

Summary

A Historical Causality Analysis of Inflation

Inflation has been one of the main points of interest to policy makers due to the fact that it eats away purchasing power, raises cost of living and lowers the real value of saving making it one of the most closely monitored macroeconomic indicators of any economy.

During 2000 to 2007, India has fared comparatively well with respect to its inflation figures vis-à-vis other countries. India's average inflation (WPI 5.2% and CPI-IW 4.6%) has been below the average of emerging and developing economies (6.7%). In 2008-09 inflation went up to 8.1% and had remained in double digits during 2010-11 and 2011-12 (Mohanty, 2013).

The indices that are most widely used in India to measure inflation are the Wholesale Price Index (WPI) and four measures of Consumer Price Index (CPI). As per the methodology adopted by the Office of Economic Adviser, Ministry of Commerce and Industry, Government of India to compute the two indices, the WPI and CPI vary widely with respect to their composition. However, the WPI has a more comprehensive and economy-wide coverage and the weights in the commodity basket are based on the value of quantities traded in the domestic market (Statistical Yearbook 2011, Ministry of Statistics and Program Implementation (MOSPI)). The WPI has also proved to be a comparatively more real-time indicator of inflation than the CPI (CPI has been tagged as the 'lagging indicator' of inflation). Also, data for CPI is restricted (CPI data is not reported as old as WPI data). The study hence uses WPI to represent inflation for the causality analysis.

A commonly used way to analyse inflation data is to use the 'core inflation' instead of the headline inflation. Within WPI, non-food manufactured inflation is considered as core inflation which is a measure of inflation excluding the volatile components of food and energy prices. Including food and energy prices may misguide the representations as it may seem that overall prices are increasing or decreasing more rapidly than they actually are. According to Motley (1997) "although these prices have substantial effects on the overall index, they often are quickly reversed and so do not require a monetary policy response". Hence the current study uses core inflation for the analysis.

According to the Statistical Yearbook 2011 of the Ministry of Statistics and Programme Implementation (MOSPI), the main reasons for the consistent rise in inflation are crude oil, global commodity price trends (due to increased deregulation and liberalization) and

exchange rate changes. The demand for food products have been seen to increase even though the production has remained stagnant. With rise in per capita income, protein based food products have been gaining on its demand. Strong demand factors in periods of high inflation and low supply elasticities, have led to further rise in inflation. NSSO 68th Round survey shows per capita consumption expenditure has increased in both rural (average 1.4% during 2004-09 to 8.7% during 2009-12) and urban (2.4% to 6.7% for the same period) areas of the country. High food prices have been followed by subsequent rises in nominal wages which led to higher consumption demand. Moderation in the recent inflation is attributable to lowering inflation of non-food articles, non-administered petroleum products (leading to a moderation of inflation in fuel and power sectors) and manufactured products.

This sets the stage for the necessity of understanding causality of inflation not only in the time domain but also in the frequency domain and trying to model it effectively so that targeting the same becomes easier.

Literature Review

Here, the mixed results depicted by existing studies for India and otherwise, for causality of inflation through various variables is discussed. This helps us identify the variables for the study and contributes to the construction of a model that is capable of covering the major sources of inflation.

The literature shows that many studies have been conducted to determine the factors causing and/or affecting inflation in the time domain but very few studies have attempted to capture the frequency domain relationships. The theories of inflation too address the time domain dependence of inflation on various factors but none of them explore the frequency domain causality to determine the long run and short run causality effects of such variables on inflation. The current study attempts to address this gap by conducting causality analysis in the frequency domain and then constructing SVAR models (based on the results received from the causality analysis) to represent inflation. The study also conducts innovation analysis to establish the effect of shocks in the selected macroeconomic variables on inflation to understand whether the effects are shortlived or longlived and the significance of the effects.

Motivation for the Study

This sets the stage for the necessity of understanding causality of inflation not only in the time domain but also in the frequency domain and trying to model it effectively so that targeting the same becomes easier. It is also evident that effect of dis-aggregated prices on the core inflation should play a vital role and hence modelling core inflation as a function of the various dis-aggregated components along with some other macroeconomic variables should be able to shed better light on the general behaviour of inflation in the economy. However, a time domain analysis may not be sufficient since it ignores the cyclical effects (if any). Hence, it is imperative to look as the spectral analysis to ascertain the cyclical or frequency wise nature of the causality. The theories of inflation address the time domain dependence of inflation on various factors but none of them explore the frequency domain causality to determine the long run and short run causality effects of such variables on inflation. The current study attempts to address this gap by conducting causality analysis in the frequency domain and then constructing SVAR models (based on the results received from the causality analysis) to represent inflation. The study also conducts innovation analysis to establish the effect of shocks in the selected macroeconomic variables on core inflation to understand whether the effects are shortlived or longlived and the significance of the effects.

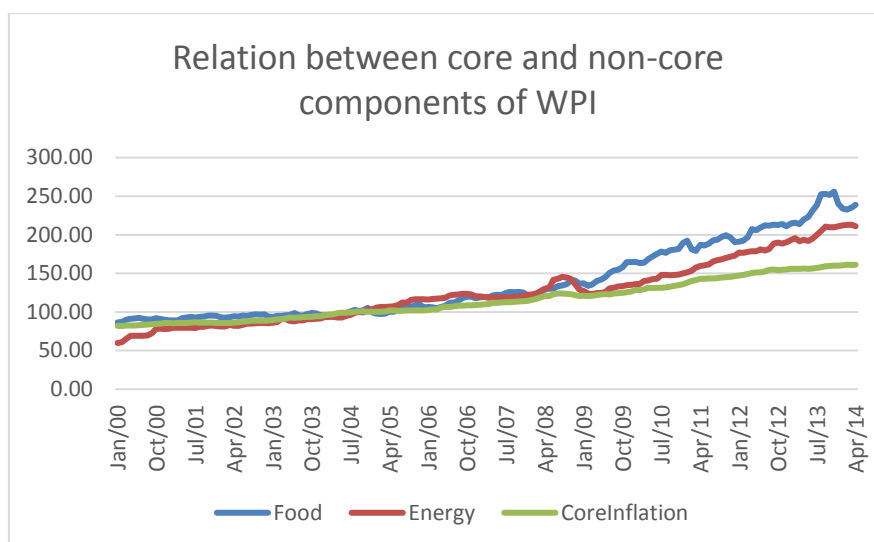


FIGURE 1-1: CORE & NON-CORE WPI – SOURCE: OFFICE OF ECONOMIC ADVISER AND AUTHOR'S CALCULATIONS

The figure above shows how core WPI is related with food and energy WPI (non-core components of WPI). Food inflation and energy inflation being two of the strongest reasons for driving overall inflation in the country (as cited by many studies), the study considers the two series while checking causality and modelling core inflation.

The other variables chosen for the study are international energy prices, money supply (all the four measures) and output gap as a measure of excess demand (computed through four filters – HP, BK, BW and CF).

Objectives and hypotheses

The objectives:

- a) To test whether the selected macroeconomic variables have significant causal effect on inflation
- b) To establish the direction and strength of the relationships
- c) To construct a model for inflation prediction

The hypotheses used for achieving the above-mentioned objectives are listed as follows:

- a) Domestic food price causes core WPI significantly
- b) Domestic energy price causes core WPI significantly

- c) Domestic output gap causes core WPI significantly
- d) Domestic money supply causes core WPI significantly
- e) International energy price causes core WPI significantly
- f) All the five macroeconomic variables have a positive effect on core inflation
- g) All the five macroeconomic variables (together) are able to explain core inflation in a statistically significant manner
- h) Each of the variables (individually) have statistically significant effect on inflation

Chapter Scheme

The study is divided into the following parts:

Chapter 1 – Introduction

This chapter provides an overview of the incidence of inflation along with the effects on expected and unexpected inflation followed by the role of policies in tackling inflation and its relation with economic growth. The chapter also touches upon the trend of inflation and notes various measures of inflation and their interrelations. The chapter also provides the rationale of the study along with the research questions and a schema for the entire thesis.

Chapter 2 – Literature Review

This chapter reports the literature available on the various variables that cause inflation. The section begins by discussing the existing theories that exist in the literature followed by discussion of studies that highlight various causal factors of inflation in India and otherwise moving on to studies related to each of the causal factors considered for the current study. Each sub-section contains literature for a particular variable, first from the global perspective and then in particular relation to studies on the Indian context (if any). The chapter notes the absence of a spectral analysis for causality of inflation for the selected variables for the current study.

Chapter 3 – Data and Methodology

This chapter spells out the data and methodology used for the study. Some of the variables had to be constructed manually from the reported data. The process of doing the same is the primary focus of the chapter followed by the econometric methods used to test causal relations among the variables. The chapter begins by citing the significance of using core inflation instead of headline inflation as the measure of inflation for the study and explains the methodology used to construct core inflation series from the wholesale price index available from the Office of the Economic Adviser. Next, the section discusses various literature on use of filters for calculating output gap and highlights in particular the four filters used for the study, namely, Hodrick-Prescott, Baxter-King, Butterworth and Cristiano-Fitzgerald filters. The methodology for constructing the filters and extracting the cyclical component and further constructing the output gap series are discussed thereafter. The sources of the variables chosen for the study are discussed. Next, the methodology for the econometric tests are discussed. The discussion begins with tests for stationarity and seasonality, in particular the HEGY test, followed by ARIMA model used to filter the data to extract the residuals to be used for causality analysis. A discussion on Granger causality in the frequency domain follows next ending with explanation of the method for innovation analysis – impulse response function and forecast error variance decomposition methods.

Chapter 4 – The model

The chapter reports the model constructed to check for causality effects of the chosen variables on core WPI. The section begins by highlighting all the variables used in the study followed by the structural VAR models constructed to test dependence of core WPI on each of the other five variables. The chapter includes the sixteen models being considered for the analysis – each model has one variant of output gap measure and one variant of money supply measure.

Chapter 5 – Results and discussions

This chapter of the study reports and explains the results for spectral causality and SVAR modelling with innovation analysis. The results show that only international energy prices have a long run causal effect on core inflation, food prices do not cause core inflation at any of the frequencies and domestic energy prices, output gap and money supply cause core inflation in the short run. The SVAR and innovation analysis shows that an unprecedented change in each of the variables (a shock) has significant effect on core inflation for subsequent periods of time and the variability of core inflation is explained significantly by each of the variables (except food inflation).

Chapter 6 – Conclusions and policy implications

The last chapter summarises the findings and points out the implications of the results. The results clearly show the endogenous nature of Indian core inflation and highlight the differences in demand side and supply side transmission mechanisms along with domestic and international effects on Indian inflation. This may be considered as a new way of looking at monetary policy making. The section also highlights the probable extension of the study.

Conclusions and Policy Implications

The spectral or frequency domain analysis of causality help us detect causality (or non-causality) at various frequencies or cycles for the time frame considered for the study. The frequency domain representation provides further crucial insights into the causality relationships by breaking down the time domain representation into frequencies that enables us to identify the existing cyclical relationship, if any.

The results reveal that international energy prices cause core inflation only in the long run but two of the output gaps cause core inflation only in the short run, one of the measures of output gap does not cause core inflation at any frequency and one measure causes core inflation in two and seven month cycles, showing by and large, the short run nature of

causality from output gap to inflation. This signifies the differences in the supply side and demand side transmission mechanisms for causing inflation. International energy prices raise domestic cost of production which in turn may reduce incentives for producers to produce as much as they have been producing earlier. This leads to a fall in the supply of the economy as a whole, vis-à-vis the existing demand in the market. As a result, prices go up. On the other hand, output gap, which is the difference of the actual production from the potential production level, is essentially an instrument to determine the extent of excess demand in the market. This excess demand forces market prices to rise, leading to inflation. Given this, it can be argued that international energy price is a supply side variable and output gap is a demand side variable, while analysing their relationships with inflation. The above results allow us to argue that the supply side mechanism for causing inflation has significant effect only in the long run and not in the short run and the demand side mechanism works mostly in the short run. These insights may be able to assist policy-makers in designing more effective policies while trying to combat inflation both in long run and short run. With the knowledge of short run and long run effects of the demand and supply side forces on inflation, both the central bank as well as the Centre should be in a better position to frame more effective policies to curtail inflation as and when the necessity arises. A rise in the cost push inflation (through international energy prices) should be targeted with a long run perspective in mind, while inflation caused through output gap channel (demand pull) should receive more attention in the short run.

Domestic energy prices cause core inflation only for cycles between seven and nine months. With energy becoming more expensive within the economy, the time for transmission required into the non-food, mineral and manufacturing sectors is at least seven months and the effect survives up to the next two months, the causality effect ceasing post that cycle. In the business cycle, energy price changes will not cause core inflation. If and when the economy

suffers from rising energy prices (which has been rampant in the Indian context) the core inflation will be affected only in the short run and not in the long run. Hence, no change in the monetary policy is required for tackling long run inflation. However, if the intention of the central bank is to curb the short run rise in core inflation, only then it would make sense to divert the instruments towards this end. This result also implies the necessity for energy efficiency and the role of the policymakers in controlling energy prices. In recent times in India, the benefits from a fall in internal energy prices has not been passed on to the domestic energy price, however, the adverse effects have been reflected almost over-night. Some amount of prudence on the part of the central government in keeping domestic energy prices under control is expected to go a long way in controlling the core inflation of the country. At the same time, efficient use of existing amount of energy resources and also promoting alternate sources of energy may play a huge role in keeping inflation within the targeted limits.

Unlike the popular belief, our results show that domestic food inflation does not cause core inflation at all, be it at any cycle or frequency. Curbing food inflation with expectations of keeping core inflation under control is hence, not a prudent path to walk down at all.

The causality results from the four measures of money supply shows that the three measures (except M2) cause core inflation only in the short run and not in the long run (only M2 shows significant causality for cycles greater than fifty-two months). Thus, by and large, the causal effect of money supply on core inflation exists statistically significantly only in the short run.

All the domestic variables of the study are found to cause core inflation in the short run (except food inflation which shows no causality) and only international energy price is seen to cause core inflation in the long run. The transmission mechanism for domestic factors is

thus found to be fundamentally different from that of the internal factor under consideration in the study.

The SVAR results imply that each of the variables under consideration in the study have positive effect on core inflation. Whether the causality effect is in the short run or in the long run or there exists no causality at all, a one unit rise in each of these variables lead to a rise in core inflation. The IRF analysis implies that any unprecedented rise in any of these variables have non-dampening effect on core inflation for almost all the variables in all of the sixteen models considered. The effect doesn't fade away but persist over significant subsequent periods. FEVD results show that the contribution of each of these variables' variances to the variance of core inflation has increased over time (on an average). This shows the endogenous nature of core inflation in India and the importance of all the variables under consideration – domestic energy price, food price, output gap, money supply and international energy prices in understanding the variability of core inflation in the Indian economy and also the individual contribution of these variables in explaining the dynamic behaviour of Indian core WPI inflation.