y_t is stationary.

(ii) Rank (Π) = 0,i.e.the matrix Π is the null matrix meaning there is no cointegration among the system

(iii) 0 < rank (Π) = r < n implying that there are n x r cointgrating vectors

The heart of the Johansen procedure is simply to decompose Π into 2 matrices α and β both of which are n x r such that Π=αβ'. Since the system contains eight variables, of which two are cointegrated vectors when applied though Johansen maximum likelihood methods.

And so the rows of β may be defined as the r distinct cointegrating vectors and the rows of α show how these cointegrating vectors are loaded into each equation in the system.

If the (n×1) vector Y_t is cointegrated there may be 0< r < n linearly independent cointegrating vectors.

But question arises how to indicate the number of cointegrated equation? For the answer of this question Johansen (1988) suggested two statistics for testing the cointegrating vectors. viz. Trace statistic (J_{trace}) and maximum eigen value statistic (λ_{max}).

$$J_{trace} = -T \sum_{i=r+1}^{N} \ln(1 - \hat{\lambda}_i) \qquad \dots (3.2.4)$$

Where, T is the effective number of observations and $\hat{\lambda}_i$ is the estimated value for the ith ordered eigen value from the Π matrix. The standard approach to the Johansen ML procedure is to first calculate the Trace and Maximum Eigenvalue statistics, then compare these to the appropriate critical values. This test is based on the log-likelihood ratio and is conducted sequentially for *r* = *n*-1,...,1,0. The name comes from the fact that the test statistic involved is the trace (= the sum of the diagonal elements) of a diagonal matrix of generalized eigen values. This test tests the null hypothesis that the cointegration rank is equal to *r* against the alternative that the cointegration rank is *n*. The latter implies that Y_t is trend stationary.

$$\lambda_{max} = -T ln(1 - \hat{\lambda}_{r+1}) \qquad \dots (3.2.5)$$

This test is also based on the log-likelihood ratio and is conducted sequentially for r = 0,1,..,k-1. The name comes from the fact that the test statistic involved is a maximum generalized eigen value. This test tests the null hypothesis that the cointegration rank is equal to r against the alternative that the cointegration rank is equal to r+1.

3.4.3 Error correction model (short run dynamics)

Empirical regularities show that inflation in developing countries is highly volatile in nature compared to the advanced countries. To understand the determinants of food inflation volatility in India for the period of short-run, error correction model have been applied.

Since the model used time series data which mostly exhibit non stationarity; variables were differenced to eliminate built up of errors in pursuit of valid results (Gujarati, 2004). The long run or static models were estimated in order to obtain residuals. Johansen procedure was used to establish existence of the cointegrating vectors. Thereafter, an error correction model was estimated of the dependent variable (i.e. food prices) and independent variables. The basic structure of error correction model is as follows:

In empirical applications, it is often vital to establish that the variables are cointegrated. As emphasized above, cointegration can be related to the idea of variables trending together or bearing an equilibrium relationship to each other.

A second important task is to estimate the long run multiplier or the long run influence of X on Y or among the in which one is dependent and other is independent variables. Both cointegration testing and estimation of the long run multiplier can be done using the regression of Y on X. However, in some cases, one may be interested in understanding short run behavior in a manner that is not possible using only the regression of Y on X. In such cases, we can estimate an error correction model (Gujrati, 2004).

An important theorem, known as the Granger Representation Theorem, says that if variables are cointegrated, then the relationship between them can be expressed as an ECM. The error correction specification entails that the variables are I(1) and cointegrated. Then their first difference is I(0), and the ECM term is I(0), hence the error term is stationary. Thus, the spurious equation situation will no longer exist since all stochastic trends disappear (Koop, 2005).

The basic structure of an ECM

$$\Delta Y_t = \alpha + \beta_0 \Delta X_{t-1} + \beta_1 ECT_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots (3.3.1)$$

Where, Δ is the first differences and ε_t is the random error of the above regression model. Here EC is the error correction component of the model and measures the speed at which prior deviations from equilibrium are corrected. Error correction models can be used to estimate the following quantities of interest for all X variables.

- Short term effects of independent variables on dependent variable.
- Long term effects of independent variables on dependent variable (long run multiplier).
- The speed at which dependent variable returns to equilibrium after a deviation has occurred in independent variables (Koop, 2005).

Determinants of Food Inflation (Short Run)

To investigate factors that affect food inflation in the short run (objective 2), an error correction model of food inflation which incorporate both demand and supply factors was derived. It is assumed that the price level is driven by monetary variables. Food inflation is also influenced by other factors such as supply shocks induced by environmental shocks like adverse weather conditions (drought, floods), cost-push variables namely transport cost transmitted from oil prices, and other demand-pull variable i.e. increase in world food prices. To investigate factors that affect food inflation, error correction model of food inflation which incorporates short and long run impact was derived.

$$\Delta FP_t = \alpha + \lambda ECT_{t-1} + \sum_{i=0}^{n-1} \beta_{1,i} \Delta CO_{t-i} + \sum_{i=0}^{n-1} \beta_{2,i} \Delta MS_{t-i} + \sum_{i=0}^{n-1} \beta_{3,i} \Delta NEER_{t-i} + \sum_{i=0}^{n-1} \beta_{4,i} \Delta CR_{t-i} + \sum_{i=0}^{n-1} \beta_{5,i} \Delta WFP_{t-i} + \sum_{i=0}^{n-1} \beta_{6,i} \Delta RF_{t-i} + \varepsilon_t \quad \ldots (3.3.2)$$

Where,

$$ECT_{t-i} = FP_{t-1} - \beta_1 CO - \beta_2 MS - \beta_3 NEER - \beta_4 CR - \beta_5 WFP - \beta_6 RF$$

And α is the constant representing a linear trend, ∆ is usual denoted as first difference, ε_t is random error, and ECT_{t-l} is the error correction term which is derived from the long run cointegrating equation.

3.5 Diagnostic statistics

Necessary diagnostics statistics have been applied to check the autocorrelation, heteroscedasticity, regression specification and normality of the model. These few tests are discussed briefly below one by one.

3.5.1 Breusch-Godfrey Serial Correlation LM test

Breusch-Godfrey developed a test for autocorrelation in the errors of a regression model. In the applied econometrics, the test is used to check the presences of serial dependence that has not been included in a proposed model structure and which, if present, would mean that incorrect conclusions would be drawn from other tests, or that sub-optimal estimates of model parameters are obtained if it is not taken into account (Godfrey and Tremayne, 2005). In order to perform this test, the study makes use of the residuals from regression analysis, and derived the test statistics. We test the hypothesis against test statistic that there is no autocorrelation of any order up to *p.*

Consider a linear regression model as in our case of food inflation variable.

$$FP_t = \alpha + \beta_1 CO + \beta_2 MS + \beta_3 NEER + \beta_4 CR + \beta_5 WFP + \beta_6 RF + \varepsilon_t \quad \dots (3.4.1)$$

The study used the ε_t from this regression and test Breusch-Godfrey test hypothesis as follows .

$$\varepsilon_t = \alpha + \mu_1 \varepsilon_{t-1} + \mu_2 \varepsilon_{t-2} + \dots\dots + \mu_p \varepsilon_{t-p} + v_t \dots\dots\dots (3.4.2)$$

The logic of the test is as follows. Substituting the expression for ε_t into the regression equation yields the following (Gujrati, 2004).

$$FP_t = \alpha + \beta_1 CO + \beta_2 MS + \beta_3 NEER + \beta_4 CR + \beta_5 WFP + \beta_6 RF + \mu_1 \varepsilon_{t-1} + \mu_2 \varepsilon_{t-2} + \dots\dots + \mu_p \varepsilon_{t-p} + v_t \quad \dots (3.4.2)$$

Where, v_t is the white noise error term. Thus to test autocorrelation in ε_t, the study tested the null hypothesis that all coefficient of ε_t are equal to zero against the alternative hypothsis that they are not equal to zero.

$H_0 = \mu_1 + \mu_2 + \ldots\ldots + \mu_p = 0$

$H_1 + \mu_1 + \mu_2 + \ldots\ldots + \mu_p \neq 0$

3.5.2 Testing for ARCH Effects

The test for an ARCH effect was devised originally by Engle (1982) and is similar to the Lagrange Multiplier (LM) test for autocorrelation. It is also a residual based test in order to check the heteroscedasticity has not been included in a proposed model.

$$\varepsilon_t = \alpha_1 \varepsilon_{t-1} + \alpha_2 \varepsilon_{t-2} + \ldots\ldots + \alpha_p \varepsilon_{t-p} \ldots\ldots\ldots (3.4.4)$$

Where ε_t is the residual from the model and *p* lags are included in this secondary regression.

$H_0 = \alpha_1 + \alpha_2 + \ldots\ldots + \alpha_p = 0$

$H_1 + \alpha_1 + \alpha_2 + \ldots\ldots + \alpha_p \neq 0$

3.5.3 Ramsey's RESET Test of model specification

Ramsey has proposed a general test of error specification called RESET (regression specification error test). The study used the Ramsey test to know the model specification. Ramsey RESET applied on the error correction model to check the specification of model as follows.

$$FP_t = \alpha + \beta_1 CO + \beta_2 MS + \beta_3 NEER + \beta_4 CR + \beta_5 WFP + \beta_6 RF + \varepsilon_t \quad \ldots (3.4.5)$$

And obtain the estimation of FP_t as FP_i, i =1,2,3.. by OLS regression.

Return the above equation introducing in some form as an additional regressors. The additional regressors are $\widehat{FP}_2$ and $\widehat{FP}_3$.. This process creates the following regression model.

$$FP_t = \alpha + \beta_1 CO + \beta_2 MS + \beta_3 NEER + \beta_4 CR + \beta_5 WFP + \beta_6 RF + \delta_1 \widehat{FP}_2 + \delta_2 \widehat{FP}_3 + \varepsilon_t \quad \ldots\ldots (3.4.6)$$

After obtaining the estimated value of δ_1 and δ_2 the tests, test the hypothesis as follows

$$H_0 : = \delta_1 + \delta_2 = 0$$
$$H_0 : = \delta_1 + \delta_2 \neq 0$$

To test null hypothesis, Ramsey proposed the F- statistic using the R^2_{OLD} obtained from the equation (3.4.5) and R^2_{new} obtained from the equation (3.4.6) as follows

$$F = \frac{R^2_{New} - R^2_{Old} / \text{Number of new regressor}}{-R^2_{New} / \text{Numer of parameters in the new model}}$$

If the computed F value is significant, say, at the 5 percent level, one can accept the hypothesis that the model is mis-specified (Ramsey, 1969).

3.5.4 Jarque–Bera (JB) Test of Normality

The test for normality described here is referred to as the Jarqa–Bera test, after the two econometricians who developed it. Using the LaGrange multiplier or score test, on the Pearson distribution Jarqa and Bera developed a test for the normality of observation and regression disturbances and hence, known as Jarqa–Bera test (Jarque and Bera, 1987).

$$JB = n\left[\frac{skewness^{\,2}}{6} + \frac{(kurtosis - 3)^2}{24}\right]$$

Where n=sample size, S=skewness coefficient and K=kurtosis coefficient. For a normally distributed variable, skewness = 0 and kurtosis =3. Therefore, the JB test of normality is a test of the joint hypothesis that skewness and kurtosis are 0 and 3 respectively. In that case, the value of the JB statistic is expected to be 0 (Gujrati, 2004).

H_0 = residual are normally distributed

H_1 = residual are not normally distributed

If the computed p-value of the JB statistic in an application is sufficiently low, which will happen if the value of the statistic is very different from 0, one can reject the hypothesis that the residuals are normally distributed. But if the p-value is reasonably high, which will happen if the value of the statistic is close to zero, we do not reject the normality assumption.

Chapter 4
Results and Discussion

This chapter analyses trends in food inflation in India since January 2006 to December 2013. An attempt has also been made to understand the drivers of food inflation and factors influencing it. Various factors have been identified by reviewing the available literature, influencing the food inflation in India, such as monetary instrument, world food prices, crude oil, rainfall and other institutional and structural factors. Johansen cointegration technique and error correction model are applied to understand the long and short run impacts of major determinants of food inflation respectively.

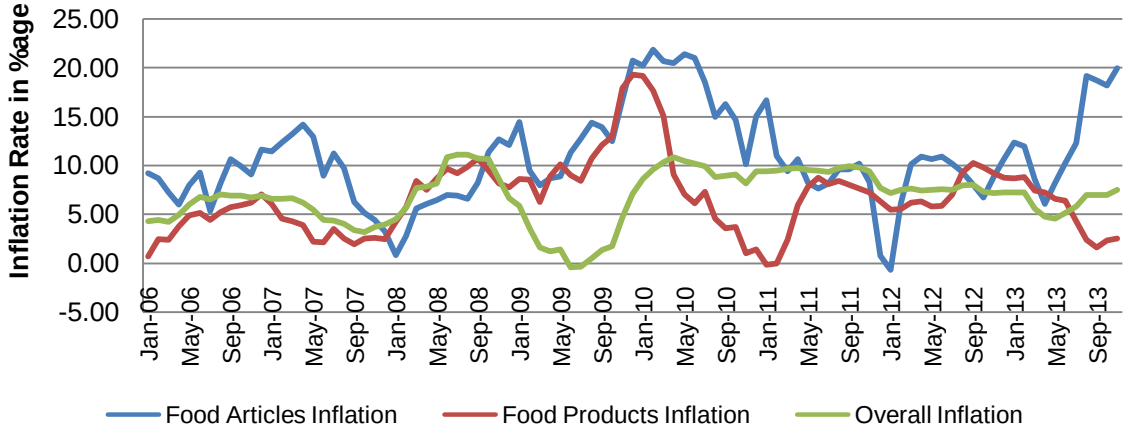
4.1 Trends in food and overall inflation

Food inflation has been a continuing entangle since the last decade. A correct diagnosis about the nature and structure of food inflation is critical for any rational policy. Average food inflation has been consistently higher than the headline inflation throughout the study period (Figure 4.1). The graph below shows the monthly movements of the wholesale inflation rate for all commodities, food articles and food products. It demonstrates that average food inflation has been higher than the headline inflation since the last decade. One of the most important worth noting points is that food inflation is caused by only food articles and not by food products. Literature in the Indian context shows the complex factors that derive the food inflation.

Food inflation is one of the leading factor that drive the overall inflation in India since the last decade. The analysis shows that it is food articles and not manufacturing food products, which are mainly responsible for the surge in inflation. Amongst major groups of inflation, primary articles inflation, y-o-y, increased to 14.19 percent on April 2007. This mainly reflected the increase in the prices of various food components, especially of wheat, rice, fruits and vegetables, milk, and eggs, fish and meat which could be attributed to higher demand, both domestic and globally (Figure 4.2). The significant role that supply side factors played in keeping inflation elevated was visible from the trends in food inflation below. From the December 2009 to June 2010, food inflation was more than 20 percent level which was caused mainly by drought of 2009 (Figure 4.1). Rupee

depreciation and an increase in crude oil prices led to a rebound of fuel inflation, resulting hike in food inflation during 2013. Inspite of these, recently during 2013 food inflation was very intricate phenomenon, which was contributed by various other institutional factors like hike in minimum support prices, procurement prices, and expansion of MGNREGS etc.

Figure 4.1
WPI Inflation Rate of Food Articles, Food products and Overall Inflation: January 2006 to December 2013



Source: Ministry of Commerce and Industry, 2014

The contribution of food products remains stagnant throughout the study period except few months from November 2009 to February 2010. This period witnessed high sugar prices, which contributed to surge in food inflation. Soon after surge in sugar prices during the initial months of 2010 due to supply shock, its prices subsequently started declining during the other months of 2010 and derive the food product inflation to a moderate level. In 2009, India exported around 65 lakh tonne of sugar. The government even granted subsidy for export of sugar, while in 2010 sugar inflation rises to 58.94 per cent resulting in sugar crisis (Mahanta, 2011).

The UPA government had initiated a number of steps to arrest the rise of food prices. These included removal of import duty on edible oils, extension of a ban on exports of pulses, duty-free imports of raw sugar and allowing state-run agencies to import zero-duty white sugar (Mahanta, 2011). These efforts of the government reduced the manufacturing food product inflation below moderate level during the second half of the 2010. However, inflation in food articles was

continuously higher due to various other factors which are discussed later in this chapter.

4.2 Components of food inflation

The study of various components of food inflation in India reveals that food inflation have outstripped during the past few years due to the shift of the consumption pattern of people from low value commodities to high value dietary products. Since January 2006, most of the time, pressure on Food Articles Price Indices (FAPI) has come from high value products, namely fruits and vegetables and protein products viz., milk, eggs, meat and fish etc. (Table 1). However, inflation rate of various components of food inflation, their price trend and weightage has shown in the appendix B.

The data regarding the consumption pattern as per the Economic Survey 2012-13 demonstrates that the share of protein foods within overall food expenditure increased from 26.28 per cent during 1950-60 to 33.71 per cent during 2007-2012. Table 1 shows that the 'Condiments and Spices' and 'other food articles' has relatively large contribution than other components in food inflation from 2006 to 2013. But, the weightage of these two components in measuring inflation is far lower than the other components. It is mandatory to mention that the weightage of food articles among all commodities is 14.33709. In a descending order, the weightage of fruits and vegetables is 3.84270 while that of cereals; milk; eggs, meat and fish; pulses, condiments and spices; and other food articles is 3.37323, 3.23818, 2.41384, 0.71662, 0.56908, 0.18347 respectively (Appendix 1.2). The weights have been assigned on the basis of entire wholesale transactions in the economy.

Consequently, protein foods and fruits and vegetables have increased faster than the other components of food inflation. But the Vegetables are perishable in nature and require infrastructure like cold storage etc. However, in case of these commodities, cold storage facility is virtually privately owned and the total cold storage capacity is about a quarter of food grain storage capacity. Inadequate cold storage facility and erratic power supply situation leads to higher wastages of such perishable items. This leads to inordinately high volatility in prices of perishable items.

Table 1
WPI-based Year-on-Year Inflation in Major Subgroups of Food Articles

Year	Cereals	Pulses	Fruits and Vegetables	Eggs, Meat and Fish	Milk	Condiments and Spices	Other Food Articles
2006	9.62	33.16	2.14	7.19	6.20	35.36	18.33
2007	10.04	4.11	14.52	4.95	6.02	14.87	5.13
2008	10.99	2.38	6.29	5.23	6.62	4.15	26.39
2009	12.53	18.14	8.85	14.85	14.32	12.84	19.78
2010	7.72	12.33	13.52	30.86	24.56	35.21	-8.37
2011	3.87	-1.81	13.80	11.49	9.55	9.10	16.38
2012	9.54	18.76	4.36	15.81	9.36	-16.23	12.48
2013	15.20	-1.41	23.82	13.27	4.96	12.08	-0.34

Source: Ministry of Commerce and Industry, 2014

4.3 Factors influencing food inflation

To understand the nature of inflation and the factor that influence it, the foremost step is to understand a relevant measure of food inflation. RBI suggests that change in wholesale prices is the best measure representing the overall picture of inflation (Mohanty, 2010; 2011). By following Mohanty 2011, the present study uses the change in wholesale prices index for the analysis purpose.

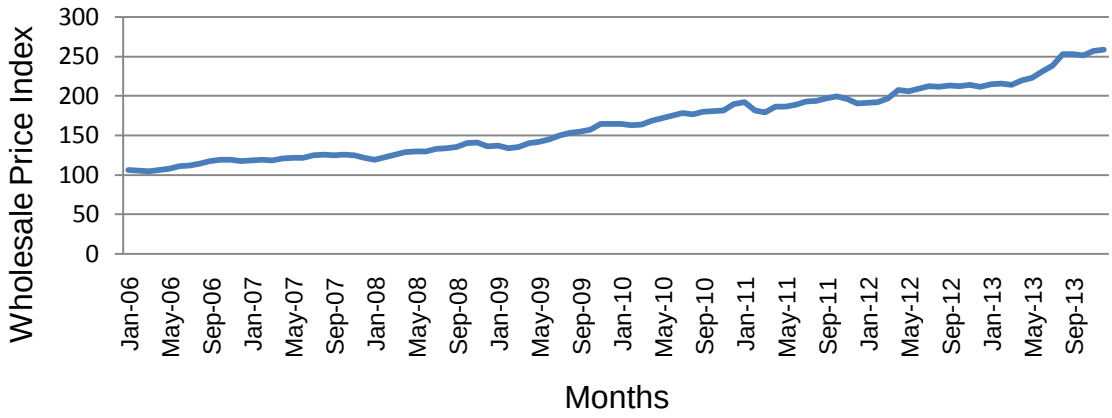
Food inflation in India is a very intricate phenomenon caused by various factors. A brief review of some of the studies present in the chapter second hypothesized differently due to the complexity of food inflation in India. In this study, an attempt has been made to understand the determinants of food inflation in India. The study analyzes the various factors, which are responsible for the surge in food inflation in India. Limited numbers of variables were used in the analysis because of the non-availability of secondary data. All the major variables with their impact on the food prices are discussed below one by one.

4.3.1 Wholesale Prices Index (WPI) of food

The wholesale prices index of food articles consisting of 69 commodities is used to determine the trend and causal relationship with other macroeconomic variables. It is worth noting here that the above series does not include the food products (manufactured food products) because their contribution in food inflation

remains stagnant during the study period (Figure 4.1). Among the various measures of inflation (Wholesale Price Index, Consumer Price Index, GDP Deflators), whole prices index have been used because RBI suggests that WPI is the best measures representing the overall picture of inflation (Mohanty, 2011).

Figure 4.2
Monthly Movement of Wholesale Price Index of Food Articles from January 2006 to December 2013



Source: Ministry of Commerce and Industry, 2014

The graphics analysis has been used as proxy for raw data because it may be complicated to visualize the simply raw data that what the data is showing? The above Figure 4.3 represents the wholesale price index movement of food articles from January 2006 to December 2013. The visual scrutiny shows that food price index shows the consistent increase throughout the entire study period but more rapidly during 2013 due to various reasons, which are discussed later in this chapter.

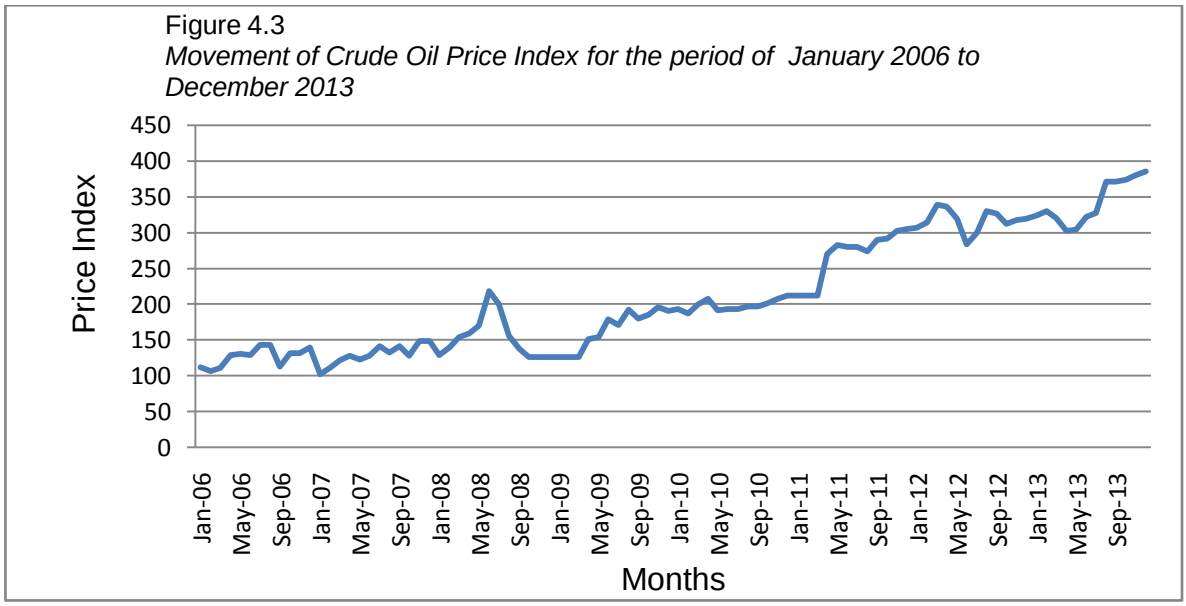
4.3.2 Crude Oil Price Index

The headline inflation in India has declined during the recent past but the food inflation has been persistently rising largely because of hike in oil prices (RBI, 2013). Hike in crude oil prices adversely affect the food prices at all levels. Recent hike in crude oil prices has affected the food prices throughout the marketing chain. Production of food items require more fertilizer (for which natural gas is a major input) and transportation — raising production costs. All these costs are passed on to consumers in the form of higher prices of food items. In addition, high petroleum prices increase the competitiveness of ethanol, further boosting

demand for corn. Various researches in both developed as well as in developing countries confirmed that hike in oil prices adversely affect the food prices through the marketing channel (Srinivasan, 2009; Wetzstein *et al.*, 2010; Alghalith, 2010; Chen and Chen, 2010;).

In order to know the impact of oil prices on the food inflation in India, crude oil prices index have been used for the analysis purpose, which include 23 commodities of oil products for the period of January 2006 to December 2013. Figure 4.3 demonstrates that crude petroleum index shows the fluctuations around the increasing trend, but throughout the study period, it shows the increasing trend similar to food prices index. From January 2006 to December 2013, the crude oil price index increased by 245 percent (Figure 4.3). For the same period, the food prices index presented in the Figure 4.3 shows 142 percent increase.

Figure 4.3
Movement of Crude Oil Price Index for the period of January 2006 to December 2013



Source: Ministry of Commerce and Industry, 2014

4.3.3 Exchange rate

Among the various factors of current surge in fuel and food inflation, sharply depreciation of rupee is one of the most responsible factors (Khundrakpam and Das, 2011; RBI, 2013). For an open economy like India, exchange rate plays an important role particularly in domestic price movement and in general for the overall development of the economy. Exchange rate contributes to increase in the prices of commodities in a very complex way. This fixes the inflation rate for internationally traded goods, thereby contributing to keep inflation under control. If

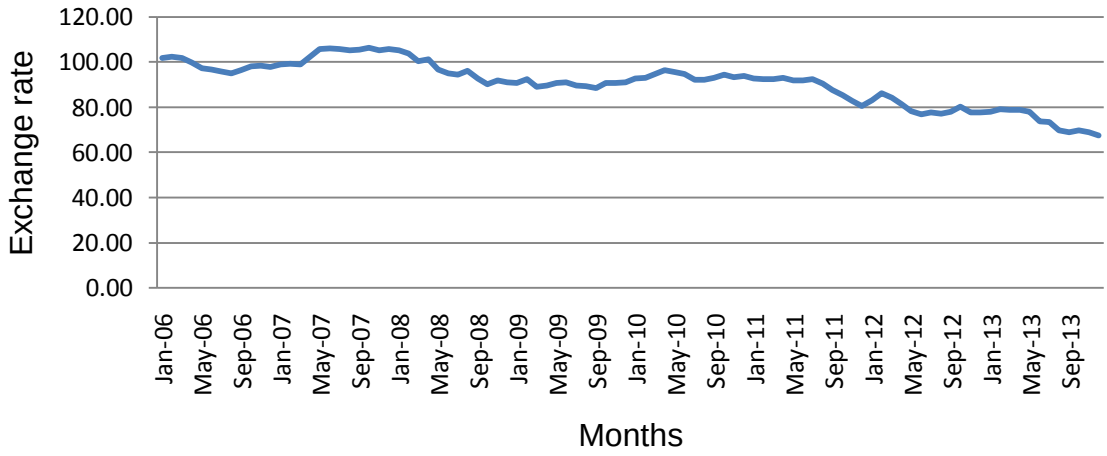
the exchange rate peg is credible, then it anchors the inflation expectations to the rate in the anchor country in which it is pegged. An exchange rate helps to solve the time-inconsistency problem by acting as an automatic rule for the conduct of monetary policy. As it is simple and direct, it is easily understood by the public. A conventional starting point for the analysis of inflation in open economies such as India is to divide the economy into two parts viz. tradable and non-tradable commodities. Exchange rate depreciation affects both tradable as well as non-tradable commodities. With depreciation of the nominal effective exchange rate, the inflation rate for tradable goods increases because it drive from 'world' inflation rate for tradable commodities. On the other hand, depreciation pass-through of the price of (tradable) inputs such as energy, particularly oil prices resulting increase in inflation.

In a traditional open economy, macroeconomic model pass through domestic prices is complete and immediate. Empirical literature seems to agree that the rising price level of commodities due to exchange rate depreciation is one of most responsible among the main forces behind inflation (Schuh, 1974; Dornbusch, 1976; Orden, 1986; 2000; Goldberg and Knetter, 1996). These studies also reveal that general price level and exchange rate have strong feedback effects.

To determine the forces behind food inflation in India nominal effective exchange have been used due to two main reasons, first, the real exchange rate is more volatile under a system of flexible exchange rates than it is under a fixed exchange rate system. Secondly, real and nominal exchange rate movements are positively correlated under flexible exchange rates (Kimbrough, 1995).

The indices of Nominal Effective Exchange Rate (NEER) are used as indicators of external competitiveness. NEER is the weighted geometric average of the bilateral nominal exchange rates of the home currency in terms of foreign currencies (RBI, 2005). The data for NEER has been shown in the Figure 4.4 for the period of January 2006 to December 2013. However, in the past few years, there has been a significant reversal and the observed effects are much like the 2008-09 global financial crisis. From January 2006 to December 2013, the rupee depreciated by nearly 34 percent (Figure 4.4).

Figure 4.4
Nominal Effective Exchange Rate movement for the period of January 2006 to December 2013



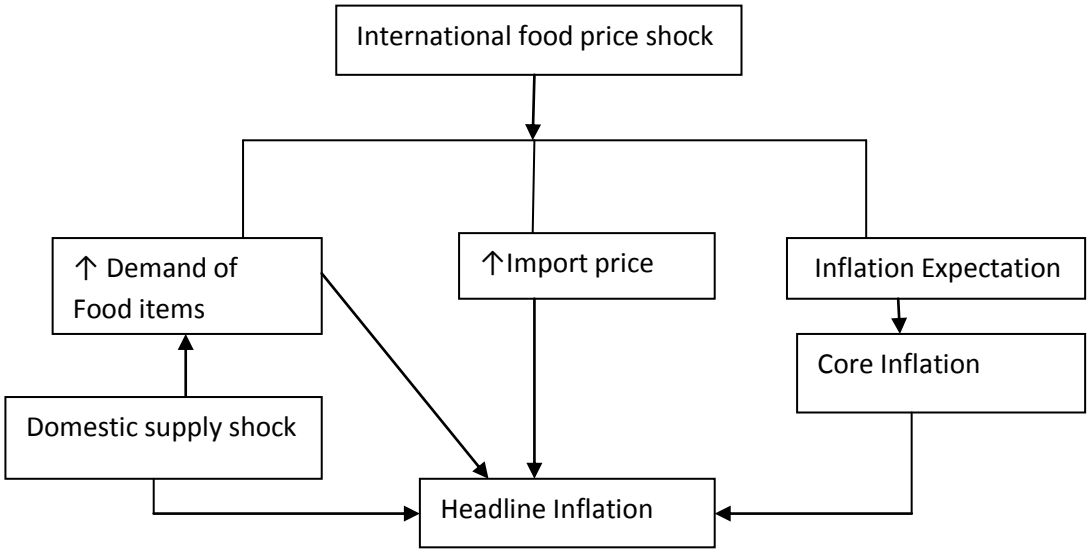
Source: Reserve Bank of India, 2013-14

4.3.4 World food price index

Domestic headline price movements are expected to be affected by changes in international food prices which could take place through several channels. First, a rise in international food prices leads to a rise in prices of imported foodstuffs which is directly reflected in domestic food and headline inflation. Second, when such a rise in imported food prices takes place, local consumers are bound to substitute away toward similar locally produced goods, increasing their demand and hence adding to inflationary pressures. Furthermore, foodstuff producers observe their own goods could be sold abroad at higher prices, leading them to allocate a greater share of their total production for export purposes, thus reducing the supply of these goods to the local market in the process (Figure 4.5).

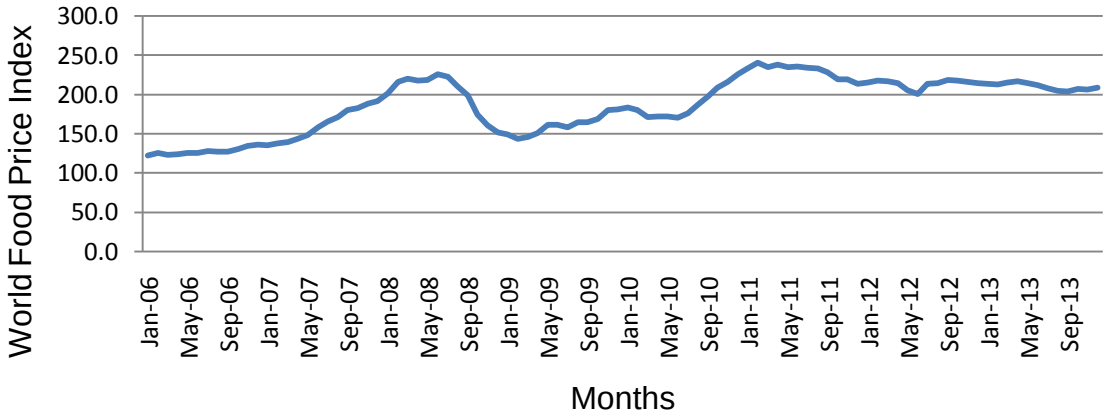
In order to know the international food inflation transmissions to local food prices, world food prices index prepared by Food and Agricultural Organization of United Nation have been used for the analysis purpose. World food prices index is a measure of the monthly change in the international price of a basket of food commodities. It consists of the average of five commodities group price indices, (Meat, Dairy, Cereals, Vegetables Oil, Sugar) weighted with the average export share of each of the groups for 2002-04 (FAO, 2014).

Figure 4.5
International food inflation transmissions to local food prices



During the past few years world food prices shows high volatility and irregular pattern due to various reasons, such as, shift in the consumption pattern, drought in some south Asian countries (Shrestha, and Chaudhary, 2012). From April 2006 onwards, the world witnessed a significant surge in food prices, which remain firm until September 2008 (Figure 4.7).

Figure 4.6
World Food Price Index for January 2006 to December 2013



Source: FAO, 2014

The average and peak food inflation rate recorded during the 38 month-period from August 2005 to September 2008 was 18.43 per cent and 45.20 per

cent respectively. After straying deeper into the negative zone in the next year with an average of -17.52 per cent, world food inflation accelerated again during 2010-11.

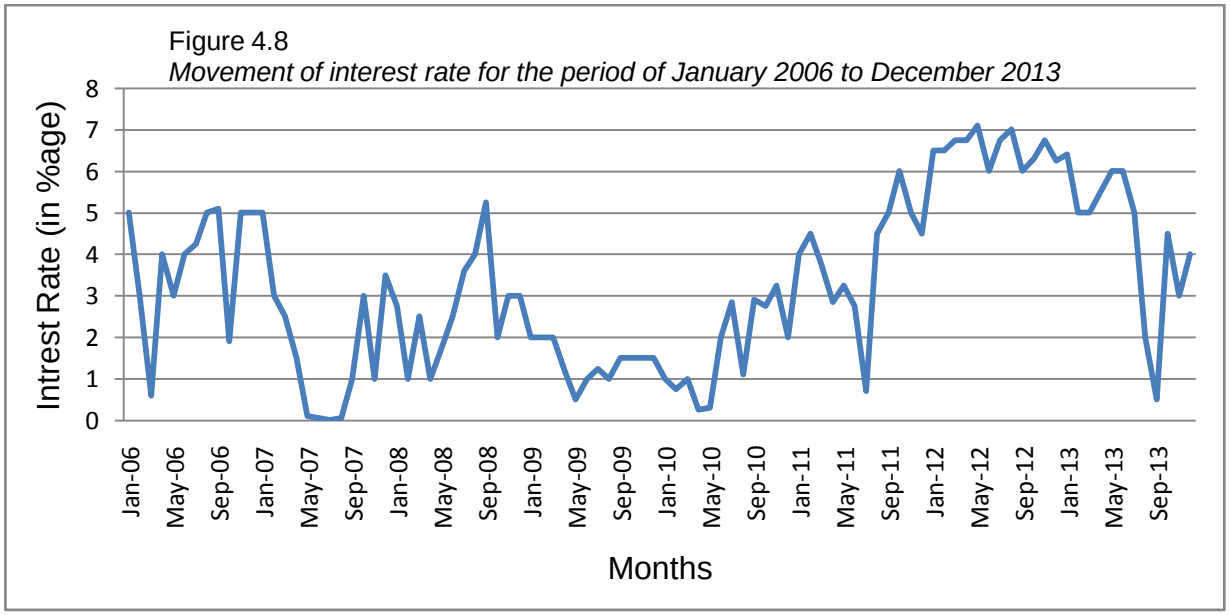
4.3.5 Interest rate

One of the oldest hypothesis in macroeconomic theory which explain the co-movement between inflation and interest rate, is the Fisherian hypothesis. In his hypothesis, Fisher advocated that there is a long-run relationship between the nominal interest rate and the expected inflation rate (Bhanumurthy and Agarwal, 2003). Since Fisherian hypothesis, various research at national and international level confirmed that interest rate is one of the leading factor which is responsible for the inflation (Lamm, 1979; Leuthold; 1981).

Household demand is affected because changes in interest rates affect savings, which affects the domestic and external demand via spending. Interest rate also affects consumer and business confidence, which in turn affects spending. Moreover, asset values are also affected by interest rates. A fall in interest rates will tend to increase the profitability of shareholders, which in turn increase the household spending. Finally, interest rate also affects the exchange rate which derive the import prices and hence, inflation.

To determine the short run deviation of food inflation from interest rate transmission, weighted average call rate data have been used for the analysis purpose. Weighted average call rate is an interest rate on a type of short-term loan that banks give to brokers who in turn lend the money to investors to fund margin accounts. When investors trading on margin experience a decline in equity past a certain level relative to the amount they have borrowed, the brokerage will issue a margin call that requires them to deposit more cash in their account or to sell enough securities to make up the shortfall. Figure 4.9 show the movement of call rate for the period of January 2006 to December 2013. The figure shows the volatility throughout the study period depending upon the market demand and supply condition. The figure demonstrates that during 2009-10, call rate was very low (around 1 percent). This period witnessed highest food inflation. During the second half of the 2013, interest rate showed the downward movement that is also evident for the hike in food and oil prices during 2013.

Figure 4.8
Movement of interest rate for the period of January 2006 to December 2013

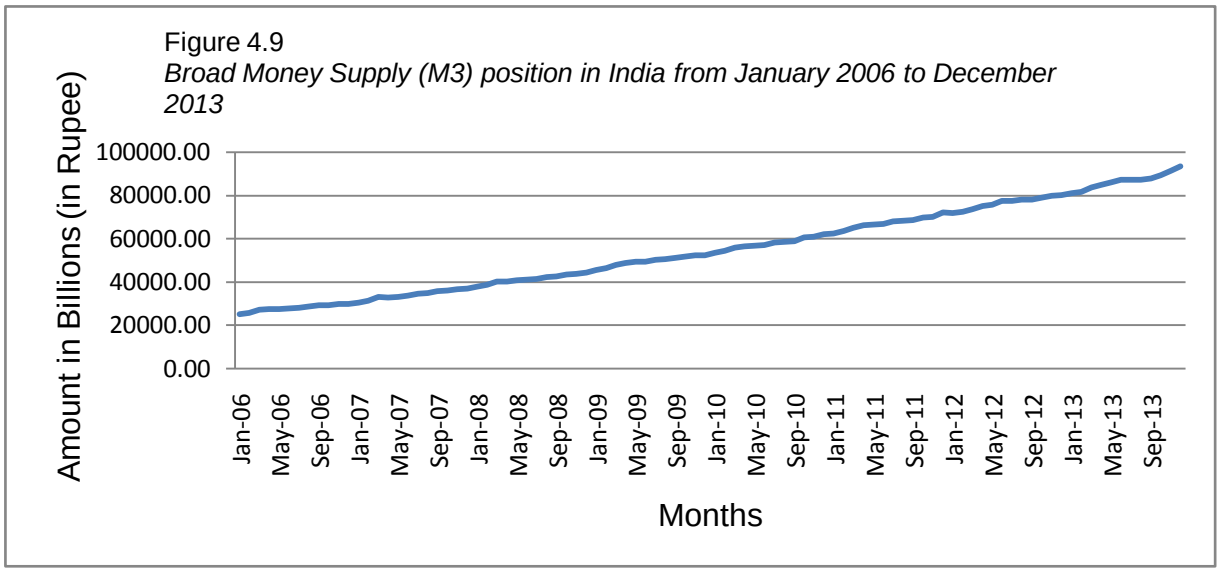


Source: Reserve bank of India, 2013-14

4.3.6 Money supply

Most economists agree that in the long run inflation depends on the money supply. The idea that increasing the supply of money increases the price levels is known as the quantity theory of money. In mathematical terms, the quantity theory of money is based upon the following relationship: M x V = P x Q; where M is the money supply, V is the velocity of money, P is the price level, and Q is total output. While most agree that money supply drives the price level in the long run and is still disagreement about its applicability in the short run. According to the quantity theory of money, the increase in money supply would lead to movement up along the aggregate supply curve this would lead to higher prices (Froyen, 2012). However, the relationships between money supply growth, inflation and interest rates is a highly debated issue in literature. Neoclassical theory states that inflation can either be controlled by increasing short-term interest rates or by reducing money supply growth. In this analysis broad money supply (M3) data have been used to analyze the impact of money supply on the food prices. Similarly, we also show the money supply data in the graph above at level, which reveal that money supply shows a time trend throughout the period. Figure 4.9 shows that money supply in India has been consistently increasing during the study period. Money supply, besides impacting the prices also have an impact on exchange rate, interest rate etc.

Figure 4.9
Broad Money Supply (M3) position in India from January 2006 to December 2013



Source: Reserve bank of India, 2013-14

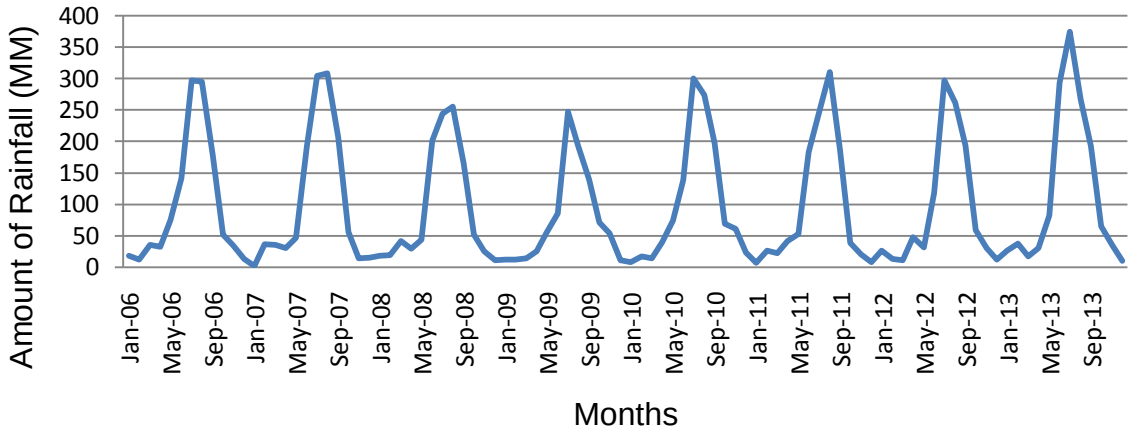
4.3.7 Rainfall

India has a tropical monsoon climate and rainfall is an important element for the economy. Although monsoons affect most parts of the country, the amount of rainfall varies from heavy rainfall to scanty in different part of the country. Historically, it is known through official and unofficial records that practically every year, some part of the country experiences drought or flood, though there are certain areas more prone to such condition than others in the country. Almost 53 percent of its gross cropped area (GCA) is rainfed. And the area under irrigation which is irrigated through different sources such as canals, tanks, watersheds and groundwater get impacted due to low rainfall (Gulati, *et al.* 2013). Rainfall impact the agricultural production in various ways, such as heavy rain destroyed the perishable (particularly vegetables) commodities and the drought adversely affects the production of agricultural commodities. By reviewing the available literature in the Indian context, we concluded that rainfall is one of the major factors which is responsible for increase in agricultural commoditiy prices particularly, food items. Most of the studies regarding the food inflation claimed that food inflation in 2009 occurred due to the drought (Chand, 2010; Ortiz *et al.* 2011; Sharma, 2011; Gulati and Saini, 2013; Mohanty, 2013).

Rainfall data in millimeter has been used in order to analyze the supply side effect of food inflation (Figure 4.10). During 2008-09 the average rainfall was low as compared to the other preceding year, while food inflation was at peak more

than 20 percent level. That is why; most of the studies relating to the food inflation claimed that rainfall was the major factor which was responsible for the hike in food prices during 2009-10.

Figure 4.10
Rainfall scenario from January 2006 to December 2013



Source: www.indiastat.com

4.4 Descriptive statistics

Descriptive statistics of seven major variables affecting food inflation are given in Table 4.1 below. The descriptive statistics presented here act as a proxy for raw data and motive to present it here is to visualize very easily.

Table 4.2
Descriptive statistics of raw data

Variables	Mean	Std. Dev.	CV	Maximum	Minimum	Obs.
Food Index	165.24	42.16	25.51	258.30	105.01	96
Crude Oil Index	212.35	83.60	39.37	385.40	101.90	96
Call Rate (%)	3.28	2.04	62.19	7.10	0.01	96
Money Supply (Rs. In billion)	55306. 41	19661.96	35.55	93590.23	25227.66	96
Exchange Rate	90.68	9.85	10.86	106.29	67.42	96
World Food Index	186.54	35.17	18.85	240.21	122.09	96
Rainfall (in MM)	97.48	101.98	104.62	375.23	1.70	96

The table shows the five parameters of descriptive statistics namely mean, standard deviation, Coefficient of Variation, maximum and minimum for the period 2006-2013.

4.5 Augmented Dicky Fuller test result

The variables used in error correction model were tested for stationarity applying the Augmented Dicky Fuller test (ADF). To allow for the various possibilities, the ADF test is estimated in three different forms, that is, under three different null hypotheses.

Table 4.3

Augmented Dickey-Fuller (ADF) Test results at Level and First Difference

Variables	t-Statistic	Critical Values at 5%	Prob.	Remarks
At Level				
Food Index	-1.241236	-3.457808	0.8957	Non-Stationary
Crude Oil Index	-2.637189	-3.457808	0.2652	Non-Stationary
Call Rate	-1.821147	-1.944248	0.0655	Non-Stationary
Money Supply	-0.848019	-3.457808	0.9568	Non-Stationary
Exchange Rate	0.522517	-2.892200	0.9867	Non-Stationary
World Food	-1.205494	-3.457808	0.9034	Non-Stationary
Rainfall	-1.578353	-1.944248	0.0603	Non-Stationary
After 1st Difference				
∆Food Index	-8.111705	-3.458326	0.000	Stationary
∆Crude Oil Index	-9.539222	-3.458326	0.000	Stationary
∆Call Rate	-13.32147	-1.944286	0.000	Stationary
∆Money Supply	-9.798360	-3.458326	0.000	Stationary
∆Exchange Rate	-8.040536	-2.892536	0.000	Stationary
∆World Food	-4.873482	-3.458326	0.007	Stationary
∆Rainfall	-6.137908	-1.944286	0.000	Stationary

The ADF test results reported in the Table 4.3 shows that all the variables at their respective levels are non-stationary at 5 per cent critical value. The number of augmenting lags (p's) are determined by minimizing on the basis of

Schwartz Bayesian information criterion. The null hypothesis for ADF is that the variable has unit root (non-stationary) against the alternative hypothesis that there is no unit root (stationary). By interpretation, we compare test statistic with critical values, if the absolute values of t-statistic are less than the critical value, we accept the null hypothesis that variables have unit root. On the other hand, if the test statistic is more than the critical values, we reject null hypothesis and accept the alternative hypothesis that variables are stationary. From the result, we accept all the null hypotheses (unit root) for all variables as the absolute values of the test statistic are less than their respective critical values at level and reject the alternative hypothesis (i.e., there is no unit root). While at first difference, we reject all the null hypotheses (unit root) as the absolute values of all the test statistics are greater than their critical values at 5 per cent significance level. Thus, we accept all the alternative hypothesizes (i.e. there is no unit root). Meaning that, all variables are stationary at first difference. All variables appear to be integrated at first difference, or the series are I(1). It is seen that all the variables are stationary at first differences, hence integrated of order one I(1).

4.6 Cointegration analysis

It is clear from the Table 4.3 which shows the result of stationarity that all variable are stationary at first difference i.e. I(1). To determine whether the seven variables in the system have equal long run relationship or not, cointegration technique is used. It helps to remove the problem of spurious regression among the variables. If two variables are cointegrated, then the spurious regression problem does not apply. If they are not cointegrated, then the spurious regression problem holds and the results obtain will be completely meaningless (Koop, 2005). There are two main techniques of cointegration available in the literature one is, Engle–Granger test and second, Johansen cointegration test. Engle–Granger test is most acceptable in case of two variables, while Johansen cointegration test is used in case of multivariate or more than two variables. Here in this study, Johansen multivariate cointegration technique is used. Johansen proposed two statistic (Maximum Eigen statistic and Trace statistic) to know the cointegrated vector among the multivariate system (Johansen, 1988; Johansen and Juselius, 1990). Below given Tables 4.4 and 4.5 present the result of Johansen cointegration vectors.

Table 4.4

Johansen cointegration test results- Trace statistic

No. of Cointegrated equations		Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
Null Hypothesis	Alternate hypothesis				
r = 0*	r ≥ 1	0.438483	140.1091	125.6154	0.0048
r ≤ 1	r ≥ 2	0.278373	85.86036	95.75366	0.1971
r ≤ 2	r ≥ 3	0.235663	55.19313	69.81889	0.4110
r ≤ 3	r ≥ 4	0.137622	29.93097	47.85613	0.7225
r ≤ 4	r ≥ 5	0.094215	16.01313	29.79707	0.7113
r ≤ 5	r ≥ 6	0.066772	6.711517	15.49471	0.6114
r ≤ 6	r = 7	0.002291	0.215615	3.841466	0.6424

Note: * *indicate the rejection of Null Hypothesis at 5 percent significance level*

Table 4.5

Johansen cointegration test result- Max Eigen statistics

No. of Cointegrated equations		Eigen value	Max Eigen Statistic	0.05 Critical Value	Prob.**
Null Hypothesis	Alternate hypothesis				
r = 0*	r ≥ 1	0.438483	54.24870	46.23142	0.0057
r ≤ 1	r ≥ 2	0.278373	30.66723	40.07757	0.3810
r ≤ 2	r ≥ 3	0.235663	25.26216	33.87687	0.3675
r ≤ 3	r ≥ 4	0.137622	13.91783	27.58434	0.8282
r ≤ 4	r ≥ 5	0.094215	9.301615	21.13162	0.8074
r ≤ 5	r ≥ 6	0.066772	6.495903	14.26460	0.5504
r ≤ 6	r = 7	0.002291	0.215615	3.841466	0.6424

Note: **indicate the rejection of Null Hypothesis at 5 percent significance level*

Table 4.4 presents the trace statistic and Table 4.5 present the maximum Eigen statistics. The first null hypothesis for both the test statistics is that there is no cointegrating vector against the alternative hypothesis that there is one cointegrating vector in the series. Similarly, for equation two the null hypothesis is at most one cointegrating equation against the alternative hypothesis of at most two or more cointegating equations. Similarly, there are null hypothesizes r ≤ 2, r ≤

3, r ≤ 4, r ≤ 5 and r ≤ 6 against their alternative r ≥ 3, r ≥ 4, r ≥ 5, r ≥ 6 and r = 7 which means that there may be at most six cointegrating vectors out of seven cointegrating equations. The null hypothesis is rejected when the absolute value of Trace statistic or Maximum Eigen value statistic is less than the critical value at 5 per cent. In our case both the statistics determine that there is only one cointegrated equation in the system.

The cointegration test is sensitive to the lag length criteria. One lag length is used as suggested by various lags length criterion. The Johansen method suggests two statistics to determine the number of cointegrating vectors, the Trace statistic and Max Eigen statistic. Both the Trace statistics and max-eigen statistics indicate the presence of one cointgrated vector at 5 per cent significance level. Hence, one cointegration equation considered based on the results of trace statistics and max-eigen statistics and concluded that there is stable long run relationship among the variables.

4.7 Long run estimate of the model

The appeal of cointegration is that it provides a formal framework for testing long-run models from actual time-series data. The cointegration technique allows nonstationary data to be used so that spurious regression results are avoided. It also gives the chance to test the validity of an economic theory. If a postulated economic relationship exists, then the variables under consideration should be cointegrated.

The long run model tells the deviation from the equilibrium model. The results of the long run model are presented in the Table 4.6. The long run relationship is impact of exchange rate, world food prices, money supply, interest rate, crude oil and rainfall on food prices. The sign of all the coefficients in the cointegration equation as per a priori expectations and significant, at 5 percent significance level.

The normalized cointegrated equations representing the long run relationships among the variables are presented in equation (4.1.1) For these long-run restrictions to arise within the cointegrating matrix, the cointegrating vectors require normalization so that the parameters of the adjustment and cointegrating matrices can be given plausible and interesting economic interpretations.

Table 4.6
Long Run Relationships with respect to food inflation

Dependant variable food price index				
Variables	Coefficients	t-Statistic	Probability	Remarks
Food Index	1			
Crude Oil Index	-0.2553082	-3.01	0.003	Significant
Money Supply	-0.7219475	-1.92	0.005	Significant
Call Rate	0.0608869	-6.75	0.000	Significant
Exchange Rate	-0.5174441	-1.92	0.005	Significant
World Food	0.336094	2.74	0.060	Not Significant
Rainfall	0.0730332	-7.56	0.000	Significant
Constant	5.105202			

In one state variable optimizing model, such normalization is obvious. Normalizing the state variable to unity produces long-run relationships consistent with economic theory. But in cases where there are multiple cointegrating vectors, there is no guidance in the literature regarding how one should normalize cointegrating vectors in applied work (Rossana, 2009). Here in this study one of working paper of RBI under entitled 'Monetary policy and food prices in India' serve as guide to normalize the cointegration vector.

While normalizing the cointegrating coefficients by setting one of the element arbitrary to one as in this case of food price index, one should need to reverse the signs of the estimated coefficients of variables (except that of variable that are normalized) to compare whether the signs are as anticipated or not. However, the relationship in the Table 4.5 can be expressed as follows:

$$FPI = 5.10 + 0.25 \times CO + 0.72 \times MS + 0.51 \times ER - 0.6 \times CR - 0.33 \times WFP - 0.7 \times RF \quad ..(4.1.1)$$

The long run equilibrium relationship among the variables in the model is obtained from cointegration vector. Normalizing cointegration vector with respect to food prices index gives the long run food price equation which has been shown above. The above equation shows that exchange rate, oil prices, money supply, and rainfall are positively related to food prices, while world food prices and rainfall interest rate are negatively related to food prices in India.

The world food prices, interest rate and rainfall are negatively related to the domestic food prices. And the all other variables like exchange rate, money supply and crude oil prices are positively related to food prices. Number of researches at national and international level confirmed that oil prices has real impact upon agricultural prices directly or indirectly (Barnard, 1983; Wetzstein *et. al.,* 2009; Shokoohi and Esmaeilin, 2011). Some studies have directly highlighted that oil prices affect the food prices (Alghalith, 2009; Chen *et. al.*, 2010; Pala, 2013). In case of India also, the coefficient of oil prices in food prices equation are positively related which shows that oil prices has real impact on food inflation. The coefficient of the oil prices indicate that in the long run 1 percent increase in oil prices lead 25 percent increase in food prices. The theoretical and empirical framework available in the literature examines the response of food and agricultural prices to change in monetary variables. Various empirical researches claimed that monetary instrument has real impact upon the food and agricultural prices in the long run period (Campa and Goldberg, 1996; Saghianan *et al.,* 2002; Asfaha and Jooste, 2007; Siddique and Hye, 2010; Khundrakpam and Das, 2011). This study also support that the monetary instruments has real impact on the food prices. The normalized equation above explains that 1 percent decrease in call rate lead to 6 percent increase in food prices in the long run. Similarly, money supply also supports the long run relationship in case of food inflation as it is positively related, explained that 1 percent increase in money supply lead to 72 percent increase in food prices. Moreover, exchange rate is also one of the major causes and contributed greatly to food inflation. In this study, the coefficient of exchange rate is also positively related and explain that in the long run, 1 percent depreciation in exchange rate lead to 51 percent increase in food inflation.

The international food prices tend to get transmitted from the international market to the domestic market via open trade. When food prices rise at the international market, the countries that are net exporter of food item could benefit from improved terms of trade. On the other hand, the countries that are net importer of food items, however, could face the challenges of meeting consumption demand. The rise in international food prices has been transmitted in varying degrees from international to local markets (Rajmal and Misra, 2009). The international food price transmission is not only a case with India, but with also various Asian developing countries. For example, while in Tanzania, 44 per cent

change in maize price is due to change in international maize prices (Barrett and Dillion, 2013). And in Ghana and the Philippines, local rice prices have adjusted by around 60 per cent of the world price change (Minot, 2011). In this study, the coefficient of world food prices is negatively related and not significant, meaning in the long run world food prices have no impact on the domestic food. Because recent hike in world food prices was due to the cereal items (Dawe, 2008; Keats, 2010) that contributed very little to domestic food inflation.

The main reason for the current surge in food prices is the supply shock due to the drought in 2009 and the carry-over effect of the low growth of food production in 2008-09 (Chand, 2010). A majority of the food commodities faced upward price pressure due to supply-side constraints, which occur due to bad weather conditions (Nair and Eapen, 2011). In addition to these, various research in the Indian context confirm that present inflationary situation has occurred due to high food prices that in turn occur due to the bad weather conditions. So in this analysis rainfall is negatively related with food inflation, which ensures that decrease in the amount of rainfall increase the prices of food and agricultural products. The coefficient of the rainfall in the above equation explained that 1 percent decrease in the amount rainfall lead to 7 percent increase in price of food articles in the long run in India. The overall long run equation demonstrates that except the world food price, all the variables have real impact upon the food price.

4.8 Error correction model estimates

The results of the error correction model are reported in Table 4.7. The error correction term of short run model is also statistically significant with a negative sign. It is another proof that long run relationship exists among the variables used in this study. The negative value of coefficient of ECT_{t-1} which is (-0.17) indicates the very high speed of convergence towards equilibrium. ECM consists of one period lagged cointegrating equation and the lagged first differences of the endogenous variables. The first differences of the endogenous variables has presented in the appendix C. It is necessary that food inflation is very sensitive than overall inflation to policy shocks like administered prices (support prices), trade policy etc. The overall result shows a significant presence of an error correction in the equation and its negative sign implies that whenever

there is disequilibrium, food prices adjust towards equilibrium to be restored as market forces are in operation.

Table 4.7

Error correction model estimates (short run causality)

Variable	Coefficient	t-Statistic	Prob.	Remarks
C	0.010106	3.307014	0.0014**	Significant
D(CO)	0.017282	0.022860	0. 0075**	Significant
D(M3)	-0.145658	-0.839381	0.4036	Not Significant
D(LCR)	0.001362	0.224051	0.8232	Not Significant
D(TNEER)	-0.153897	-1.506696	0.1355	Not Significant
D(WFP)	0.036051	0. 0589386	0.0070**	Significant
D(RF)	0.000667	0.297135	0.7671	Not Significant
ECT_{t-1}	-0.175431	-3.532482	0.0011**	Significant
R-squared = 0.175652 F-statistic = 2.648286		Durbin-Watson stat = 1.677580 Prob(F-statistic) = 0.015699		

Note: (**) indicates the significant s of the coefficient at 5 percent critical level.

The estimated value of ECT_{t-1} is 0.17, indicating the speed of adjustment to long-run equilibrium in response to disequilibrium, which is due to short-run shocks of the previous period. Since we have monthly data, it takes almost 17 months to restore complete equilibrium.

Empirical results of this study reveal that crude oil and world food prices have positive relation with food price inflation and both are statistically significant in the short run. Since the last decade, world food prices remained very volatile in nature, some times as high as 28 per cent in 2007, subsequently, sharply declined in 2009 and reached the -20 percent, again started increasing and crossed the 20 percent level in 2011 (Figure 1.1). The major driving force, which drives the international food prices, is the cereals. There are many factors behind these increases: increased biofuels demand; higher oil prices that have raised prices for agricultural inputs such as fuel and fertilizer; short-term supply shocks due to adverse weather conditions (Dawe, 2008). When during the short run the demand of food (cereals) increased at international level, the prices also increased and adversely affects on the prices

of domestic food in the short run only. While in the long run the coefficient of world food is not statistically significant due to its volatility nature. Money supply, interest rate and exchange rate have no impact in the short run, while in the long run these are major driving force to food inflation. The results are in conformity with an earlier study of the RBI in case of three variables viz. interest rate, exchange rate, and money supply. The study shows that all the three variable caused the food prices in the long run but in the short run, the food inflation is free from monetary phenomenon (Khundrakpam and Das, 2011). While other variables such as crude oil and world food transmission have real impact on domestic food articles. And rainfall is also positively related with food prices in the short run but not significant.

4.9 Diagnostic Tests

In this study necessary diagnostic test have been used to check the problem of normality, serial correlation, and heteroscedasticity and model specification. The results of all tests are given in the Table 4.8. The result of the normality test (Jarque-Bera Statistic) indicates that the model is normally distributed. Normality property is also need for valid inferences while performing hypotheses testing. The test has null hypothesis indicating that the error term in the model has skewness and kurtosis corresponding to a normal distribution. The results of normality test (Jarque-Bera Statistic) shows that the null hypothesis has to be rejected and model is normally distributed. Next Autoregressive Conditional Heteroscedasticity (ARCH effect) and Breush-Godfrey Serial Correlation LM Test have been used in order to check the Heteroscedasticity and Serial Correlation. In the regression context, the classical linear regression model assumes that such autocorrelation does not exist in the disturbances μ_i. Heteroscedasticity is a violation of the assumption of the classical linear regression model. It occurs if different observations' errors have different variances. Ramsey RESET Test has admitted to check the linearity of the model. For example if we treat the non-linear model as linear regression model then the result would be inconsistent for policymaking. The result indicates that the there is no Heteroscedasticity and no problem of serial correlation which is also crucial for the time series analysis.

Table 4.8
Diagnostic Tests (Long run Model)

Normality Test (Jarque-Bera Statistic)	Jarque-Bera Statistic= 2.682240	Probability = 0.0967
Serial Correlation (Breush-Godfrey Serial Correlation LM Test)	F-statistic = 2.401739	Probability=0.251553
ARCH Test (Autoregressive Heteroskedasticity Test)	F-statistic = 0.000598	Probability = 0.9805
Model Specification Test (Ramsey RESET Test)	F-statistic = 0.188760	Probability = 0.6650

The result of the Ramsey RESET Test claimed that the model is well specified proposed by the Specification Test (Ramsey RESET Test) that have been used to check the stability of the model and coefficients. Further, the result of this model confirms that the coefficients are stable and correct specification of model.

Chapter 5
Conclusions and Policy Suggestions

5.1 Conclusions

During the past few years, global food inflation has gone up very sharply. Particularly, south Asia has witnessed the high food inflation, although it was affected in various region of Asia differently. In India, also food inflation has been creeping up during the recent past. From the January 2006 to December 2013, food inflation in India remained 10.39 per cent on average, some times as high as 21.37 per cent in May 2010 and 20 per cent in November 2013. This reflects that 10.39 per cent more expenditure on food has been increasing every month since January 2006. In a developing country like India, food price inflation is least tolerated as on average household spend about 60 percent of expenditure on food (NSSO, 2011). Thus, food inflation in India acts as a strong 'hidden tax' for the poor masses. In the developing country context, food inflation increased the living cost of the household, resulting malnutrition and hence, productivity loss.

Extensive research efforts have been devoted to understand the behavior of food prices in India. Several factors have been identified that contribute to food inflation in India such as monetary factors (money supply, interest rate, and exchange rate), cost-push factors (crude oil), demand side (world food prices, shift in consumption pattern), supply side (rainfall) and other structural and institutional factors. Time series data from January 2006 to December 2013 of seven major variables affecting food inflation viz., food prices index, crude oil prices index, nominal effective exchange rate, weighted average call rate, money supply, world food prices index and rainfall was used for empirical analysis due to the availability of monthly data for these variables. The study employed Johansen cointegration and error correction model in order to comprehend the long and short behavior of food inflation in India respectively. Johansen cointegration requires the same order of integration of time series and to fulfill the Johansen test properties, ADF unit root test has been applied and the result of the ADF exhibits that the underlying series is clearly I(1). Maximum Eigen Statistic (λ_{max}) and Trace Statistic (J_{trace}) were used in order to confirm the cointegrating vectors among the underlying series. Both statistics confirmed the existence of co-integration and same number

(one) of co-integrating vectors. And various diagnostics test have been applied and their results proved to very significant as per a priori expectations.

Results indicate that food inflation (food articles) has been occupying the leading drivers of the headline inflation throughout the study period. It is also analyzed that food inflation is caused due to shift of dietary habits of the people. In the long run model, the signs of the coefficients are as per a priori expectations. The empirical results indicate that in the long run, all the variables viz. money supply, interest rate, crude oil, exchange rate and rainfall except the world food prices index caused food inflation. Among all, money supply has been a principal determinant of food inflation and its coefficient explained that in the long run, one percent increase in money supply caused the 72 percent increase in food inflation and in the short run, money supply does not play any role to increase the food inflation.

The global food price crisis from early 2007 to mid-2008 witnessed rapid increase in the international prices of maize, wheat, rice, and other cereal items (Dawe, 2008; Keats *et. al.,* 2010) and the cereals contributed very little to domestic food inflation throughout the study period. The results point out that increase in the demand for protein and high value food items has been the principal components of food inflation during the past few years resulting from the increased income and growing middle class which helped to bring up new diets like dairy and meat into middle classes in new places around the world. One of the important variables affecting food prices in the short run is the international price which raises the domestic price in the country. In the short run, global prices have real transmission affect due to sharp depreciation of rupee recently and the rise in crude oil prices led to a rebound in food inflation (RBI, 2013). An important conclusion of the study is that the most significant variable which affects food prices in the long run as well as in the short run is crude oil. Findings of the study show that 'crude oil' has a dominant role in determining food price inflation both in long run and short run in India. The negative value of coefficient of ECT_{t-1}, which is (-0.17), indicate the very high speed of convergence towards equilibrium. The estimated value of ECT_{t-1} is 0.17, indicating the speed of adjustment to long- run equilibrium in response to disequilibrium, which is due to short run shocks of the previous period. Since the studies have monthly data, it takes almost 17 months to restore complete equilibrium.

Most important findings of this study can be summarized by saying that food inflation is a global phenomenon and that the food inflation hurts poor more than the rich. Overall, the above analysis shows food inflation as a major structural and policy issue. The decline in agriculture sector has been happening over the last decade and the impact on prices is being felt now because of rising incomes, depreciation of rupee and hike in oil prices. Demand for food is undergoing structural shifts as income rises. Based on result, the study concluded that food inflation in India is a very complex phenomenon that is caused by various factors such as demand and supply as well cost push factors. The important conclusion of the study is that food price fluctuations are a function of supply, which is linked to natural forces such as, unseasonal rains has been a major determinants for the prices of perishable commodities such as fruit and vegetables in certain parts of the country. And demand, which is linked to changing tastes, growth in consumption of pulses, fruits, meat, eggs and dairy items is more than double the consumption growth in cereals. Inflation in these items has been higher than in cereals. Depreciation of rupee hits the oil prices above their equilibrium level, which in turn hits the food prices in the country. Cereal has been a major driver, driving the international prices during the recent past because of the drought in certain Asian countries; increased demand of cereals in the international market raised the prices in the domestic market for the short run because the country is the exporter of food grains.

5.2 Policy Suggestions

Agriculture plays a pivotal role in the Indian economy. agricultural sector in India accounted for 14.1 percent of the GDP and employed 60 percent of the labor force (Economic Survey, 2012-13). The relative change in agricultural prices determines the income of the farmers, their investment decisions and the productivity in this sector. Thus, understanding the factors that influence food and agricultural prices is fundamental for the design of policies aimed that the sustainable growth in this sector and the rest of the economy. The study suggests the following few recommendations based on the empirical results.

1. Over the past few years, demand for protein based fruit and vegetables have increased manifolds, resulting in sharp increase in their prices. Several studies in Indian context (Suryanarayana and Gopal, 2011;

Fatehpuria, 2013) have shown that about 30 per cent of the fruits and vegetables go waste as post harvest losses due to their highly perishable nature. Therefore, Government should invest in post harvest cold chain facilities and develop cold storages; and improve the infrastructure of agricultural markets so that losses are avoided which will ultimately help to reduce the prices. Further, creation of artificial leakages due to speculative hoarding by the middlemen needs to be checked. Agricultural production can be boosted by investing in R&D for better quality seeds.

2. Indian agricultural is heavily dependent upon the monsoon, as coefficient of the rainfall is also significant in this study, and explains that rainfall has long run real impact upon the food inflation. To reduce the dependency on monsoon, particularly in rain fed areas, the study suggests that investments should be made for rainwater harvesting. Rainwater harvesting generally involves creation of structures such as check-dams, ponds and percolation tanks at a planned set of places along the flow path. The use of micro-irrigation methods such as drip irrigation and sprinkler irrigation need to be further promoted in water deficient areas.
3. In order to reduce the dependency on import of oil, government should encourage the use of bio-fuels. Although increasing demand of biofuel will increase the prices of food items but comparatively lesser than the crude oil.
4. Monetary policy has a limited role, although the money supply is a chief determinant of food inflation. Rising food prices pose a serious challenge to monetary policy. On the one hand, tightening monetary policy would be ineffective in the face of an exogenous shock to relative prices which may be behind recent food price inflation. Moreover, tightening monetary policy could choke the agricultural supply response and dampen growth in countries experiencing a slowdown at the same time that food and energy prices are high. On the other hand, loosening monetary policy, driven by the need to manage capital inflows and real exchange rate appreciations, would exacerbate the situation. Governments are also reorienting trade policy by, for example, easing import restrictions. Eliminating tariffs can help boost supply, but if global prices remain high and volatile, well designed policy interventions to protect the poor would still be needed.

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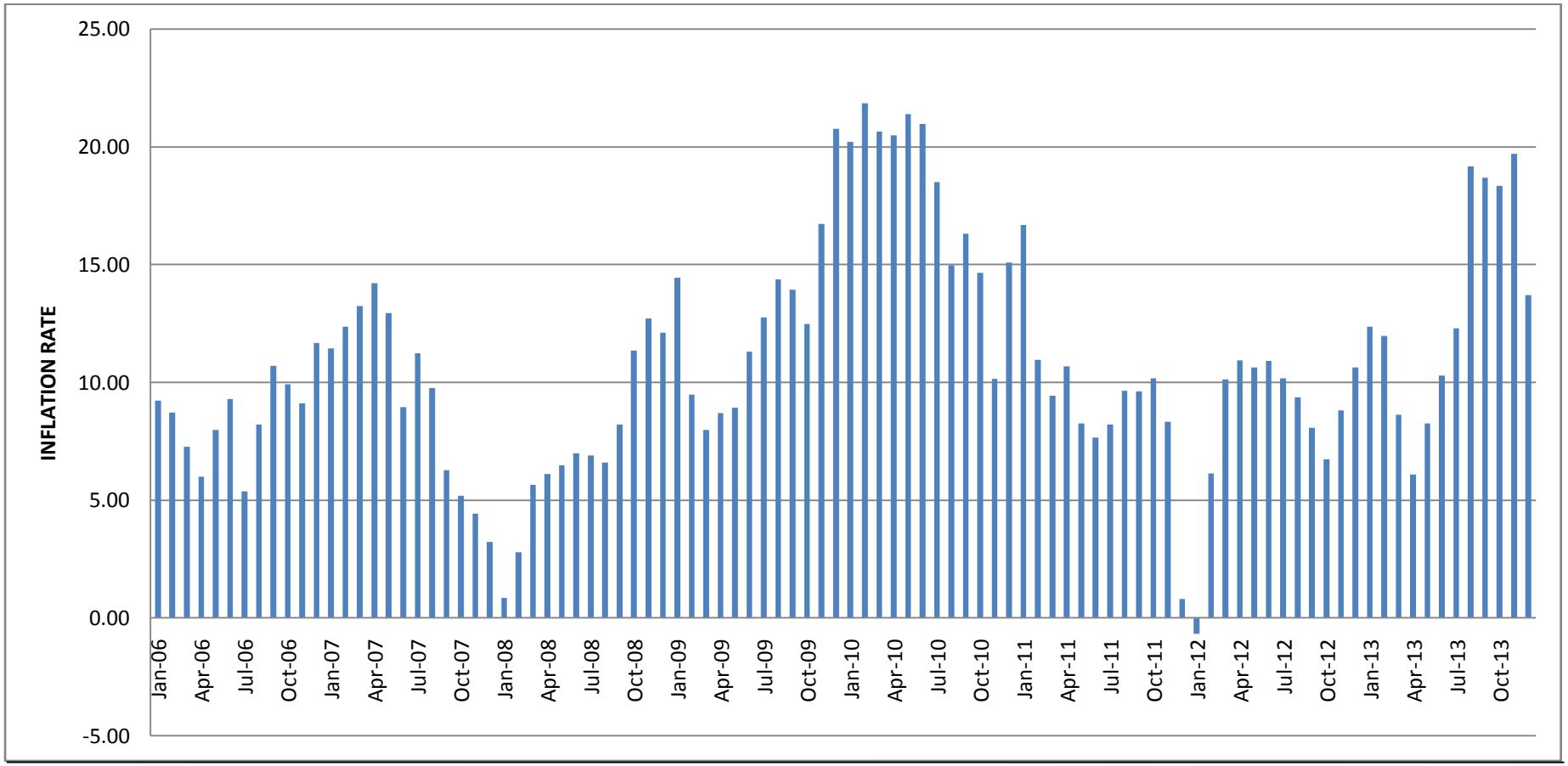
Appendix A

Figure

Food articles inflation from the January 2006 to December 2013



Source: Ministry of commerce and industry, 2014.

Appendix B

The appendix shows the inflation rate, prices trend and weightage of all the components of food articles for the period of January 2006 to December 2013.

Table A.1

Inflation rates of the components of food articles for the period of January 2006 to December 2013.

Months	Cereals	Condiments and Spices	Other food articles	Pulses	Fruit and vegetables	Milk	Eggs, Meat and Fish
Jan-06	8.78	0.30	9.79	25.84	13.04	0.90	13.14
Feb-06	9.01	6.47	17.11	27.09	7.97	2.29	12.60
Mar-06	8.02	18.21	11.58	29.76	3.88	2.99	7.98
Apr-06	8.02	25.81	14.74	32.46	-3.15	2.48	9.92
May-06	9.49	34.11	21.36	34.20	-0.40	5.18	8.01
Jun-06	8.64	37.73	25.20	34.82	3.20	7.31	8.21
Jul-06	6.78	41.75	26.55	28.44	-5.27	5.70	5.54
Aug-06	7.42	48.63	25.63	28.16	1.95	6.42	6.80
Sep-06	9.96	57.43	18.16	35.72	3.70	8.86	8.60
Oct-06	10.61	57.95	21.66	46.47	0.98	11.2	1.98
Nov-06	13.92	52.77	16.55	38.82	-2.92	10.6	2.78
Dec-06	14.53	48.53	12.97	33.47	6.46	10.4	2.02
Jan-07	11.42	55.16	15.17	26.60	9.38	8.88	2.68
Feb-07	10.51	48.60	6.93	26.66	12.13	9.06	7.25
Mar-07	10.05	27.99	9.26	16.27	19.83	8.52	10.04
April-07	12.56	23.02	10.71	13.21	23.35	8.51	8.56
May-07	10.83	16.87	8.23	8.57	23.92	6.16	10.31
Jun-07	9.74	11.94	5.75	3.60	16.17	2.67	6.26
Jul-07	11.45	12.92	3.28	6.11	22.73	4.65	3.94
Aug-07	11.43	8.91	1.85	4.82	19.44	5.39	0.26
Sep-07	8.80	2.16	-1.02	-3.43	13.28	3.93	-0.70

Oct-07	10.27	-1.72	-2.58	-11.68	7.94	3.69	4.62
Nov-07	7.68	-1.03	1.16	-12.11	6.43	5.25	4.42
Dec-07	6.30	-0.89	5.12	-12.72	3.30	6.21	2.43
Jan-08	7.16	-6.39	8.06	-12.32	-2.59	5.62	-2.26
Feb-08	8.05	-3.96	6.87	-10.68	2.61	4.82	-0.09
Mar-08	10.78	2.71	11.48	0.89	5.37	5.08	1.29
Apr-08	12.30	1.05	13.69	-0.67	5.43	6.33	1.70
May-08	12.30	4.48	17.77	-0.82	4.87	7.23	1.72
Jun-08	12.30	10.81	24.17	2.29	3.96	8.52	1.49
Jul-08	11.56	11.66	30.62	3.18	2.57	7.73	4.88
Aug-08	11.13	11.78	37.54	7.78	-1.45	7.22	9.65
Sep-08	11.02	8.68	44.85	8.13	2.71	7.48	11.97
Oct-08	11.24	7.16	48.60	9.54	13.96	6.68	11.65
Nov-08	11.66	3.32	40.72	10.95	20.64	6.10	9.85
Dec-08	12.32	0.69	32.92	12.54	17.36	6.53	11.80
Jan-09	12.22	2.80	33.19	15.59	25.50	6.87	13.00
Feb-09	12.94	1.69	32.14	15.19	7.82	6.22	8.56
Mar-09	11.96	6.31	27.63	7.65	-1.32	13.6	7.90
Apr-09	10.88	7.00	25.85	10.79	4.68	11.7	5.84
May-09	11.75	7.01	43.09	14.60	5.26	11.4	2.50
Jun-09	12.26	4.02	34.73	14.12	10.19	12.5	8.42
Jul-09	11.15	2.80	27.54	18.12	11.50	14.2	14.93
Aug-09	11.23	6.94	9.63	17.44	15.49	14.3	18.72
Sep-09	13.36	18.31	5.36	19.52	7.63	16.7	19.87
Oct-09	11.56	23.51	0.63	20.54	2.64	19.0	19.29
Nov-09	14.29	35.46	4.96	29.11	5.07	22.1	27.62
Dec-09	16.45	38.55	7.50	32.07	14.72	21.8	29.37
Jan-10	15.36	37.34	0.11	38.06	7.89	26.5	31.60
Feb-10	12.72	36.01	0.39	26.93	15.89	28.5	34.31
Mar-10	10.48	33.66	-4.51	25.02	16.25	24.8	35.51
Apr-10	8.04	35.39	-9.10	24.08	14.32	27.9	38.61
May-10	7.07	36.13	-21.00	24.52	15.80	28.3	45.52

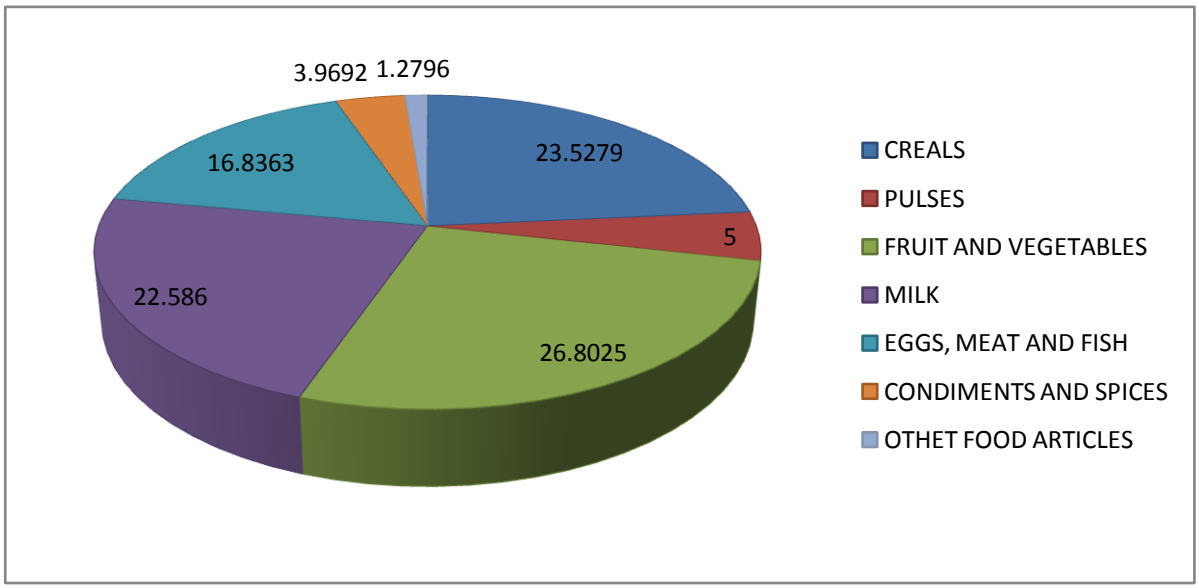
Jun-10	7.43	39.73	-21.58	23.02	18.86	26.2	38.99
Jul-10	8.35	43.47	-17.73	14.40	13.22	26.0	31.42
Aug-10	8.49	39.88	-6.49	7.75	3.32	26.8	26.99
Sep-10	6.68	32.49	-4.47	3.86	12.19	24.1	29.52
Oct-10	4.84	30.17	-3.85	0.21	12.39	21.0	27.37
Nov-10	3.19	23.85	-2.44	-10.00	7.86	18.0	18.93
Dec-10	1.59	37.74	-3.56	-11.74	25.79	18.3	19.42
Jan-11	1.76	37.69	0.38	-13.33	39.97	13.7	15.69
Feb-11	3.43	30.83	6.06	-5.24	16.10	12.5	12.74
Mar-11	3.48	20.45	4.66	-3.97	18.92	4.43	13.54
Apr-11	4.42	16.52	15.45	-6.37	26.48	2.87	11.14
May-11	5.76	16.82	24.94	-9.21	15.23	6.11	6.59
Jun-11	5.05	10.25	27.46	-9.33	7.49	11.5	9.88
Jul-11	5.20	2.03	24.83	-7.48	11.62	10.7	9.56
Aug-11	5.16	-0.59	19.63	-4.26	18.29	9.41	10.42
Sep-11	4.13	0.08	18.37	2.90	15.06	10.2	11.88
Oct-11	4.32	4.07	21.25	10.25	13.48	11.1	12.43
Nov-11	2.15	0.76	17.19	14.96	8.96	10.9	11.40
Dec-11	1.74	-14.90	16.87	13.73	-15.25	11.0	13.10
Jan-12	2.25	-20.56	17.57	11.01	-22.17	12.3	18.27
Feb-12	1.83	-19.94	12.41	7.86	0.55	11.7	20.00
Mar-12	4.64	-13.17	12.64	10.10	10.01	15.2	17.40
Apr-12	6.84	-14.79	11.69	11.29	11.04	15.6	17.54
May-12	5.62	-20.44	8.28	16.77	14.81	11.9	17.13
Jun-12	6.64	-19.25	10.21	20.59	17.58	7.46	16.69
Jul-12	8.06	-13.71	8.11	28.57	10.51	8.01	16.59
Aug-12	10.77	-10.73	19.21	34.54	5.43	6.68	14.20
Sep-12	14.35	-13.00	18.60	28.98	0.05	6.45	13.22
Oct-12	16.28	-18.28	10.97	19.86	-2.92	6.35	13.10
Nov-12	17.84	-17.57	9.95	18.77	2.95	6.18	14.24
Dec-12	19.08	-11.66	11.09	16.25	8.90	6.15	12.66
Jan-13	18.60	-3.67	6.79	15.89	18.41	4.52	11.20

Feb-13	18.63	2.66	8.55	13.95	14.46	4.52	12.37
Mar-13	17.86	3.73	20.17	10.84	2.25	4.42	11.42
Apr-13	15.52	10.90	11.31	10.52	-4.13	4.04	10.44
May-13	15.95	16.64	0.29	5.95	2.88	4.46	11.38
Jun-13	17.87	17.01	-2.46	1.59	9.45	4.08	12.48
Jul-13	17.71	13.48	-0.54	-7.43	20.59	3.02	12.02
Aug-13	15.57	10.17	-8.39	-14.70	44.00	6.02	20.15
Sep-13	13.44	12.18	-7.82	-13.42	49.97	5.77	13.37
Oct-13	11.37	15.28	-7.84	-10.72	46.60	5.64	17.55
Nov-13	11.32	23.23	-6.36	-10.56	52.56	6.25	15.19
Dec-13	10.19	25.39	-11.06	-7.19	30.77	6.93	11.40

Source: Ministry of Commerce and Industry, 2014

Figure 1.1

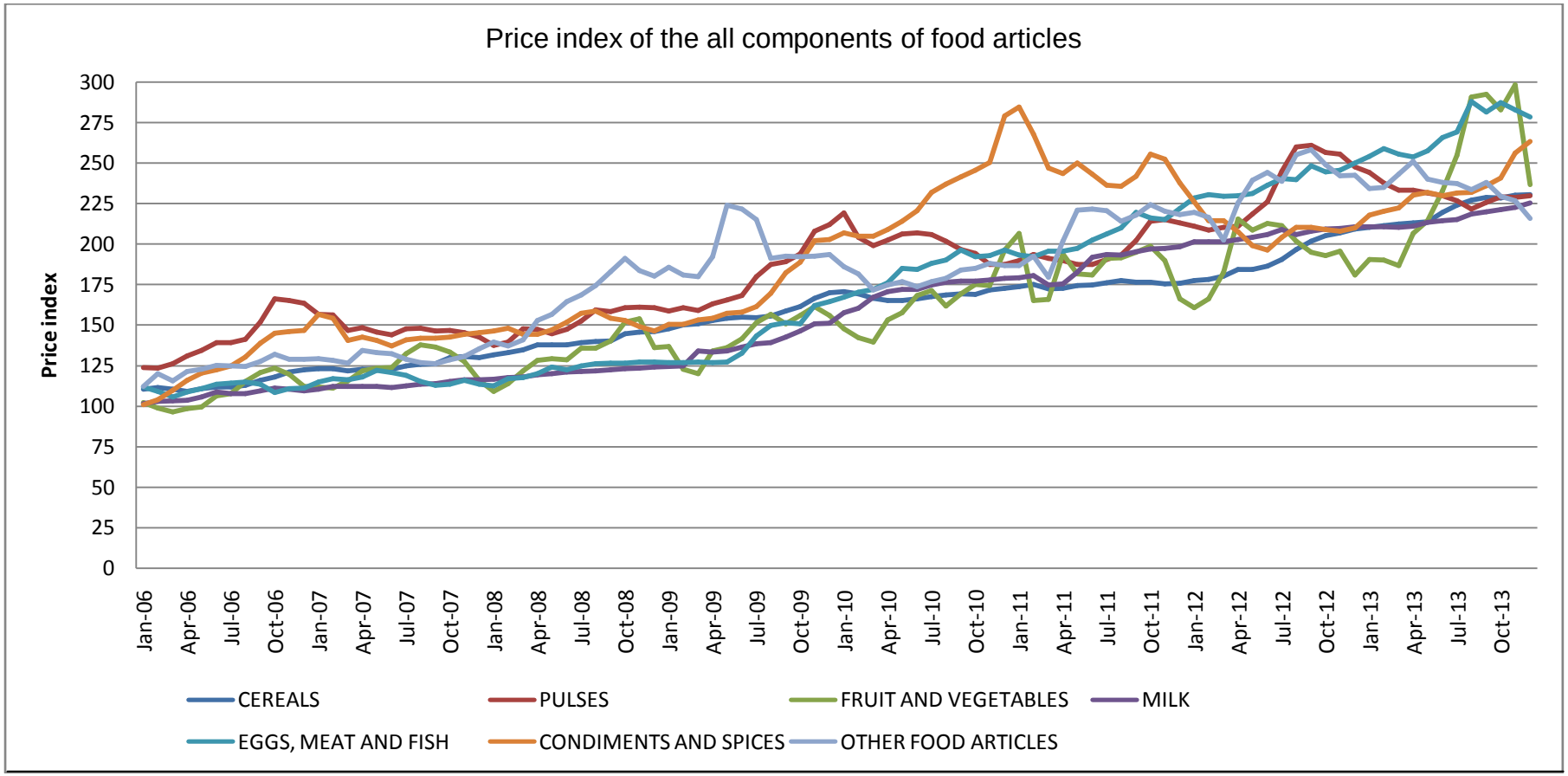
Weightage of the components of food articles



Source: Ministry of Commerce and Industry, 2014

Figure B.2

Prices trend of the different components of food articles for the period of January 2006 to December 2013

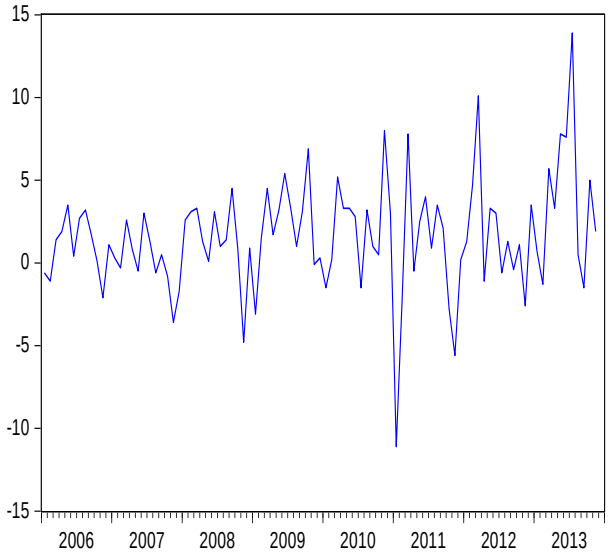


Source: Ministry of Commerce and Industry, 2014

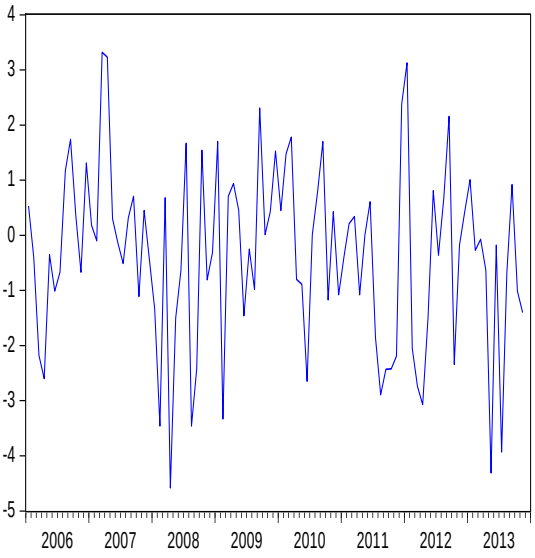
Appendix C

The appendix describes the data in graphics form at first difference because error correction model require the data in the first difference that I have used in the short run analysis.

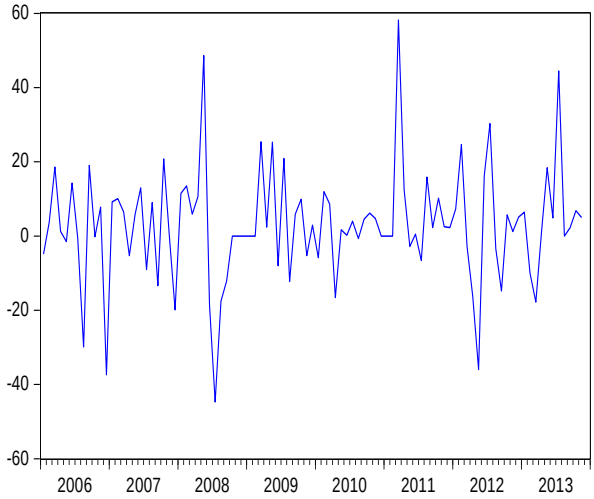
FOOD PRICE INDEX



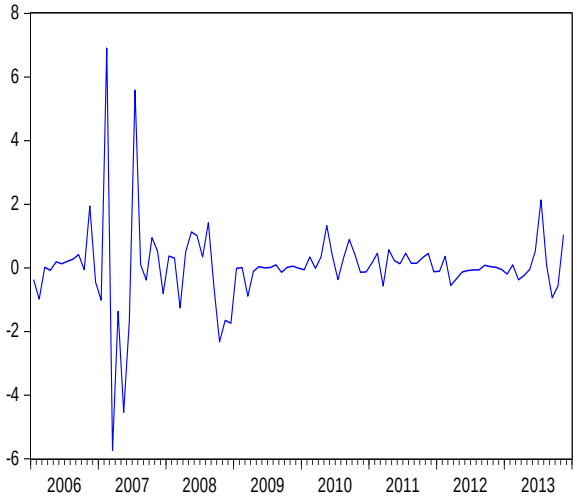
EXCHANGE RATE



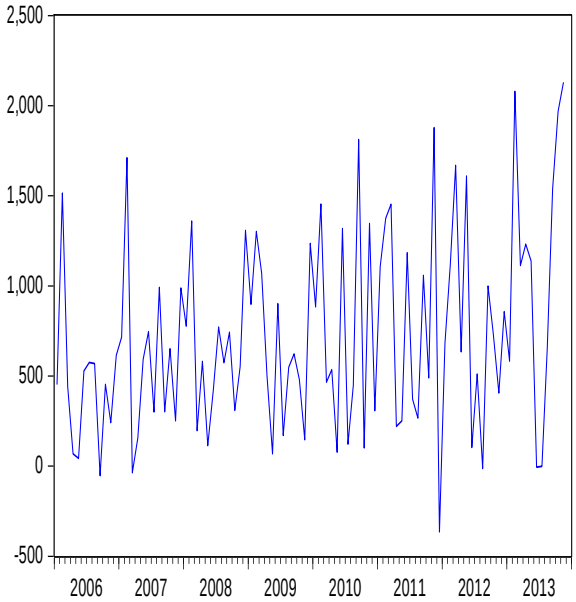
CRUDE OIL PRICE INDEX



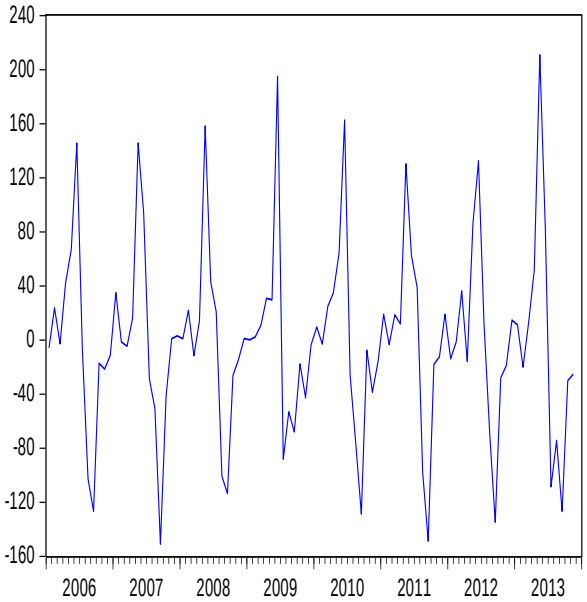
INTEREST RATE



MONEY SUPPLY



RAINFALL



WORLD FOOD PRICE INDEX