Inflation and Relative Price Variability in India-
A Decomposition Analysis

Sartaj Rasool
S Raja Sethu Durai
M Ramachandran

DEPARTMENT OF ECONOMICS
PONDICHERY UNIVERSITY

May 2011
Inflation and Relative Price Variability in India-
A Decomposition Analysis

Sartaj Rasool
Research Scholar, Department of Economics, Pondicherry University, Puducherry – 605 014

S Raja Sethu Durai
Assistant Professor, Department of Economics, Pondicherry University, Puducherry – 605 014

M Ramachandran
Professor, Department of Economics, Pondicherry University, Puducherry – 605 014

Abstract

This study aims at decomposing relative price variability due to real factors, inflation and their interaction, using the methodology proposed by Clements-Nguyen (1981, 1982) for India. The empirical evidence from highly disaggregated commodity-wise monthly data for the period from April-1994 to November-2009 suggests that the real factors such as technical change, real income growth etc. account for 55 percent of total relative price variability and the rest is attributed to inflation. Also distribution of cross sectional variance shows that almost 60 percent of it is contributed by 30 commodities indicating that variability in the relative prices is driven by only few commodities. The more crucial inference that emerges from the empirical analysis is that the threshold inflation rate that minimizes the relative price variability seems to have been 4.5 percent, which is consistent with the official threshold rate maintained by the Reserve Bank of India.

Keywords: Key words: Inflation, Relative price variability, Decomposition analysis, Minimum-variance inflation rate

JEL Classification: E31; E32

1 Corresponding author email: sartajrasool@gmail.com
1. Introduction

Price stability is the predominant objective of monetary policy of central banks all over the world. Monetary policy—whether expressed in terms of interest rates or growth of monetary aggregates—has been increasingly geared toward the achievement of low and stable inflation. Price stability means that keeping the inflation rate at a level that is not hindering the households and businesses in every day decision making. High inflation can hamper growth because of number of factors: lowers economic efficiency, redistribution of wealth, aversion to long term contracts and excessive resources are devoted to hedging inflation risks (Barrow, 1996; Fisher, 1983). In developing economies, an additional cost of high inflation emanates from its adverse effects on the low and fixed income group. In general, the idea is that businesses and households are thought to perform poorly when inflation is high and unpredictable.

It has been found that inflation proceeds in a very ragged manner with some prices rising by more than average an others by less (Parks, 1978). This finding is extremely important because these relative price distortions may cause costly resource reallocations, which would have to be included in any evaluation of the cost of inflation. Basically, higher inflation effects real sector of the economy through its effect on inflation uncertainty and relative price variability (RPV). This follows from the fact that higher inflation uncertainty results in shorter length of contracts than the optimal length or induces risk premia for long-term arrangements, raises costs for hedging against inflation risks, leads to unanticipated redistribution of wealth and also indexing becomes more prevalent. All of which reduce economic efficiency relative to a world of more stable prices. More important, due to increasing relative price variability agents' ability to distinguish between changes in relative and absolute prices decreases. The role of the market-price system in coordinating economic activity and transmitting information become impeded, thus reducing economic efficiency further. Thus, both, inflation uncertainty and RPV reduce the efficiency of market prices as a coordinator of economic activity and affect negatively investment decisions (Caballero, 1991). The resulting price structure is distorted from initial cost and preference fundamentals and may induce resource misallocation and welfare loss (Fisher, 1981). Other than inflation real factors such as demand shift variables, resources, weather and technology can also cause changes in relative prices of commodities. However, relative price adjustments associated with changes in demand shift variables, resources, weather and technology are essential for the efficient allocation of resources.

The existence of a positive correlation between inflation and relative price variability was observed by Mills (1927) and Graham (1930) much earlier, it received little attention until the mid-1970s when Vining and Elwertowski (1976) re-examined this relationship. Interestingly, the publication of their work coincided with the aftermath of the high and extremely volatile inflation of the early 1970s, which many economists blamed on so called ‘supply shock’. These supply shocks were typically associated with increases in the relative prices of such as energy and food. The debates and discussions of that period brought to the fore the importance of relative price changes.

One stream of the literature that attempts to explain the relationship between inflation and relative price variability focuses on the sources of relative price changes. For example, using a multi-sectoral supply-and-demand model that fits the misperceptions model framework of Lucas (1973) and Parks
(1978) show that changes in real income and unanticipated inflation explain a large part of relative price variance. This model has been extensively utilized for the study of the relation between inflation, inflation uncertainty, and relative price variability (e.g. Cukierman and Wachtel, 1979, Hercowitz, 1981). Hercowitz (1981) extends the misperceptions models of Lucas (1973) and Barro (1976) to show that unanticipated money growth is responsible for the rise in relative price dispersion, which is inflationary. Fischer (1981,1982) describes the asymmetric price response hypothesis, associated previously with Schultz (1959) and Tobin (1972), whereby different prices respond differently to disturbances, so that any shock to the price system is spread asymmetrically across its components.

These studies have focused mainly on the underlying factors of relative price variability with attributing it to unanticipated inflation, real income changes and unanticipated money growth. It is clear from the existing literature that variability in relative prices originates from either from real factors or from inflationary factors (monetary) or both, which may varied from time to time and across commodities. However the issue of relative importance of the real and inflationary factors is not very clear. It is of interest to know the proportion of variability in relative prices attributed to real and to inflationary factors for analysing the relative importance. It will be also interesting to analyse the dynamic shares of these sources (real and inflation) which may vary from time to time and also across commodities. In other words it will be very useful to policy makers to understand whether change in a relative price of a particular commodity is due to real factors such as change in real income, technology, supply shock (which is essential for the efficient allocation) or inflationary factors such as changes in inflation, unanticipated inflation, money supply (which is very distortionary) or both.

In this backdrop this study aims at analysing the relative shares of real and inflationary factors in causing variability in relative prices of commodities. This analysis will give an idea about the variability in relative prices attributed fully to real factors that is natural rate of relative price variability as called by Clements and Nguyen (1981). Also this study gives an estimate of minimum variance inflation rate that is inflation rate which is associated with minimum variability of relative prices.

We have used a methodology proposed by Clements and Nguyen(1981) that studied the relation between inflation and variability of relative price changes. Using the highly disaggregated commodity wise data on Wholesale price index (WPI) for the sample period from April-1994 to November-2009 the study estimates the proportions of relative-price variability that can be attributed to real factors and inflation. Also, the study identifies those commodities which contribute most to total relative price variability and analyses their inflation and real component in their respective shares. This gives an idea about the commodities whose relative prices are distorted mainly by inflationary factors. Next the study aims at estimating minimum-variance inflation rate and natural rate of relative price variability for India.

This study differs from Clements–Nguyen (1982) in the manner that we have used highly disaggregated monthly WPI data across 419 commodities which enables the decomposition at very micro level. In addition to that, the study asses the time varying shares of different commodities in total relative price and analyses the decomposition of the each commodity-share individually in each month. This provides microscopic view of time varying components of inflation and real factors in the composition of total relative price variability for each
month and for each commodity. Also, since the data are monthly and sample size is fairly large, we have run a Bai-Perron (1998) multivariate structural break test which found three breakpoints and divided sample into four subsamples. A comparison is made of position for low inflationary period with that of high inflationary period, this gives an assessment of the composition and distribution of relative price variability in various inflationary regimes.

The findings of the study suggest that the 60 percent of the total relative price variability is attributed to top 30 commodities and rest to all other commodities. This shows that high fluctuations in the prices of only few commodities is responsible for major part of the observed total variability of the relative prices. Also, the decomposition analysis carried shows that, in total relative price variability 45 percent is inflation component and 55 percent is real component for the period of study. This proportion of inflation and real component seems to vary with inflation rate across the subsamples. The share of inflationary component seems to increase in high inflationary period and decreases in low inflationary situation as is expected. The more crucial inference that emerges from the empirical analysis is that the threshold inflation rate that minimizes the relative price variability seems to have been 4.5 percent, which is broadly consistent with the official threshold rate maintained by the Reserve Bank of India. Also, the natural rate of relative price variability is calculated at 0.06 percent for the study period.

In the following section 2 of the paper we discuss data and methodology and in section 3 empirical estimates are given, subsequently section 4 draws conclusion of the study.

2. Data and the Econometric Methodology

Clements and Nguyen (1981, 1982) proposed a model that studied the relation between inflation and variability of relative-price changes. The model enables the identification of those commodities whose relative prices are distorted by inflation (or by real factors). It also provides measures of the natural rate of relative price variability which is associated with zero inflation and the minimum-variance inflation rate that is the inflation rate which minimizes the variability of relative prices. Subsequently, they introduced an interesting methodology for decomposing relative price variability into the components due to the real factors, inflation and interaction (see, Clements and Nguyen 1982). They applied this decomposition procedure to Australian data for the period 1959-1978 across 7 commodity groups and find that inflation accounts for 24 percent of relative price variability during the period.

To compute the aggregate inflation rate and the moments of the distribution of relative price changes, we use the Wholesale Price Index (WPI) and its sub-indices at highly disaggregated level. The old measure of WPI comprises 435 commodities under three different categories. The complete time series derived from a uniform definition of the sub-indices of each commodities covering the entire sample period were available on 419 commodities out of total 435 commodities. Monthly data on these 419 commodities for the period from April 1993 to November 2009 is used for the analysis. The choice of the sample period is dictated by the availability of consistent and uniform time series on price indices of these commodities over the period. The data on WPI and their respective weights is collected from the website of Office of the Economic Advisor, Ministry of Commerce and Industry, Government of India.
2.1. Inflation and variability of relative price changes

The sample moments of the distribution of relative price changes is computed as follows. The realization of the price in ith commodity ($i=1,\ldots,419$) observed in period $t$ is denoted by $p_{it}$ and $\ln$ denotes the log change operator. The rate of change in ith commodity price index from $t-12$ to $t$ time period will be denoted by $\pi_{it}$ and is calculated as given in equation 2.1. This measures the annual rate of inflation for each month.

$$\pi_{it} = \ln(p_{it}/p_{i(t-12)})$$ (2.1)

The aggregate inflation rate $\pi_i$ in period $t$ can then be computed as the weighted average of the changes of the sub-indices, as follows

$$\pi_i = \sum_{i=1}^{n} \omega_i \pi_{it}$$ (2.2)

where $n$ denotes the number of commodities in the sample and $\omega_i$ represents the weight of $i^{th}$ commodity in the WPI basket. Using aggregate inflation rate $\pi_i$, the higher order central moments of the distribution of relative price changes are easily computed. The relative price variability that is cross-sectional variance of this distribution denoted as $\lambda_i$ is given by:

$$\lambda_i = \sum_{i=1}^{n} \omega_i (\pi_{it} - \pi_i)^2$$ (2.3)

This is a measure of the degree to which price changes are disproportionate, or a measure of changes in relative prices. Thus if all prices move equipropor tionally (i.e., if all relative prices are constant) therefore, $\pi_{it}=\pi_i$, and $\lambda_i=0$.

Clements and Nguyen (1981, 1982) point of departure is the following relationship between the relative price change of a commodity $i$ and the rate of inflation:

$$\omega_i (\pi_{it} - \pi_i) = \alpha_i + \beta_i \pi_i + \epsilon_i$$ (2.4)

Where $\alpha_i$ and $\beta_i$ are commodity specific parameters and $\epsilon_i$ is a random disturbance term with the usual classical properties. It follows from the (2.4) that $(\alpha_i/\omega_i)$ is the autonomous trend in the relative price of commodity $i$, reflecting real changes in the economy and $(\beta_i/\omega_i)$ is the elasticity of the relative price of $i$ with respect to inflation rate $\pi_i$. Also, if $\beta_i > 0 (<0)$, $\pi_{it}$ rises more (less) than proportionately with the general inflation rate $\pi_i$, so that relative price of commodity $i$ rises (falls).

Variance of relative prices in equation (2.3) can be equivalently expressed as

$$\lambda_i = \sum_{i=1}^{n} \omega_i [(\alpha_i/\omega_i) + (\beta_i/\omega_i)\pi_i]^2$$ (2.5)

Finally the component due to the interaction of real changes and inflation is

2.2. Decomposition of variance of relative prices

The share of commodity $i$ in $\lambda_i$ is

$$\theta_{it} = \omega_i [(\alpha_i/\omega_i) + (\beta_i/\omega_i)\pi_i]^2 / \lambda_i$$ (2.6)

The $\theta_{it}$’s are non-negative and have a unit sum. This will give the distribution of relative price variability across the commodities in time period $t$.

The effects of real changes on the relative price of commodity $i$ are given by the coefficient $\alpha_i$ in equation (2.4), thus the real component of $\theta_{it}$ is given by

$$\theta_{it}^R = (\alpha_i^2/\omega_i) / \lambda_i$$ (2.7)

which is non-negative. The corresponding inflation component is

$$\theta_{it}^I = (\beta_i^2/\omega_i) / \lambda_i$$ (2.8)

which is also non-negative.

---

2 The equation is estimated for all 419 commodities included in the sample using Ordinary Least Squares estimation.
\[ \theta_i^{RI} = 2\alpha_i (\beta_i / \omega_i) \pi_i^2 / \lambda_i \]  
(2.9)
which may be either negative or positive. It follows that
\[ \theta_i^R + \theta_i^I + \theta_i^{RI} = \theta_i \]  
(2.10)
Summing \( \theta_i^R, \theta_i^I \) and \( \theta_i^{RI} \) over \( i \), respectively gives the share of real component, inflation component and interaction component, in \( \lambda_i \).
That is
\[ \lambda_i^R = \sum_i (\alpha_i^2 / \omega_i) / \lambda_i = \sum_i \theta_i^R \]  
(2.11)
gives the real component. Similarly the share of inflation component is
\[ \lambda_i^I = \sum_i (\beta_i^2 / \omega_i) / \lambda_i = \sum_i \theta_i^I \]  
(2.12)
and the share of interaction is
\[ \lambda_i^{RI} = \sum_i 2\alpha_i (\beta_i / \omega_i) \pi_i / \lambda_i = \sum_i \theta_i^{RI} \]  
(2.13)
It follows that,
\[ \lambda_i^R + \lambda_i^I + \lambda_i^{RI} = 1 \]  
(2.14)
Summing \( \theta_i^R, \theta_i^I \) and \( \theta_i^{RI} \) over \( t \), that is
\[ \theta_i^R = \sum_t \theta_i^{Rt} ; \quad \theta_i^I = \sum_t \theta_i^{It} ; \quad \theta_i^{RI} = \sum_t \theta_i^{RIt} \]  
(2.15)
gives the components of share of commodity \( i \) in total relative price variance.
And the total share of commodity \( i \) in total relative price variability is given by
\[ \theta_i = \theta_i^R + \theta_i^I + \theta_i^{RI} \]  
(2.16)
To calculate total \( \lambda_i^R, \lambda_i^I \) and \( \lambda_i^{RI} \) that is real, inflation and interaction component for the overall sample period, \( \lambda_i^t, \lambda_i^I \) and \( \lambda_i^{RI} \) has been summed respectively, over \( t \). That is
\[ \lambda_i^R = \sum_t \lambda_i^{Rt} ; \quad \lambda_i^I = \sum_t \lambda_i^{It} ; \quad \lambda_i^{RI} = \sum_t \lambda_i^{RIt} \]  
(2.17)
2.3. Minimum-variance inflation rate and natural rate of relative price variability
By using the equation (2.5) we can derive the natural rate of relative price variability,
\[ \lambda_i = \sum_{i=1}^{n} \omega_i \left[ (\alpha_i / \omega_i) + (\beta_i / \omega_i) \pi_i \right]^2 = \lambda(\pi_i) \]  
(2.18)
that is relative price variability corresponding to zero inflation. Since this value is determined entirely by real factors such as income, tastes, technology etc. hence it is called as natural rate of relative price variability.

By differentiating equation (2.5) with respect to \( \pi \) and putting \( \partial \lambda / \partial \pi = 0 \) gives minimum-variance inflation rate, \( \pi^* \), i.e.
\[ \pi^* = -\sum_i \alpha_i (\beta_i / \omega_i) / \sum_i (\beta_i^2 / \omega_i) \]  
(2.20)
3. The Empirical Results
This section provides empirical results and discussions under different headings.
3.1. Commodity shares and Cross sectional decomposition of relative price variance
The share of a commodity \( (\theta_i) \) in the total variance of relative price changes is given in column 4 of the Table\(^3\). Interestingly top 30 commodities almost contribute 60 percent of the total relative price variability for the sample period of the study, the shares of only these dominant commodities has been presented\(^4\). The relative price of Texturised Yarn alone accounts for 6 percent of total variability in relative price. Next to this is high speed diesel oil with 5 percent share.

The entries in columns 3 to 4 decompose \( \theta_i \) into real \( (\theta_i^R) \) and inflation \( (\theta_i^I) \) component for each commodity. The results shows that 6 percent share of Texturised Yarn in total relative price variance is whole made up of real factors and no visibility of inflation

\(^3\)The results are shown for only top 30 commodities, full information can be obtain from author on request.

\(^4\)Month wise decomposition and commodity share is not presented here so as to save the space. However these figures gives some idea about the month wise decomposition.
component. Similarly for High speed diesel oil 93 percent of its share is real component and 7 percent is inflation

In Table 2 these dominant commodities are arranged in terms of their percentage share of real and inflation component in their respective contributions to total variance of relative prices.

For the commodities like Liquefied petroleum gas, Iron ore, Texturised Yarn, High speed diesel oil, Kerosene, T.V. sets B & W and the category Capsule other than vitamin & antibiotics, the major component of their share in relative price variance is of real factors. It evident that all the 2 percent share \((\theta_I)\) of Iron ore comes from real factors such as supply shocks, real income growth etc. As given in Table 2 the variability in the relative prices of these top few commodities commodities is due to real factors.

From bottom, Table 2 shows commodities whose major component in their respective shares is of inflation factors. For the commodities like, Naptha, Furnace oil, Computer & Computer Based System and Capsule other than vitamin & antibiotics the major share (almost 100 percent for few) is of inflation component in their respective contributions to the total relative price variance. Thus variability in relative prices of these commodities is mainly due to inflationary factors. It is evident from estimates that there are only few commodities among these top 30 whose relative prices are affected mainly due to the inflation factors. Real component is dominant in most of commodities.

\[ \frac{\theta^R}{(\theta^R + \theta^I)} \]

\[ \frac{\theta^I}{(\theta^R + \theta^I)} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]

\[ \frac{\theta^R}{\theta^I} \]

\[ \frac{\theta^I}{\theta^R} \]
Table 2: High inflation and real component commodities*

<table>
<thead>
<tr>
<th>COMMODITY</th>
<th>(θᵢ)</th>
<th>(θᵢᵢ)</th>
<th>(θᵢᵢᵢ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T.V. sets B&amp;W</td>
<td>1</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Iron ore</td>
<td>2</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Texturised Yarn</td>
<td>6</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Electricity for Agriculture</td>
<td>1</td>
<td>98</td>
<td>2</td>
</tr>
<tr>
<td>Kerosene</td>
<td>1</td>
<td>98</td>
<td>2</td>
</tr>
<tr>
<td>Liquified petroleum gas</td>
<td>2</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td>Tablet except vitamin &amp; penicillin</td>
<td>2</td>
<td>94</td>
<td>6</td>
</tr>
<tr>
<td>High speed diesel oil</td>
<td>5</td>
<td>93</td>
<td>7</td>
</tr>
<tr>
<td>Picture Tubes (Color)</td>
<td>1</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>TV sets Color</td>
<td>3</td>
<td>89</td>
<td>11</td>
</tr>
<tr>
<td>Polyster Yarn</td>
<td>5</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>Lime stone</td>
<td>1</td>
<td>86</td>
<td>14</td>
</tr>
<tr>
<td>Synthetic Yarn</td>
<td>1</td>
<td>76</td>
<td>24</td>
</tr>
<tr>
<td>Polyster staple fibre</td>
<td>3</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Fish-Inland</td>
<td>1</td>
<td>66</td>
<td>34</td>
</tr>
<tr>
<td>Milk</td>
<td>1</td>
<td>66</td>
<td>34</td>
</tr>
<tr>
<td>Poultry chicken</td>
<td>1</td>
<td>63</td>
<td>37</td>
</tr>
<tr>
<td>Purified Terephthalic Acid</td>
<td>1</td>
<td>59</td>
<td>41</td>
</tr>
<tr>
<td>Cotton Yarn-Cones</td>
<td>1</td>
<td>57</td>
<td>43</td>
</tr>
<tr>
<td>Cotton Yarn-Hanks</td>
<td>2</td>
<td>56</td>
<td>44</td>
</tr>
<tr>
<td>Acid all Kinds</td>
<td>2</td>
<td>53</td>
<td>47</td>
</tr>
<tr>
<td>Raw Cotton</td>
<td>5</td>
<td>51</td>
<td>49</td>
</tr>
<tr>
<td>Sugar</td>
<td>1</td>
<td>48</td>
<td>52</td>
</tr>
<tr>
<td>Rectified spirit</td>
<td>1</td>
<td>48</td>
<td>52</td>
</tr>
<tr>
<td>Deoiled cake</td>
<td>1</td>
<td>39</td>
<td>61</td>
</tr>
<tr>
<td>Ammonium sulphate and content</td>
<td>1</td>
<td>33</td>
<td>67</td>
</tr>
<tr>
<td>Computer &amp; Computer Based System</td>
<td>3</td>
<td>26</td>
<td>74</td>
</tr>
<tr>
<td>Furnace oil</td>
<td>1</td>
<td>9</td>
<td>91</td>
</tr>
<tr>
<td>Capsule other than vitamin &amp; antibiotics</td>
<td>2</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td>Naptha</td>
<td>1</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>58</td>
<td>1966</td>
<td>1034</td>
</tr>
</tbody>
</table>

*all figures given are in percentage

Thus it indicates that the major component of relative price variability is built of real factors and relatively less visibility of inflation.

3.3. Decomposition of total relative price variability across various periods

Below Table 4 (column 1, 2 and 3) gives the components of total relative price variability attributed to real factors (λᵢᵢ), inflation (λᵢ), and interaction (λᵢᵢᵢ), and column 4 and 5 show figures of (λᵢᵢ) and (λᵢ) after allocation of interaction term (λᵢᵢᵢ).^6^ The position is given for each sub-sample separately. For the period of study on an average, 55 percent of the total relative price variability is built of real component and the rest is attributed to inflation. This shows that proportion of relative price variance which can be attributed to real factors such as technological changes, supply shock, real income growth etc. is higher than inflation component.

Thus in India 45 percent of total relative price variability is build-up of inflation component which is very high. The share of inflation component is highest in the high inflationary period from April-1994 to June-1996 and lowest in low inflation period. Also the inflation component is greater than its respective real component in high inflation period and lower in low inflation. Since average inflation rate does not vary too much across the rest of the sample periods so does the shares of (λᵢᵢ) and (λᵢ). Therefore it seems that in higher inflationary periods the share of inflation component in relative price variance increases and vice-versa. Also the share of interaction component is highest in the period July-1997 to February-2001, which means that for this period relative price of commodities are increasing due to real changes, but decreasing due to inflation.

^6^ results are provided only for five dominant commodities in each subsample, full information can be collected on the request.
Table 4: Decomposition of relative price variability*

<table>
<thead>
<tr>
<th>COMMODITY</th>
<th>((\theta))</th>
<th>((\theta^*))</th>
<th>((\theta'))</th>
</tr>
</thead>
<tbody>
<tr>
<td>April-1994 to June 1996</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw Cotton</td>
<td>5</td>
<td>42</td>
<td>58</td>
</tr>
<tr>
<td>Chillies(Dry)</td>
<td>4</td>
<td>78</td>
<td>22</td>
</tr>
<tr>
<td>Capsule other than vitamin &amp; antibiotics</td>
<td>3</td>
<td>23</td>
<td>77</td>
</tr>
<tr>
<td>Cotton Yarn-Cones</td>
<td>3</td>
<td>38</td>
<td>62</td>
</tr>
<tr>
<td>Compter &amp; Computer Based System</td>
<td>3</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>July-1996 to February 2001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerosene</td>
<td>9</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td>Liquified petroleum</td>
<td>6</td>
<td>24</td>
<td>76</td>
</tr>
<tr>
<td>Polyster Yarn</td>
<td>5</td>
<td>97</td>
<td>3</td>
</tr>
<tr>
<td>High speed diesel oil</td>
<td>5</td>
<td>1</td>
<td>99</td>
</tr>
<tr>
<td>Tablet execptvit &amp; pencil</td>
<td>4</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>March-2001 to November-2003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cakes &amp; Sweet Roles</td>
<td>8</td>
<td>39</td>
<td>61</td>
</tr>
<tr>
<td>Packed tea</td>
<td>5</td>
<td>58</td>
<td>42</td>
</tr>
<tr>
<td>Coffee</td>
<td>4</td>
<td>44</td>
<td>56</td>
</tr>
<tr>
<td>Urad</td>
<td>4</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Aviation turbine fuel</td>
<td>3</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td>December-2003 to November-2009</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron ore</td>
<td>8</td>
<td>2</td>
<td>98</td>
</tr>
<tr>
<td>Acid all Kinds</td>
<td>5</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Sugar</td>
<td>4</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>Bars &amp; rods</td>
<td>3</td>
<td>34</td>
<td>66</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2</td>
<td>68</td>
<td>32</td>
</tr>
</tbody>
</table>

*All figures given are in percentage

3.4. Minimum-variance inflation rate and natural rate of relative price variability

To evaluate the minimum-variance inflation rate and natural rate of relative price variability equations (2.19) and (2.20) were used. For each time period (sub-sample) these estimates were calculated separately to have an idea of variations in these estimates over the period of time and across different inflationary situations.

The estimated minimum-variance inflation rate seem to be 4.5 percent for the entire sample period, which is consistent with the official threshold rate maintained by the Reserve Bank of India. The estimate of natural rate of relative price variability is 0.06 percent for the same period.

However, there are dramatic variations in these estimates across various the subsamples of the study period. The minimum-variance inflation rate seems to have been 7 percent for the period April-1994 to June-1996 which is characterised by the average inflation rate of about 8 percent. For the lower inflationary period from March-2001 to November-2003 the minimum-variance inflation rate is 3.5 percent which is lowest of all. Thus from the empirical estimates, it is evident that the minimum-variance inflation rate seem to be higher (lower) for the higher (lower) inflationary regime and it varies between 3.5 to 7.1. The natural rate of relative price variability varies between 0.11 to 0.19. It is lowest for period from December-2003 to November-2009 and is highest for the period from July-1996 to February-2001.

Table 5: Minimum-variance inflation rate*

<table>
<thead>
<tr>
<th>Sample Period</th>
<th>((\tau))</th>
<th>(\lambda(0))</th>
<th>((\tau^*))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994M4-2009M11</td>
<td>4.7</td>
<td>0.06</td>
<td>4.5</td>
</tr>
<tr>
<td>1994M4-1996M6</td>
<td>8.3</td>
<td>0.16</td>
<td>7.1</td>
</tr>
<tr>
<td>1996M7-2001M2</td>
<td>4.1</td>
<td>0.19</td>
<td>4.0</td>
</tr>
<tr>
<td>2001M3-2003M11</td>
<td>3.3</td>
<td>0.13</td>
<td>3.5</td>
</tr>
<tr>
<td>2003M12-2009M11</td>
<td>4.4</td>
<td>0.11</td>
<td>4.1</td>
</tr>
</tbody>
</table>

*All figures given are in percentage

4. Conclusion

Application of the methodology suggested by Clements and Nguyen (1981, 1982) to Indian data on WPI data appears to yield several interesting results. The estimates indicate that the ingredients, inflation component and real components of relative price variability account for 45 and 55 percent respectively. This proportion of inflation and
real components vary slightly across the subsamples. However these proportions seem to be quite opposite for high and low inflationary periods. The proportion due to inflation factors is highest during initial months of sample period (April-1996 to June-1996) which is characterised by the high inflation rate. Thus the share of inflation component seem to increase in high inflationary period and decreases in low inflationary situation. Cross commodity distribution of relative price variance in India shows commodities like iron ore, Texturised Yarn, High speed diesel oil, raw cotton, Computer & Computer Based System, LPG, TV sets Color and Polyster staple fibre dominate in share over the period of study. Almost 60 percent of total relative price variability is attributed to top 30 commodities and rest to all other commodities. Thus we conclude that major constituent of high variability in relative prices is due to these few dominant commodities and care full attention should be paid to the moments of prices of these commodities in any assessment of relative price variability. From the policy perspective, the fluctuations in the prices of these commodities may give important signals regarding the movements in overall relative price variability. The more crucial inference that emerges from the empirical analysis is that the threshold inflation rate that minimizes the relative price variability seems to have been 4.5 percent, which is broadly consistent with the official threshold rate maintained by the Reserve Bank of India. These estimates of minimum-variance inflation rate and the natural rate of relative price variability may provide useful benchmarks for monitoring the economy and for assessing the effects of policy change on structure of relative prices to Reserve Bank of India.

References


