CHAPTER: 5

DETERMINATION OF PRICE CHANGE
Determination of Price Change

5.1 Introduction

The destabilizing effect in the standard of living of the people as a result of price rise is extensive. Price fluctuations render the economic environment highly uncertain. In an uncertain economic environment investors shy away and capital flight occurs. Investments are concentrated in highly speculative activities from where capital may be withdrawn at short notice. Inflation erodes the real value of financial assets and resources for investment. A proper study of price variation over a period of time for a vast country like India can not be undertaken at the national level. Only it has to be supplemented with regional studies.

The issues to be discussed in this chapter are as follows:

(i) How have the prices in Manipur been changing during 1973 – 1996?
(ii) What are the determinants of price change? Both time series and structural modeling will be attempted.

5.2 Pattern of price change in Manipur

Omla Salam (1998) undertook the first systematic study of price statistic in Manipur\(^1\). The study dealt with the following monthly prices

(i) Retail price of Rice (RRICE)
(ii) Retail price of firewood (RFUEL)
(iii) Retail price of Fish (RFISH)
(iv) Retail price of Milk (RMILK)
(v) Retail price of Sugar (RSUGAR)
(vi) Retail price of Kerosene (RKEROSENE)
(vii) Retail price of Chilly (RCHILLY)
(viii) Retail price of Pulses (RPULSES)

(ix) Wholesale price of firewood (WFUEL)
(x) Wholesale price of Mustard oil (WOIL)
(xi) Wholesale price of Pulses (WPULSES)
(xii) Wholesale price of Rice (WRICE)

The period of study was 1973 Jan-1988 December. The data were collected from the Khwairamband market in Imphal.

Descriptive statistics such as mean, standard deviation, coefficient of variations, skewness and kurtosis were calculated for 1973 – 80, 1981- 88 and 1973-88. Table 5.1 gives the relative rankings of the dispersion of the prices. RCHILLY was found to have the highest dispersion over the entire period and the sub-sample 1981 – 88. Chilly is a sub- category of spices and has a small weight in the consumption basket.

Table 5.1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>RCHILLY</td>
<td>RKEROSENE</td>
<td>RCHILLY</td>
</tr>
<tr>
<td>2.</td>
<td>RFISH</td>
<td>RFISH</td>
<td>RFISH</td>
</tr>
<tr>
<td>3.</td>
<td>RMILK</td>
<td>RCHILLY</td>
<td>RPULSES</td>
</tr>
<tr>
<td>4.</td>
<td>WFUEL</td>
<td>RPULSES</td>
<td>RMILK</td>
</tr>
<tr>
<td>5.</td>
<td>RFUEL</td>
<td>WPULSES</td>
<td>WPULSES</td>
</tr>
<tr>
<td>6.</td>
<td>RPULSES</td>
<td>WOIL</td>
<td>WOIL</td>
</tr>
<tr>
<td>7.</td>
<td>RKEROSENE</td>
<td>WFUEL</td>
<td>RRICE</td>
</tr>
<tr>
<td>8.</td>
<td>WPULSES</td>
<td>RFUEL</td>
<td>RKEROSENE</td>
</tr>
<tr>
<td>9.</td>
<td>RRICE</td>
<td>RSUGAR</td>
<td>WRICE</td>
</tr>
<tr>
<td>10.</td>
<td>WOIL</td>
<td>RMILK</td>
<td>RSUGAR</td>
</tr>
<tr>
<td>11.</td>
<td>WRICE</td>
<td>WRICE</td>
<td>RFUEL</td>
</tr>
<tr>
<td>12.</td>
<td>RSUGAR</td>
<td>RRICE</td>
<td>WFUEL</td>
</tr>
</tbody>
</table>

Source: Omila Salam (1998), op.cit. P-38

The current study retains the choice of prices because of their importance in a typical Manipuri consumption basket and their availability in a regular basis. Table 5.2 shows
the importance of these categories in terms of percentage of value of consumption per person for a period of 30 days. Cereals were the most important consumption expenditure category having a weight of 43.98%, 42.37% and 43.97% in 32\textsuperscript{nd} round (1977-78), 38\textsuperscript{th} round (1983) and 42\textsuperscript{nd} round (1986-87) of NSS respectively in rural Manipur. In urban Manipur the corresponding weights were 37.42 %, 42.77 % and 38.25 % respectively\textsuperscript{2}. Among cereals such as rice, jowar, bajra, maize, wheat and barley, rice dominates the consumption basket overwhelmingly. In the 43\textsuperscript{rd} round (1987-88) of NSS, 99 % and 98 % of total quantity of cereals consumed in rural and urban Manipur was rice.\textsuperscript{3}

Table 5.2

Weight of selected items in consumption
Basket of Manipur (50\textsuperscript{th} round NSS 1993-94)

<table>
<thead>
<tr>
<th>Item</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cereals (rice)</td>
<td>35.68</td>
<td>40.06</td>
</tr>
<tr>
<td>2. Pulses</td>
<td>2.20</td>
<td>2.04</td>
</tr>
<tr>
<td>3. Milk &amp; milk products</td>
<td>1.75</td>
<td>0.80</td>
</tr>
<tr>
<td>4. Edible oil</td>
<td>3.10</td>
<td>2.72</td>
</tr>
<tr>
<td>5. Meat, egg, fish</td>
<td>7.65</td>
<td>9.01</td>
</tr>
<tr>
<td>6. Sugar</td>
<td>1.37</td>
<td>1.30</td>
</tr>
<tr>
<td>7. Spices (Chilly)</td>
<td>1.96</td>
<td>1.87</td>
</tr>
<tr>
<td>8. Fuel &amp; light</td>
<td>8.46</td>
<td>8.03</td>
</tr>
<tr>
<td>Total</td>
<td>62.17</td>
<td>65.83</td>
</tr>
</tbody>
</table>


The period of study is extended upto 1996 Dec. The periodization scheme adopted is based on the five-year plans. The data points of the plans were as follows.

- 4\textsuperscript{th} Five-Year Plan: 1973 Jan-1974 March.
- 5\textsuperscript{th} Five-Year Plan: 1974 April-1979 March.
- 6\textsuperscript{th} Five-year plan: 1980 April-1985 March.


\textsuperscript{3} Servekshana vol.XV No. 1 1991, PP 35-36
7th Five-year plan: 1985 April-1990 March.

Table 5.3 gives the coefficient of variation of prices during the plans. It shows that the price dispersion has been persistently high for retail price of chillies over the five-year plans. The dispersion for retail and wholesale prices of rice, the major item of expenditure, have been relatively lower over the plans. It declined sharply during the VIIIth plan. Dispersion was highest during the VIIth plan.

Table 5.3

<table>
<thead>
<tr>
<th>Item</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RRICE</td>
<td>15.59</td>
<td>14.09</td>
<td>16.57</td>
<td>17.45</td>
<td>13.27</td>
<td>54.45</td>
</tr>
<tr>
<td>2. WRICE</td>
<td>16.05</td>
<td>14.44</td>
<td>16.03</td>
<td>18.68</td>
<td>13.8</td>
<td>54.67</td>
</tr>
<tr>
<td>3. RPULSES</td>
<td>4.63</td>
<td>21.82</td>
<td>11.38</td>
<td>21.29</td>
<td>23.03</td>
<td>67.78</td>
</tr>
<tr>
<td>4. RSUGAR</td>
<td>3.62</td>
<td>19.34</td>
<td>15.45</td>
<td>14.87</td>
<td>15.09</td>
<td>50.01</td>
</tr>
<tr>
<td>5. RKEROSENE</td>
<td>24.97</td>
<td>42.03</td>
<td>23.32</td>
<td>14.69</td>
<td>37.22</td>
<td>66.64</td>
</tr>
<tr>
<td>6. RMILK</td>
<td>3.55</td>
<td>9.11</td>
<td>16.65</td>
<td>11.11</td>
<td>10.74</td>
<td>52.04</td>
</tr>
<tr>
<td>7. RFISH</td>
<td>13.88</td>
<td>28.24</td>
<td>13.49</td>
<td>20.01</td>
<td>30.68</td>
<td>56.19</td>
</tr>
<tr>
<td>8. RFUEL</td>
<td>31.93</td>
<td>8.39</td>
<td>12.38</td>
<td>17.65</td>
<td>-</td>
<td>51.30</td>
</tr>
<tr>
<td>9. WPULSES</td>
<td>5.82</td>
<td>22.88</td>
<td>12.41</td>
<td>21.31</td>
<td>20.96</td>
<td>68.32</td>
</tr>
<tr>
<td>10. WOIL</td>
<td>20.79</td>
<td>20.57</td>
<td>10.78</td>
<td>21.21</td>
<td>-</td>
<td>42.33</td>
</tr>
<tr>
<td>11. WFUEL</td>
<td>35.16</td>
<td>7.93</td>
<td>13.15</td>
<td>16.40</td>
<td>-</td>
<td>50.30</td>
</tr>
<tr>
<td>12. RCHILLY</td>
<td>35.67</td>
<td>24.14</td>
<td>42.99</td>
<td>35.43</td>
<td>44.65</td>
<td>84.44</td>
</tr>
</tbody>
</table>

The relative stability in the prices of rice during the VIIIth plan occurred when the prices of other items were highly unstable. Retail prices of Pulses, Fish, chilly and Firewood had the highest inter-plan dispersion during this period. Fluctuations in prices of rice would have had the most destabilizing impact on the standard of living during the VIIth plan (1985 April – 1990 March).
In order to calculate the monthly growth rate of these prices, the series are deseasonalised since the monthly time series have seasonal components. These seasonal components are removed by using seasonal indices that measure the seasonal variation in the series. Seasonal adjustment techniques are based on the presumption that a time series \( Y_t \) can be represented as the product of 4 components:

\[
Y_t = L \times S \times C \times I
\]

Where
- \( L \) = value of the secular trend
- \( S \) = value of seasonal component
- \( C \) = value of cyclical component
- \( I \) = Irregular component

The procedure followed in this method is as follows: A 12-month moving average \( \hat{Y}_t \) is computed

\[
\hat{Y}_t = \frac{1}{12} (y_{t+6} + \ldots + y_t + y_{t-1} + \ldots + y_{t-5})
\]

\( \hat{Y}_t \) is an estimate of \( L \times C \). The original data are then divided by \( \hat{Y}_t \) to obtain an estimate of the combined seasonal and irregular components, \( S \times I \).

\[
\frac{L \times S \times C \times I}{L \times C} = S \times I = y_t \hat{Y}_t = z_t
\]

To eliminate the irregular component \( I \), we averaged the value of \( z_t \) corresponding to the same months e.g. to calculate the seasonal index for June, the average of the value in June each year (June 1973, June 1974, ..., June 1996) is calculated. The sum of seasonal index for the 12 months should be 12. For the retail prices of rice (RRICE) the sum was 11.9568. Therefore each index should be multiplied by \( 12/11.9568 = 1.0036 \) so that the sum of the seasonal indices so adjusted is 12. This gives the final seasonal index of the month. The seasonally adjusted time series is obtained by dividing each series by the final seasonal index.\(^4\)

This deseasonalization exercise was carried out to 10 prices viz. retail price of rice, pulses, chilly, sugar, fish, firewood and wholesale price of rice, pulses, firewood and mustard oil. The new variables created and seasonal indices were shown in table no. 5.4

<table>
<thead>
<tr>
<th>Month</th>
<th>RRICE</th>
<th>WRICE</th>
<th>RPULSES</th>
<th>WPLUSE</th>
<th>RCHILLY</th>
<th>RSUGAR</th>
<th>RFISH</th>
<th>RFUEL</th>
<th>WFUEL</th>
<th>WOIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0.87529</td>
<td>0.87401</td>
<td>0.93754</td>
<td>0.97775</td>
<td>1.0696</td>
<td>0.97225</td>
<td>0.97225</td>
<td>1.0023</td>
<td>1.0173</td>
<td>1.0294</td>
</tr>
<tr>
<td>February</td>
<td>0.91045</td>
<td>0.90249</td>
<td>0.97223</td>
<td>0.98114</td>
<td>1.0976</td>
<td>1.0057</td>
<td>1.0057</td>
<td>0.99231</td>
<td>1.0190</td>
<td>1.0077</td>
</tr>
<tr>
<td>March</td>
<td>0.91486</td>
<td>0.92232</td>
<td>0.98032</td>
<td>0.98324</td>
<td>1.1366</td>
<td>0.96318</td>
<td>0.96318</td>
<td>0.98844</td>
<td>0.99567</td>
<td>0.98085</td>
</tr>
<tr>
<td>April</td>
<td>0.97178</td>
<td>0.97931</td>
<td>1.0037</td>
<td>1.0079</td>
<td>1.1236</td>
<td>0.96807</td>
<td>0.96807</td>
<td>0.991</td>
<td>0.99469</td>
<td>0.956</td>
</tr>
<tr>
<td>May</td>
<td>1.0336</td>
<td>1.0320</td>
<td>1.0258</td>
<td>1.0341</td>
<td>1.1545</td>
<td>0.99472</td>
<td>0.99472</td>
<td>0.98286</td>
<td>0.98497</td>
<td>0.96606</td>
</tr>
<tr>
<td>June</td>
<td>1.0463</td>
<td>1.0441</td>
<td>1.0294</td>
<td>1.0158</td>
<td>1.0894</td>
<td>1.0253</td>
<td>1.0466</td>
<td>0.98299</td>
<td>0.97307</td>
<td>0.97418</td>
</tr>
<tr>
<td>July</td>
<td>1.0611</td>
<td>1.0614</td>
<td>1.0458</td>
<td>1.0223</td>
<td>0.91195</td>
<td>1.0116</td>
<td>1.0667</td>
<td>0.98495</td>
<td>0.97944</td>
<td>0.99152</td>
</tr>
<tr>
<td>August</td>
<td>1.0782</td>
<td>1.0767</td>
<td>1.0219</td>
<td>1.0182</td>
<td>0.79445</td>
<td>1.0309</td>
<td>1.0523</td>
<td>0.99119</td>
<td>0.98228</td>
<td>1.0063</td>
</tr>
<tr>
<td>September</td>
<td>1.0919</td>
<td>1.0934</td>
<td>1.0151</td>
<td>1.0154</td>
<td>0.78340</td>
<td>1.0010</td>
<td>0.9977</td>
<td>0.0021</td>
<td>0.98850</td>
<td>1.0207</td>
</tr>
<tr>
<td>October</td>
<td>1.0772</td>
<td>1.0950</td>
<td>1.0014</td>
<td>1.0016</td>
<td>0.83741</td>
<td>1.0619</td>
<td>0.95994</td>
<td>0.99969</td>
<td>0.98762</td>
<td>1.0145</td>
</tr>
<tr>
<td>November</td>
<td>1.0437</td>
<td>1.0304</td>
<td>0.98530</td>
<td>0.98068</td>
<td>0.97834</td>
<td>0.98846</td>
<td>0.97843</td>
<td>1.0197</td>
<td>1.0287</td>
<td>1.0223</td>
</tr>
<tr>
<td>December</td>
<td>0.8955</td>
<td>0.8886</td>
<td>0.98303</td>
<td>0.96171</td>
<td>1.0232</td>
<td>0.96976</td>
<td>0.97924</td>
<td>1.0614</td>
<td>1.0485</td>
<td>1.0304</td>
</tr>
</tbody>
</table>

Table 5.5 shows the monthly growth rate of ten items over various plans. RC2 had the highest growth rate over the entire period and RS2 had the lowest growth rate. Both retail and wholesale prices of rice had the highest growth rate during the VIIth plan. The growth rate doubled from Vth plan to VIth plan. For the entire period, the annual growth rate of price of rice worked out to be 7.68 percent. RP2, WP2, RC2 & RS2 had the highest growth rates during the VIIIth plan.

Table 5.5

Inter Plan monthly Growth Rate of Prices**

<table>
<thead>
<tr>
<th>Item</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR2</td>
<td>*</td>
<td>0.32</td>
<td>0.698</td>
<td>0.87</td>
<td>0.54</td>
<td>0.64</td>
</tr>
<tr>
<td>WR2</td>
<td>*</td>
<td>0.32</td>
<td>0.70</td>
<td>0.91</td>
<td>0.58</td>
<td>0.64</td>
</tr>
<tr>
<td>RP2</td>
<td>*</td>
<td>0.74</td>
<td>0.42</td>
<td>0.95</td>
<td>1.21</td>
<td>0.77</td>
</tr>
<tr>
<td>WP2</td>
<td>*</td>
<td>0.80</td>
<td>0.49</td>
<td>0.91</td>
<td>1.1</td>
<td>0.77</td>
</tr>
<tr>
<td>RC2</td>
<td>7.36</td>
<td>-0.37</td>
<td>1.29</td>
<td>1.18</td>
<td>1.73</td>
<td>0.79</td>
</tr>
<tr>
<td>RS2</td>
<td>*</td>
<td>*</td>
<td>-0.26</td>
<td>0.60</td>
<td>0.97</td>
<td>0.55</td>
</tr>
<tr>
<td>RF2</td>
<td>4.66</td>
<td>1.33</td>
<td>*</td>
<td>0.37</td>
<td>1.25</td>
<td>0.62</td>
</tr>
<tr>
<td>RFU2</td>
<td>8.03</td>
<td>0.31</td>
<td>0.63</td>
<td>0.84</td>
<td>-----</td>
<td>0.78</td>
</tr>
<tr>
<td>WFU2</td>
<td>9.48</td>
<td>0.24</td>
<td>0.67</td>
<td>0.82</td>
<td>-----</td>
<td>0.79</td>
</tr>
<tr>
<td>WO2</td>
<td>4.86</td>
<td>0.48</td>
<td>*</td>
<td>0.88</td>
<td>-----</td>
<td>0.57</td>
</tr>
</tbody>
</table>

Note:
* Insignificant at 5%
----- data not available
** Specification used: log yt = a+bt
5.3 Stochastic Time Series modelling of prices:

There may be situations where it is impossible or undesirable to "explain" \( y(t) \) - a representation of historical performance of some economic variables - using a structural model. The time series models are used when little information is known about the determinants of the variable of primary concern and a sufficiently large number of data is available. A time series model provides a description of the random nature of the stochastic process that generated the sample of observations under study. The description is not in terms of cause- and effect relationship as in regression models but in term of how that randomness is embodied in the process. If the stochastic process is fixed in time i.e. if it is stationary, then it is possible to model the process via an equation with fixed co-efficient that can be estimated from past data. Otherwise it will be difficult to represent the time series by a simple algebraic model.

Let us assume that each value \( Y_1, Y_2, \ldots Y_T \) of the time series is drawn from a set of jointly distributed random variable i.e. there exists some probability distribution function \( p(Y_1, \ldots, Y_T) \) that assigns probabilities to all possible combinations of values of \( y_1, \ldots y_T \). If the series \( y_t \) is stationary then

\[
p(y_t, \ldots y_{t+k}) = p(y_{t+m}, \ldots y_{t+m+k})
\]

\[
P(y_t) = p(y_{t+m}) \text{ for any } t, m \& k.
\]

It is a process whose joint distribution and conditional distribution both are invariant with respect to displacement in time.

Many of the time series in economics are non-stationary. If they are differenced one or more times, the resulting series are stationary. Such a non-stationary time series is said to be homogenous with degree of homogeneity being equal to the number of times the original non-stationary series has to be differenced to get a stationary series.

While there are many functional forms for relating \( y_t \) to its past values and lagged random disturbances, the following form known as Integrated autoregressive moving average of order \((p, d, q)\) or ARIMA \((p, d, q)\) has been chosen because of its generality.
The ARIMA (p, d, and q) process can be written as

\[ \phi(B)^d y_t = \delta + \theta(B) \epsilon_t \]

with

\[ \phi(B) = 1 - \phi_1 B - \phi_2 B^2 - \ldots - \phi_p B^p \]
\[ \theta(B) = 1 - \theta_1 B - \theta_2 B^2 - \ldots - \theta_q B^q \]

B is the backward shift operator.

d is the number of times \( y_t \) has to be differenced to get a stationary series

\( \Delta \) is the difference operator. The error terms are normally distributed and independent of each other.

There is no guarantee that every non-stationary time series will be homogeneous. Any homogeneous non-stationary time series can be modeled as an ARIMA process of order (p,d,q). The practical problem is to choose the most appropriate values for p,d and q. Our strategy will be as follows: Firstly a stationary time series will be derived from the given time series. Secondly the model will be estimated using trial values of p and q to obtain the residuals \( \hat{\epsilon}_t \). If the model has been specified correctly the residuals should resemble a white noise process as the unobservable error terms. The adequacy of the model can be tested by computing the Box-Pierce Statistic, which is defined as

\[ Q = T \sum_{K=1}^{K} \hat{r}_K^2 \]

where \( T \) is the number of observations in the time series.

\( \hat{r}_K \) is the sample auto correlation function (for displacement k)

If the model is correctly specified, the statistic Q will be distributed as \( \chi^2 (k-p-q) \).

If several models pass this diagnostic test, the model with lowest square root of the mean sum of squares of the residuals i.e. \( \sqrt{\frac{\sum \hat{\epsilon}^2}{T}} \) is chosen.

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The unit root test is a popular test of stationarity. A time series that has a unit root is known as a random walk, which is a nonstationary time series. If we run the following regression

\[ Y_t = \rho Y_{t-1} + u_t \]

and find that \( \rho = 1 \), then the stochastic variable \( Y_t \) has a unit root. Under the null hypothesis that \( \rho = 1 \), the conventionally computed t statistic is known as the \( \tau \) (tau) statistic whose critical values have been tabulated by Dickey and Fuller on the basis of Monte Carlo simulations. Dickey Fuller tables have been considerably extended by Mackinnon through Monte Carlo simulations. The tau test is also known as the Dickey Fuller test. If the computed absolute value of the \( \tau \) statistic exceeds the Dickey Fuller absolute critical \( \tau \) values, we do not reject the hypothesis that the given time series is stationary. If it is less than the critical value, the time series is nonstationary.

The Dicky-Fuller test is applied to regression run in the following form

\[ \Delta Y_t - \beta_1 + \delta Y_{t-1} + u_t \text{ where } \Delta Y_t = Y_t - Y_{t-1} \]

The null hypothesis is \( H_0: \delta = 0 \) i.e there is a unit root. For this model, the 1%, 5% and 10% critical \( \tau \) statistics as computed by Mackinnon are -3.5073, -2.8951 and -2.5844 respectively.\(^6\)

Since the computed \( \tau \) values for the 10 deseasonalized price series are smaller than the 1%, 5% and 10% critical values, we do not reject the \( H_0: \delta = 0 \) i.e. each of the 10 deseasonalized price series exhibits a unit root i.e. all of them are nonstationary.

Formal Tests for stationarity for the original deseasonalized price series.

\[ \Delta RR2_t = 0.06321 - 0.00703 RR2_{t-1} \]

\[ t = (1.218) \quad (-0.744) \]

\[ r^2 = 0.6503 \quad DW = 2.6405 \]

\[ \Delta WR2t = 4.2698 - 0.00312 WR2_{t-1} \]

\[ (1.006) \quad (-0.384) \]

\[ r^2 = 0.00054 \quad DW = 2.1942 \]

\(^6\) Gujarati, D.N. (1995): "Basic Econometrics". P-720

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\[ \Delta RP_{2t} = -0.0283 + 0.01322 \text{ RP}_{2t-1} \]
\[ (-0.394) \quad (2.005) \]
\[ r^2 = 0.014 \quad \text{DW} = 2.257 \]

\[ \Delta WP_{2t} = -1.9337 + 0.01233 \text{ WP}_{2t-1} \]
\[ (-0.32) \quad (2.124) \]
\[ r^2 = 0.016 \quad \text{DW} = 2.0334 \]

\[ \Delta RC_{2t} = 0.4215 + 0.00097 \text{ RC}_{2t-1} \]
\[ (0.739) \quad (0.064) \]
\[ r^2 = 0.000014 \quad \text{DW} = 2.222 \]

\[ \Delta RS_{2t} = 0.11894 - 0.00929 \text{ RS}_{2t-1} \]
\[ (1.239) \quad (-0.832) \]
\[ r^2 = 0.0025 \quad \text{DW} = 2.667 \]

\[ \Delta RF_{2t} = 1.4396 - 0.315 \text{ RF}_{2t-1} \]
\[ (2.203) \quad (-2.053) \]
\[ r^2 = 0.0151 \quad \text{DW} = 2.12 \]

\[ \Delta RFU_{2t} = 0.30638 + 0.000101 \text{ RFU}_{2t-1} \]
\[ (0.998) \quad (0.014) \]
\[ r^2 = 0.0000009 \quad \text{DW} = 2.331 \]

\[ \Delta WFU_{2t} = 0.19655 + 0.00289 \text{ WFU}_{2t-1} \]
\[ (0.92) \quad (0.549) \]
\[ r^2 = 0.0013 \quad \text{DW} = 1.964 \]
\[ \Delta \text{WO}_2 = 3.9884 - 0.0106 \text{WO}_2_{t-1} \]

\[
(1.321) \quad (-0.889)
\]

\[ r^2 = 0.0035 \quad \text{DW} = 2.03. \]

**RR2:**

RR2, the deseasonalized retail price of rice, was found to be nonstationary. It was converted into a stationary series by differencing once.

\[
\text{DR}_t = 0.0456 - 1.3335 \text{RR}_t \quad (1.985) \quad (-22.283)
\]

Where \( \text{DR}_t = \text{R}_t - \text{R}_{t-1} \)

\[
\text{R}_t = \text{RR}_2 \text{R}_t - \text{RR}_2_{t-1}
\]

ARIMA (1,1,0) and ARIMA (1,1,1) pass the diagnostic test. The Box-Pierce statistics for K=14 were 20.505 and 20.027 respectively. ARIMA (1,1,1) was chosen as its root mean square error (RMS) of 0.3725 was less than that of ARIMA (1,1,0) which was 0.3748.

ARIMA (1,1,1): \( (1 + 0.10158B)R_t = 0.0318 + (1 - 0.2564B)\epsilon_t \)

**WR2:** The deseasonalized wholesale price of rice became a stationary series after differencing once.

\[
\text{DWR}_t = 3.0901 - 1.1002 \text{WR}_{t-1} \quad (1.576) \quad (-18.267)
\]

Where \( \text{DWR}_t = \text{WR}_t - \text{WR}_{t-1} \)

\[
\text{WR}_t = \text{WR}_2 \text{R}_t - \text{WR}_2_{t-1}
\]

The Box-Pierce statistic for K=20 for models that pass the diagnostic test and their RMS are given below:
Table 5.6

<table>
<thead>
<tr>
<th>Model</th>
<th>Box-Pierce statistics</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,0,1</td>
<td>28.4757</td>
<td>31.46477</td>
</tr>
<tr>
<td>0,0,2</td>
<td>27.6616</td>
<td>31.52282</td>
</tr>
<tr>
<td>0,0,3</td>
<td>28.8044</td>
<td>31.42631</td>
</tr>
<tr>
<td>0,0,4</td>
<td>28.7727</td>
<td>31.34557</td>
</tr>
<tr>
<td>2,0,2</td>
<td>27.459</td>
<td>31.36299</td>
</tr>
</tbody>
</table>

Hence the specification (0,0,4) was chosen.

**ARIMA (0,0,4)**

\[ WR_t = 2.8204 + (1 - 0.14467 B - 0.20435 B^2 - 0.078298 B^3 - 0.042853 B^4) \varepsilon, \]

**RP2:** The deseasonalized retail price of pulses was differenced once to get a stationary series.

\[ DRP_t = 0.10319 - 1.0978 \; RP_{t-1} \]

\[ (2.643) \; (-18.225) \]

Where \( RP_t = RP_{2t} - RP_{2t-1} \)

\( DRP_t = RP_t - RP_{t-1} \)

The specifications (0,0,3),(0,0,4),(0,0,5) and (0,0,6) passed the diagnostic test with the following Box-Pierce statistics 25.4029, 23.6915, 21.6133 and 15.8026 respectively for K=20. Their RMS were 0.6349, 0.6335, 0.6293 and 0.6199 respectively. Hence the specification(0,0,6) was chosen. The estimated model was

\[ RP_t = 0.09585 + (1 - 0.089040B - 0.076849B^2 - 0.060821B^3 - 0.0668B^4 - 0.18594B^5 + 0.17664B^6) \varepsilon, \]

**WP2:** The deseasonalized wholesale price of pulses was differenced once.

\[ DWP_t = 8.5710 - 0.9897 \; WP_{t-1} \]

\[ (2.57) \; (-16.382) \]

Where

\[ WP_t = WP_{2t} - WP_{2t-1} \]

\[ DWP_t = WP_t - WP_{t-1} \]

The specifications (5,0,1), (0,0,5), (1,0,5) and (2,0,5) passed the diagnostic test for K=20 with Box-Pierce statistic values 27.1857, 28.2029, 28.1561 and 26.7237
respectively. Their RMS were 53.241, 53.298, 53.29857 and 53.18484 respectively. Hence the specification (2,0,5) was chosen.

**ARIMA (2,0,5)**

\[(1 - 0.1201B + 0.29148B^2)WP_t = 10.265 + (1 - 0.1032B + 0.13354B^2 + 0.068649B^3 - 0.023869B^4 - 0.10534B^5)e_t\]

**RS2:** The deseasonalized retail price of sugar was differenced once.

\[DRS_t = 0.06238 - 1.3448R_{S_{t-1}}\]

\[(1.581) (-23.635)\]

where \(RS_t = RS_{2t - RS_{2t - 1}}\)

\[DRS_t = RS_t - RS_{t-1}\]

The Box-Pierce statistics of models passing the diagnostic test for \(K=20\) and their RMS are given below:

<table>
<thead>
<tr>
<th>Model</th>
<th>Box-Pierce statistics</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,1</td>
<td>15.1643</td>
<td>0.64305</td>
</tr>
<tr>
<td>5,1,1</td>
<td>13.8819</td>
<td>0.64155</td>
</tr>
<tr>
<td>0,1,5</td>
<td>12.5957</td>
<td>0.64064</td>
</tr>
<tr>
<td>0,1,4</td>
<td>12.9523</td>
<td>0.64093</td>
</tr>
<tr>
<td>0,1,3</td>
<td>13.3067</td>
<td>0.64109</td>
</tr>
<tr>
<td>0,1,2</td>
<td>15.2013</td>
<td>0.64299</td>
</tr>
<tr>
<td>0,1,1</td>
<td>14.9</td>
<td>0.65262</td>
</tr>
</tbody>
</table>

Model (0,1,5) was chosen.

**ARIMA(0,1,5):**

\[RS_t = 0.049602 + (1 - 0.40475B - 0.000713B^2 - 0.052953B^3 - 0.014023B^4 - 0.017922B^5)e_t\]

**RC2:** The deseasonalized retail price of chilly was differenced once.
DRC_t = 0.516 - 1.2039 RC_{t-1} \\
\quad (1.538) \quad (-18.856)

where, \( RC_t = RC_{2t} - RC_{2t-1} \) \\
DRC_t = RC_t - RC_{t-1}

Table 5.8

<table>
<thead>
<tr>
<th>Model</th>
<th>Box-Pierce statistics for K=12</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0,1,2</td>
<td>19.5262</td>
<td>5.5058</td>
</tr>
<tr>
<td>0,1,3</td>
<td>19.4838</td>
<td>5.4977</td>
</tr>
<tr>
<td>0,1,4</td>
<td>18.6936</td>
<td>5.4629</td>
</tr>
<tr>
<td>0,1,5</td>
<td>23.7462</td>
<td>5.5212</td>
</tr>
<tr>
<td>0,1,6</td>
<td>15.5646</td>
<td>5.4353</td>
</tr>
</tbody>
</table>

The model (0,1,6) was chosen.

ARIMA (0,1,6):
\[
RC_t = 0.45255 + (1 - 0.18558 \, B + 0.05941 \, B^2 + 0.06152 \, B^3 \\
+ 0.05325 \, B^4 - 0.07228 \, B^5 + 0.19045 \, B^6) \varepsilon,
\]

RF2: The deseasonalised retail price of fish was differenced once.

DRF_t = 0.25504 - 1.0778RF_{t-1} \\
\quad (0.885) \quad (-17.862)

where \( RF_t = RF_{2t} - RF_{2t-1} \) \\
DRC_t = RF_t - RF_{t-1}

Table 5.9

<table>
<thead>
<tr>
<th>Model</th>
<th>Box-Pierce statistics for K=20</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,1,1</td>
<td>22.3891</td>
<td>4.59988</td>
</tr>
<tr>
<td>1,1,2</td>
<td>27.6499</td>
<td>4.65734</td>
</tr>
<tr>
<td>0,1,2</td>
<td>27.5795</td>
<td>4.65337</td>
</tr>
<tr>
<td>0,1,4</td>
<td>19.3852</td>
<td>4.5792</td>
</tr>
<tr>
<td>0,1,5</td>
<td>18.909</td>
<td>4.5657</td>
</tr>
</tbody>
</table>

The model (0,1,5) was chosen.
ARIMA(0,1,5):

\[ RF_t = 0.23827 + (1 - 0.11003 B - 0.20136 B^2 - 0.016479 B^3 - 0.14405 B^4 - 0.04557 B^5)\varepsilon_t, \]

RFU2: The deseasonalized retail price of firewood was differenced once.

\[ DRFU_t = 0.36323 - 1.1658 RFU_{t-1} \]

(2.720) (-17.496)

where \( RFU_t = RFU_{t-1} - RFU_{t-1} \)

\[ DRFU_t = RFU_t - RFU_{t-1} \]

Table 5.10

<table>
<thead>
<tr>
<th>Model</th>
<th>Box-Pierce statistics for K=25</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,1,1</td>
<td>10.9537</td>
<td>1.916214</td>
</tr>
<tr>
<td>5,1,1</td>
<td>10.9832</td>
<td>1.914859</td>
</tr>
<tr>
<td>0,1,1</td>
<td>17.3349</td>
<td>1.940074</td>
</tr>
<tr>
<td>0,1,2</td>
<td>13.6503</td>
<td>1.92479</td>
</tr>
<tr>
<td>0,1,4</td>
<td>12.0739</td>
<td>1.924778</td>
</tr>
<tr>
<td>0,1,5</td>
<td>10.3421</td>
<td>1.840047</td>
</tr>
</tbody>
</table>

The model ARIMA (0,1,5) was chosen.

ARIMA (0,1,5)

\[ RFU_t = 0.27868 + (1 - 0.2216 B - 0.08634 B^2 - 0.02655 B^3 - 0.012996 B^4 + 0.030386 B^5)\varepsilon_t, \]

WFU2: The deseasonalized wholesale price of firewood was differenced once.

\[ DWFU_t = 0.29844 - 0.98213 WFU_{t-1} \]

(3.119) (-14.477)

where \( WFU_t = WFU_{t-1} - WFU_{t-1} \)

\[ DWFU_t = WFU_t - WFU_{t-1} \]

Table 5.11

<table>
<thead>
<tr>
<th>Model</th>
<th>Box- Pierce statistics at K=25</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,1,1</td>
<td>19.214</td>
<td>1.3733</td>
</tr>
<tr>
<td>0,1,1</td>
<td>20.9284</td>
<td>1.3820</td>
</tr>
<tr>
<td>0,1,2</td>
<td>21.5163</td>
<td>1.3787</td>
</tr>
<tr>
<td>0,1,3</td>
<td>20.0346</td>
<td>1.3759</td>
</tr>
</tbody>
</table>
The model ARIMA(0,1,5) was chosen.

**ARIMA(0,1,5)**

\[ WF_{U_t} = 0.27207 + (1 - 0.020603 B - 0.02742 B^2 - 0.048349 B^3 \\
- 0.03452 B^4 + 0.02242 B^5) \varepsilon_t \]

**WO2**: The deseasonalized wholesale price of mustard oil was differenced once.

\[ DWO_t = 1.6945 - 1.1099 WO_{t-1} \]

\[ (1.474) \ (-15.268) \]

where \( WO_t = WO_2_t - WO_2_{t-1} \)

\[ DWO_t = WO_t - WO_{t-1} \]

Table 5.12

<table>
<thead>
<tr>
<th>Model</th>
<th>Box-Pierce Statistics for K=20</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,1</td>
<td>23.5229</td>
<td>16.8395</td>
</tr>
<tr>
<td>5,1,1</td>
<td>19.294</td>
<td>16.60179</td>
</tr>
<tr>
<td>0,1,1</td>
<td>23.8884</td>
<td>16.8435</td>
</tr>
<tr>
<td>0,1,3</td>
<td>26.2316</td>
<td>16.7613</td>
</tr>
<tr>
<td>0,1,5</td>
<td>18.4002</td>
<td>16.5393</td>
</tr>
</tbody>
</table>

The model ARIMA (0,1,5) was chosen.

**ARIMA(0,1,5):**

\[ WO_t = 1.3958 + (1 - 0.1081B + 0.026732B^2 - 0.10085B^3 - 0.02375B^4 + 0.15546B^5) \varepsilon_t \]

Graphically, deseasonalised retail prices of rice, wholesale price of rice, retail price of pulses, wholesale price of pulses, retail price of sugar, retail price of chilly, retail price of fish, retail price of firewood, wholesale price of firewood, wholesale price of mustard oil and their differenced once series are shown in figure 5.1 to 5.10 respectively.
FIG. 5.1

RR2= • RR2= DESEASONALIZED RETAIL PRICE OF RICE PER KG
DRR2= • DRR2= RR2 DIFFERENCED ONCE

Month
FIG. 5.2

HR2: DESEASONALIZED WHOLESALE PRICE
OF RICE PER QUINTAL
DHR2: HR2 DIFFERENCED ONCE

Month
0 500 1000 1500

-500
FIG. 5.3

RP2: DESEASONALIZED RETAIL PRICE OF PULSES PER KG
DRP2: RP2 DIFFERENCED ONCE

Month


0 5 10 15 20 25 30
FIG. 5.4

HP2: — HP2: DESEASONALIZED WHOLESALE PRICE OF PULSES PER QUINTAL

MAP2: — MAP2: HP2 DIFFERENCED ONCE

Month


-500 0 500 1000 1500 2000 2500 3000
FIG. S.5

RS2 = DESEASONALIZED RETAIL PRICE OF SUGAR PER KG
DRS2 = RS2 DIFFERENCED ONCE

Month

FIG. 5.G

RC2 = Deseasonalized retail price of chilly per mg
DRC2 = RC2 differenced once
FIG. 5.7

RF2 = \( \text{DESEASONALIZED RETAIL PRICE OF FISH PER KG} \)

DRF2 = RF2 DIFFERENCED ONCE

Month


-25 0 25 50 75 100
FIG. 5.8

RFU2: DESEASONALIZED RETAIL PRICE OF FIREWOOD PER MAUND (40 KG)
DRFU2: RFU2 DIFFERENCED ONCE
FIG. 5.9

WFU2: DESEASONALIZED WHOLESALE PRICE OF FIREWOOD PER MOUND (40 KG)

DWFU2: WFU2 DIFFERENCED ONCE

Month

5.4 Structural modeling of prices:

In this section single equation structural models of prices of rice and fish only will be studied. Other prices have not been considered due to non-availability of data on related variables. The models considered were as follows:

(i) \[ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + U \]

(ii) \[ Y = \alpha_0 + \alpha_1 Z + U \]

Where \( Y \) = Price(RRICE/WRICE/RFISH)

\( X_1 \) = Output

\( X_2 \) = real net state domestic product (NSDPR)

\( X_3 \) = price lagged by one period

\( Z \) = Demand gap (GAPRICE/GAPFISH)

These specifications have drawn on the work of Raj(1966) and Divatia & Pani(1968). Raj (1966) argued that observed movements in the relative price of food grains can be explained fairly well by imbalance between demand and supply , without allowing for speculative changes in the holdings of food grains stocks or appealing to monetary theories.\(^7\) Divatia & Pani (1968) modeled the price of cereals as a function of total supply of cereals , real income , liquid assets held and cereal prices lagged by one period \(^8\). They emphasized that any model for the price of an agricultural good should include real income and/or monetary resources as determinant of its demand. One major reason behind the choice of these specifications was the availability of data of relevant variables.

Data base: In order to make the data compatible, the monthly time series have been converted into time series in financial year i.e. from April to March next year. Demand for rice can be worked out on the basis of nutritional norm and consumption pattern because the demand for rice can be expected to rise due to population growth and income growth.

Rao, V.K.R.V. (1982) provides nutritional requirement of cereals based on nutritional norms applied to the population by age and sex\(^9\). The nutritional criteria are based on the balanced diet basket as formulated by the Indian Council for Medical

\(^7\) Raj , K.N. (1966) "price behaviour in India, 1949-66 : An exploratory hypothesis" Indian Economic Review No.2 vol. 1 ;PP56-78.


Research in 1980. According to this norm, adult men and adult women require 520 gm. and 440 gm. of cereals for moderate work respectively. Boys and Girls of 10-12 years age group require 420 gm. and 380 gm. respectively. Children in the age group 1-3 years and 4-6 years require 175 gm. and 270 gm. respectively. The requirement associated with the ICMR norm can be calculated by projecting the increase in population and composition by age and sex. Since the composition by age and sex is rarely worked out as an annual series, the projection of population alone is used to derive the demand. The mean of 520 gm. for male and 440 gm. for female is 480 gm. Annually it is 175.2-kg per capita. Since rice is the predominant cereal in the consumption basket of a typical Manipuri, cereal requirement has been equated with requirement for rice. Demand is obtained by multiplying the projected population with 175.2 kg.

Rice is not an inferior good and its demand will increase with rise in income. As the income effect on demand for rice has not been accounted for, the estimate of demand based on ICMR norm and population growth is an underestimate of actual demand. It is not known to what extent the age-sex composition of population, if properly accounted for, would have lowered the rice requirement.

Ideally supply of rice would have 3 components viz. net production, stock with the government and net import. However data on stock and net import are not available on a regular basis. Therefore total supply of rice is represented by 87.5 percent of the output and is thus also an underestimate of total supply of rice. Supply is subtracted from demand to obtain the demand-gap. In the case of fish the demand-gap is obtained by subtracting fish production from consumption requirement of fish. The alternative uses of fresh fish produced in the state, and import of fish from other states such as Andhra Pradesh, West Bengal have not been used as their data are not available on a regular basis.

Fig. 5.11 & 5.12 show the Demand supply gap for rice and fish in Manipur.
CHAPTER 5 - DETERMINATION OF PRICE CHANGE

Retail Price of rice (RRICE):

\[ RRICE_t = -1.521 + 0.00165 \times (OUTPUT)_t + 0.00011 \times (NSDPR)_t + 0.6704 \times RRICE_{t-1} \]

\[ (0.84) \quad (1.747) \quad (2.883)^* \]

\[ R^2 = 0.97 \quad DW = 2.310 \]

\[ RRICE_t = -3.0557 + 0.000303 \times NSDPR_{t+1} \]

\[ (15.369)^* \]

\[ R^2 = 0.961 \quad DW = 1.9497 \]

\[ RRICE_t = 126850 + 0.0015202 \times (OUTPUT)_{t+1} \]

\[ (0.933) \]

\[ R^2 = 0.337 \quad DW = 1.9593 \]

\[ RRICE_t = -0.08712 + 1.1009 \times RRICE_{t-1} \]

\[ (25.134)^* \]

\[ R^2 = 0.968 \quad DW = 2.562 \]

Notes:

* significant at 5%

+ corrected for auto / correlation by Cochran – Orcutt procedure.

These estimates show that price lagged by one year had been the most important determinant of retail price of rice.

The elasticity estimate is as follows:

\[ \log (RRICE)_t = 0.03725 + 1.024 \log (RRICE)_{t-1} \]

\[ (27.634) \]

\[ R^2 = 0.973 \quad DW = 2.471 \]

The impact of demand-supply gap is as follows:

\[ RRICE_t = 1861.6 - 0.0015 \times (GAPPRICE)_{t+1} \]

\[ (-0.81) \]

\[ R^2 = 0.5779 \quad DW = 1.8902 \]

\[ \log (RRICE) = 502.04 + 0.0004763 \times \log (GARRICE)_{t+1} \]

\[ (0.544) \]
\[ R^2 = 0.172 \quad \text{DW} = 2.4496 \]

+ Corrected for autocorrelation by Cochran-Orcutt procedure.

Thus the demand-supply gap does not have any significant impact on RRICE.

**Wholesale Price of Rice (WRICE):**

\[ \text{WRICE}_t = -193.46 - 0.05199 (\text{OUTPUT})_t + 0.019901 (\text{NSDPR})_t + 0.3698 (\text{WRICE})_{t-1} \]

\[ (-0.252) \quad (3.416)^* \quad (1.742) \]

\[ R^2 = 0.967 \quad \text{DW} = 2.4188 \]

\[ \text{WRICE}_t = -8.676 + 1.1028 \text{WRICE}_{t-1}^* \]

\[ (41.64) \]

\[ R^2 = 0.952 \quad \text{DW} = 2.8095 \]

\[ \text{WRICE}_t = 3305400 - 0.076764^* (\text{OUTPUT})_t \]

\[ (-0.405) \]

\[ R^2 = 0.304 \quad \text{DW} = 2.8189 \]

\[ \text{WRICE}_t = -315.96 + 0.030137^* (\text{NSDPR})_t \]

\[ (19.376)^* \]

\[ R^2 = 0.961 \quad \text{DW} = 1.9497 \]

* Significant at 5% level

+ Corrected for autocorrelation using Cochran-Orcutt procedure.

The estimates of elasticities are as follows:

\[ \log \text{WRICE}_t = 155.1 - 0.087763 \log (\text{OUTPUT})_t^* \]

\[ (-0.879) \]
\[ R^2 = 0.212 \quad \text{DW} = 2.8605 \]

\[ \log \text{WRICE}_t = -10.54 + 1.6371 \log \text{NSDPR}_t \]

(25.921)*

\[ R^2 = 0.969 \quad \text{DW} = 1.81 \]

\[ \log \text{WRICE}_t = -0.037023 + 1.018 \log \text{WRICE}_{t-1}^* \]

(24.918)*

\[ R^2 = 0.969 \quad \text{DW} = 2.77 \]

* Significant at 5% level
+ Corrected for auto-correlation using Cochran Orcutt procedure.

In the case of WRICE, real net state domestic product was found to be a highly significant explanatory variable.

The impact of demand – supply gap was as follows:

\[ \text{WRICE}_t = 94366 + 0.10834 \text{ (GAPRICE)}_t \]

(0.509)

\[ R^2 = 0.075 \quad \text{DW} = 2.7682 \]

\[ \log \text{WRICE}_t = 302.54 - 0.000001 \log (\text{GAPRICE})_t^* \]

(-0.035)

\[ R^2 = 0.171 \quad \text{DW} = 2.799 \]

The estimates show that demand – supply gap was not a significant explanatory variable.
Retail Price of Fish (RFISH):

\[
\text{RFISH}_t = 0.46624 + 1.1617 \text{(OUTPUT)}_t + 0.00046 \text{(NSDPR)}_t + 0.5418 \text{(RFISH)}_{t-1}
\]

\[
\begin{array}{c}
\text{(0.298)} \\
\text{(0.225)} \\
\text{(2.451)}^*
\end{array}
\]

\[
\hat{R}^2 = 0.854 \quad \text{DW} = 2.111
\]

\[
\text{RFISH}_t = 14.986 + 4.2452 \text{(OUTPUT)}^*_t
\]

\[
\begin{array}{c}
\text{(4.933)}
\end{array}
\]

\[
\hat{R}^2 = 0.798 \quad \text{DW} = 2.0248
\]

\[
\text{RFISH}_t = -11.147 + 0.00197 \text{(NSDPR)}^*_t
\]

\[
\begin{array}{c}
\text{(5.44)}
\end{array}
\]

\[
\hat{R}^2 = 0.82 \quad \text{DW} = 2.0255
\]

\[
\text{RFISH}_t = 4.2155 + 0.9672 \text{(RFISH)}_{t-1}
\]

\[
\begin{array}{c}
\text{(9.946)}
\end{array}
\]

\[
\hat{R}^2 = 0.823 \quad \text{DW} = 2.428
\]

Though individually OUTPUT and NSDPR have significant impact on RFISH, their specifications suffered from autocorrelation. However in the multiple regression framework these variables became insignificant.

The estimate of elasticity is as follows.

\[
\log \text{(RFISH)}_t = 0.53475 + 0.87298 \log \text{(RFISH)}_{t-1}
\]

\[
\begin{array}{c}
\text{(13.122)}^*
\end{array}
\]

\[
\hat{R}^2 = 0.89 \quad \text{DW} = 2.48
\]

The impact of demand – supply gap is as follows:
\\ \text{CHAPTER 5- DETERMINATION OF PRICE CHANGE}\\

\[ \text{RFISH}_t = 2568.6 + 1.6926 \text{ (GAPFISH)}_t^+ \]
\[ (1.568) \]
\[ \frac{2}{R} = 0.144 \quad \text{DW} = 2.271 \]

\[ \text{Log (RFISH)}_t = 4.8513 + 0.26934 \text{ log (GAPFISH)}_t^+ \]
\[ (2.256)^* \]
\[ \frac{2}{R} = 0.31 \quad \text{DW} = 2.0789 \]

The regression coefficient was found to be significant in the double – log form. A one percent rise in demand – supply gap of fish would have raised the retail price of fish by 0.27 percent.

The Lead- Lag Structure of Wholesale and Retail Prices

It is presumed that any price movement originates first in the wholesale market which is than transmitted to retail price of the commodity. It will be of interest to study the impact of wholesale price on retail price of a commodity. In this section we study this issue with respect to the prices of rice, pulses and firewood for which data are available. The elasticities of retail prices with respect to current wholesale prices lagged by one period are calculated with due correction for auto correlation using the double – log function.
### Table 5.13

Elasticity of retail price with respect to Wholesale price

<table>
<thead>
<tr>
<th>Variables</th>
<th>Current period</th>
<th>Lagged by one period</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR2</td>
<td>1.0015*</td>
<td></td>
<td>0.99</td>
</tr>
<tr>
<td>RR2</td>
<td></td>
<td>0.99805</td>
<td>0.978</td>
</tr>
<tr>
<td>RP2</td>
<td>0.9933*</td>
<td></td>
<td>0.99</td>
</tr>
<tr>
<td>RP2</td>
<td></td>
<td>0.9946*</td>
<td>0.987</td>
</tr>
<tr>
<td>RFU2</td>
<td>0.97341*</td>
<td></td>
<td>0.993</td>
</tr>
<tr>
<td>RFU2</td>
<td></td>
<td>0.95785*</td>
<td>0.982</td>
</tr>
</tbody>
</table>

Notes: * Corrected for auto Correlation using Cochran- Orcutt procedure.

Table 5.13 shows that the elasticity of retail prices with respect to wholesale prices in the current period have been uniformly higher than that of wholesale prices lagged by one period. Only in the case of RR2, a 1 percent rise in WR2 would elicit a proportionately higher percentage rise. These results suggest that retail prices respond to wholesale price changes without considerable lag.

The lag structure was further studied by using lags of wholesale prices upto 12 months. The stepwise regression procedure was used to select the variables to be included. The results were as follows:

$$\log RR_2t = -4.59731 + 0.93622 \log WR_2t + 0.07154 \log WR_{2t-10}$$

(42.027) \hspace{1cm} (3.141)

$$\bar{R}^2 = 0.9918$$

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\[ \log RP_{t} = -4.52532 + 0.79753 \log WP_{t} + 0.19908 \log WP_{t-2} \]

\[ \bar{R}^2 = 0.9921 \]

\[ \log RFU_{t} = 0.12533 + 0.9269 \log WFU_{t} + 0.01587 \log WFU_{t-1} \]

\[ \bar{R}^2 = 0.9929 \]

The findings show that current value of the wholesale price has the highest impact on the retail price. Lagged values in general have small impact. The long lag in the case of RR2 and comparatively shorter lag in the case of RP2 can be given an interpretation in terms of the nature of the commodities. Since domestic production of rice dominates total supply of rice, past values of prices may have a role in formation of price expectations by local producers. The role of local factors may be reflected in the importance of lagged values. In the case of pulses insignificant proportion of local production to total supply has been translated into insignificant long lags. This interpretation however is not valid in the case of firewood where 100 percent domestic production is the rule. The lags are found to be short.
5.5 Conclusion:

The exercise in stochastic modeling of prices is summed up in the following table no. 5.14

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR2</td>
<td>ARIMA (1,1,1)</td>
</tr>
<tr>
<td>WR2</td>
<td>ARIMA (0,1,4)</td>
</tr>
<tr>
<td>RP2</td>
<td>ARIMA (0,1,6)</td>
</tr>
<tr>
<td>WP2</td>
<td>ARIMA (2,1,5)</td>
</tr>
<tr>
<td>RS2</td>
<td>ARIMA (0,1,5)</td>
</tr>
<tr>
<td>RC2</td>
<td>ARIMA (0,1,6)</td>
</tr>
<tr>
<td>RF2</td>
<td>ARIMA (0,1,5)</td>
</tr>
<tr>
<td>RFU2</td>
<td>ARIMA (0,1,5)</td>
</tr>
<tr>
<td>WFU2</td>
<td>ARIMA (0,1,5)</td>
</tr>
<tr>
<td>WO2</td>
<td>ARIMA (0,1,5)</td>
</tr>
</tbody>
</table>

Majority of the series have moving average specifications. Only RR2 and WP2 are found to have autoregressive component in the model. The implication for forecasting is that MA (q) can provide forecasting information only up to q periods in the future. For instance ARIMA (0,1,6) for RC2 can provide forecast up to 6 periods only. On the other hand the AR model, the process has an infinite memory.

In the case of structural modeling of RRICE, price lagged by one year is found to be the most important determinant. A one-percent rise in RRICE would raise the next period price by 1.024 percent. The demand-supply gap did not have any significant impact on RRICE. In the case of WRICE, real net state domestic product (NSDPR) was found to have significant positive impact with an elasticity of 1.637. Demand-supply gap was an insignificant factor. In the case of RFISH, both the value of RFISH lagged by one year and demand-supply gap were found to have significant positive impact with elasticity values of 0.87 and 0.27 respectively.
A study of the lead-lag structure of wholesale and retail prices revealed that current period wholesale prices of rice, pulse and fuel have greater impact on current period retail prices than lagged values of wholesale prices. The step-wise regression procedure revealed different lag structures where the current values predominated.