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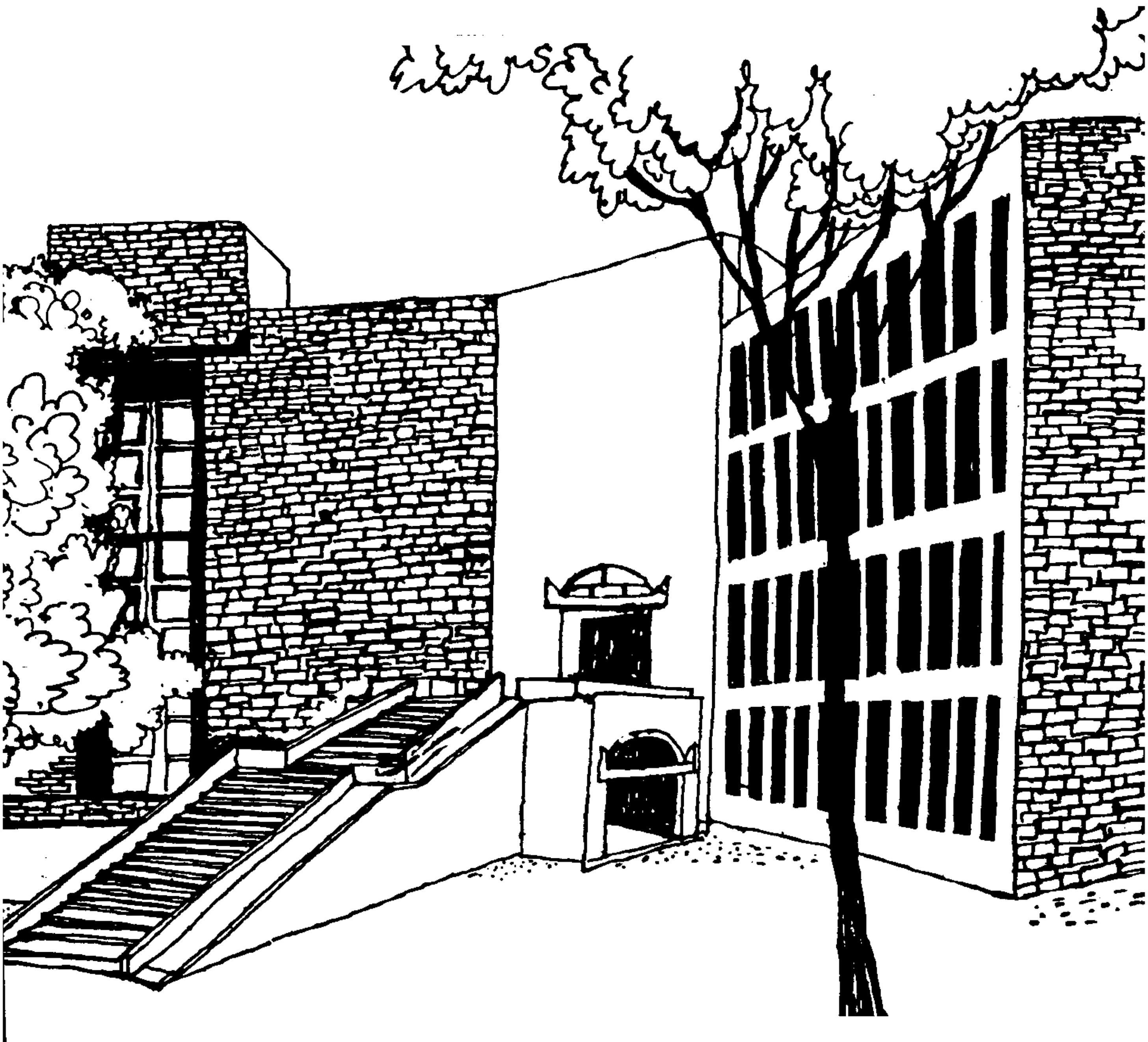

AN EVALUATION OF FARMERS' PRICE EXPECTATION PROCESS

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An Evaluation of Farmers' Price Expectation Process

Gopal Naik and K.R. Babu[1]

ABSTRACT

Most dynamic models involve expectation of one or more variables. Existence of several expectation hypotheses, none of them being preeminent for all situations, makes it difficult to choose an expectation process while building models. In this context it would be helpful if empirical validity of different hypotheses is available for broad categories or situations. This study is aimed at evaluating farmers expectation process in terms of different hypotheses available. Here, the land allocation to chilly crop is assumed to be primarily based on expectation of subsequent prices. The resultant model from different expectation hypotheses are fitted on the acreage under chilly crop. Also, four different types of price indices for the period 1949-50 to 1988-89 are used to estimate and test the models. The best fit model is selected based on R^2, Amemiya Prediction Criteria (APC) and forecast accuracy measured by Root Mean Square Error (RMSE). The actual best fit model (ideal model) for price is also identified using the above criteria and compared with the best expectation model used by farmers to assess the accuracy of the expectation form used. The results indicates that the extrapolative model proposed by Turnovsky is the best model for explaining farmers' expectations. This model also seems to be the ideal model for forecasting prices, especially for the recent years.

Introduction

Randomness of variables necessitates formation of expectations. Most dynamic models invariably include expectation of one or more variables. Estimation of such system/equation requires prior knowledge on the form of expectation process. For example, a simplified form of the often used, market model in agriculture contains price in expected form as follows

$$Q_t = a_0 - a_1 P_t + u_t \qquad \text{(Demand equation)}$$

$$S_t = b_0 + b_1 E_{t-1}(P_t) + v_t \qquad \text{(Supply equation)}$$

$$Q_t = S_t \qquad \text{(Equilibrium condition)}$$

where Q_t is the quantity demanded, S_t is the quantity supplied, P_t is the price and $E_{t-1}(P_t)$ refers to the conditional expectation of price at t-1 for time t. The supply equation indicates that the quantity of supply depends on the farmers expectation of price of the commodity during the planting season. But how exactly do the farmers form expectation of prices ?

Despite its importance, the process of formation of expectation is one of the least understood area. This is mainly because expectations are not easily observable and hence one can only hypothesis the form a decision maker uses. Since late fifties, several hypotheses have been put forth to explain the process of formation of expectation, such as adaptive,

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rational, etc. However, none of these hypotheses is preeminent (Lovell,1986). There are strengths and weaknesses in each of these hypotheses, and the empirical findings also do not support the dominance of any single hypothesis.

It is quite possible that individual decision makers, depending on their background, economic environment, and the situation form expectation of variables differently. As Lovell (1986) puts it, "expectations are rich and varied measurements." Therefore, a particular hypothesis may suit a particular situation better than other situations. Also, within an industry individual firms may use different process to form expectation of a single variable. Muth (1985) and Hirsch and Lovell (1969) based on their survey of business firms found that some firms are perennial optimists while other firms are perennial pessimists. This may result in a situation where aggregate expectation process is not easily discernable or may conform to a different hypotheses than the one at individual level. Lovell (1986) reported that

> "at the firm level Ferber's law and the exponential smoothing model yield better estimate of anticipated sales than is provided by the actual realization as proxy. For industry aggregates, however, it is better to use actual sales as a proxy for anticipations rather than to assume that expectations are generated either by Ferber's law or by exponential smoothing. This discrepancy arises because the cancelling or offsetting forecasting errors of individual firms makes aggregate anticipations much more accurate predictions of aggregate realizations."

Nevertheless, there may be situations where a majority of the firms follow a particular type of process to generate expected values[2].

In this paper an attempt is made to identify the hypothesis which closely resembles the process of expectation of Indian chilly growers and evaluate it in terms of its accuracy by comparing it with other hypotheses. Also, an ideal hypotheses for the growers of this crop is identified and compared with the actually used model to examine how far farmers can improve their expectation process. It is hoped that this would provide useful information regarding farmers expectation process and possibility of improving their accuracy of forecasts. It may also facilitate the model builders to use appropriate form of expectation process.

Expectation Theory

Several expectations hypotheses/models have been proposed since mid-fifties. For the purpose of presenting these hypotheses we define P as

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[2] There are even controversies regarding whether direct empirical tests of a particular hypotheses should be done or not. For example, while Tobin (1980) and Simon (1979) have supported direct empirical testing of rational expectation hypotheses, others like Prescott (1977) have opposed such testing.

the predicted (expected value), A is the actual value and t refer to time period.

Classical Model

Classical model which is also known as 'naive' model assumes that the expected value is equal to the latest known value. That is

$$P_t = \alpha_0 + \alpha_1 A_{t-1} \qquad \ldots \qquad (1)$$

where $\alpha_0 = 0$ and $\alpha_1 = 1$.

Extrapolative Models

Extrapolative model proposed by Goodwin (1941) is of the form

$$P_t = A_{t-1} + \beta(A_{t-1} - A_{t-2}). \qquad \ldots \qquad (2)$$

Here the assumption is that a certain fraction of the latest change is added to the latest observed value. Turnovsky (1970) based on the interviews with a number of businessmen found the following form of extrapolative model to be suitable

$$P_t = A_{t-1} + \beta(A_{t-1} - A_{t-2})/A_{t-2} \qquad \ldots \qquad (3)$$

Ferber, also based on the interviews with a number of business enterprises, suggested that in making forecasts firms incorporate seasonal movements in prices. His quarterly model can be specified as

$$P_t = \alpha_0 + A_{t-1} [\alpha_1 + \alpha_2 (A_{t-1} - A_{t-5}) / A_{t-5}]. \qquad \ldots \qquad (4)$$

If $\alpha_0 = \alpha_2 = 0$ and $\alpha_1 = 1$ then expectations are same as last year. This model

can be modified to suit the annual data as follows

$$P_t = \alpha_0 + \alpha_1 A_{t-1} + \alpha_2 A_{t-1} (A_{t-1} - A_{t-2}) / A_{t-2}. \qquad \ldots \qquad (4a)$$

This model differs from Turnvosky's model in converting proportional change as adjustment factor into an absolute value.

Adaptive Expectation (Exponential Smoothing)

Adaptive expectation proposed by Cagan (1956) and Nerlove (1958) is based on the assumption that the expected value is adjusted by an amount proportional to the most recently observed forecast error[3]. That is,

$$P_t = P_{t-1} + \alpha(A_{t-1} - P_{t-1}) \qquad \ldots \qquad (5)$$

By substituting the value of P_{t-k} repeatedly in (4) we can obtain

[3] The adaptive expectation model has its origin in Hick's concept of elasticity of expectations (Hicks, 1939)

$$P_t = \alpha A_{t-1} + (1-\alpha) \alpha A_{t-2} + (1-\alpha)^2 \alpha A_{t-3} + \ldots \quad (5a)$$

A similar model called 'Perverse Adaptive Expectations' has the form

$$P_t = A_{t-1} + \beta (A_{t-1} - P_{t-1}) \quad \ldots \quad (6a)$$

which on repeated substitutes for P_{t-k} results as follows:

$$P_t = (1 + \beta) A_{t-1} - (1+ \beta) \beta A_{t-2} + (1 + \beta)\beta^2 A_{t-3} + \ldots \quad (6b)$$

Note that if $\beta = 0$ then the model (6b) reduces to naive model.

Implicit Expectation

Developed by Mills (1957), this model assumes that the prediction error is not correlated with actual realization. That is

$$P_t = \alpha_0 + \alpha_1 A_t + e_t \quad \ldots \quad (7)$$

where $\alpha_0 = 0$; and $\alpha_1 = 1$; $E(e) = 0$

Based on this it is possible to use the actual realization as a proxy for the expected value. Muth's (1961) rational expectation is considered precisely the reverse of implicit expectation (Lovell, 1986).

Rational Expectations

This model proposed by Muth (1961) assumes that the prediction error must be uncorrelated with the entire set of information that is available to the forecaster at the time the prediction is made. Lovell (1986) terms this condition for 'full rationality' or 'strong rationality' or 'sufficient expectation'. For ' weak rationality ' it is enough if the forecast error be distributed independently of the anticipated value, that is

$$A_t = \alpha_0 + \alpha_1 P_t + e_t \quad \ldots. \quad (8)$$

where $\alpha_0 = 0$; and $\alpha_1 = 1$; $E(e) = 0$.

Since P_t should be correlated with A_t the variance of A_t is larger than the variance of P_t which is the reverse of implicit expectations. This weak rationality implies that if lagged values of A_t are added as explanatory variables in the above equation their coefficients should not be significantly different from zero. That is

$$A_t = \alpha_0 + \alpha_1 P_t + \alpha_2 A_{t-1} + e_t \quad \ldots. \quad (9)$$

where $\alpha_2 = 0$.

For empirical analysis Lovell (1961) has proxied out the unobserved expectation variables by assuming that the predicted changes is a fraction of observed changes. That is

$$P_t - A_{t-1} = \Gamma(A_t - A_{t-1}) + e_t \quad \ldots \quad (9a)$$

Therefore,

$$P_t = A_{t-1} + \Gamma\ (A_t - A_{t-1}) + e_t \qquad \ldots \quad (9b)$$

With $\Gamma = 1$ this model reduces to either implicit or rational expectations, depending on whether it is assumed that e_t is distributed independently of P_t or A_t.

Rational expectation is said to follow if the expectations and the realizations follow the same autoregression. Fisher and Tanner (1978), and Lovell (1986) used the following form to test rational expectation

$$P_t = \beta_1 A_{t-1} + \beta_2 A_{t-2} + e_t. \qquad \ldots (10)$$

Simon (1979) cautioned that single valued forecasts applied with linear decision rules are inadequate to reflect decision framework, and, therefore certainty equivalence have been proposed, which is consistent with rational expectation. Certainty equivalence also has its drawback as it requires the loss function to be quadratic and there must be no sign constraints on the decision variable. Also, even when the loss function is quadratic the certainty equivalence may not go through because the variance of the loss depends on the decision. Also, when loss function is asymmetric the loss function will not hold true.

Moving Average Model

Fisher and Tanner (1978) suggested that for those farmers who found it difficult to formulate expectation "the best strategy was to take an authentic average of past values of the series." That is

$$P_t = [A_{t-1} + A_{t-2} + A_{t-3}]/3. \qquad \ldots \quad (11)$$

Empirical Evidence

Rational expectation hypothesis, because of its appealing theoretical base, has attracted lot of attention in terms of testing for its empirical validity. Muth (1985) tested alternative theories of expectation based on the data from five business firms. He found that in majority of the cases the variance of anticipations is larger than the variance of the realization, which is inconsistent with the rational expectation hypotheses. Others like De Leeuw and McKelvey (1981,1984) for prices and Gramlich (1983) and Leonard (1982) for wages found their results inconsistent with the rational expectation hypotheses. The results of these and other studies led Lovell (1986) to conclude that "the empirical evidence does not establish that the received doctrine of rational expectations dominates alternative hypotheses about expectations. Several economists (Modigliani and Sauerlander (1955), Eckstein, Mosser and Cebry (1984)) have found that survey observation on expectational variables can be of assistance in the empirical modelling of economic behavior and econometric forecasting (Lovell, 1986).

Framework of the study

In this study, we attempt to identify the model that fits most closely the expectation process of farmers growing chilly. Chilly crop has been selected because of the following reasons. First, chilly being a cash crop, the acreage response will depend mainly on the expected price (unlike in case of foodgrains where home consumption may make the farmers less responsive to prices). Second, unlike for many other crops there is no government support prices for chilly. Therefore, market forces are the only basis to form expectation and could vary very much across individuals. Third, most of its production is concentrated in four adjacent states: Andhra Pradesh, Karnataka, Maharastra and Tamil Nadu. Hence the condition will not differ substantially from one market to another. And finally, export and import of chilly is also a small fraction of the total production. Therefore, domestic market conditions are the main considerations.

The acreage under any crop is primarily dependent on expected price and yield of the crop, expected price and yield of the competing crops during the planting period[4]. Since price fluctuations are usually higher than the yield fluctuations, price expectation can be assumed to be more critical than yield[5]. We consider here the expected prices of the crop as the main variable influencing acreage under chilly crop[6]. The current crop acreage also depends on the previous years acreage due to certain advantages in continued cultivation. Therefore, previous years acreage has also been included in the model. That is

$$L_t = f\ (L_{t-1},\ E_t\ P_{t+1}) \qquad \ldots \qquad (12)$$

where L_t is acreage under chilly crop and P_t is the price of this crop expected to prevail after harvest. Assuming linear functional form for equation (7), that is

$$L_t = \alpha_0 + \alpha_1 L_{t-1} + \alpha_2\ E_t\ P_{t+1} + e_t. \qquad \ldots\ldots\ldots \qquad (13)$$

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[4]Changes in cost structure of that particular and competing crops can also influence acreage. The type of competing crops vary from place to place. Therefore, considering all these crops at the aggregate level may not reflect their actual influence at regional level.

[5]In the case of Rabi crop the moisture availability can also determine crops to be planted in rainfed conditions. In Kharif season this happen only if monsoon starts much later than expected.

[6] Expected prices of competing crops are also important factors. However, there are difficulties regarding the number of commodities to be included as competing crops.

different expectation model reported earlier are substituted in this equation and are estimated using OLS.

Model Selection

In order to select the best fit model adjusted R^2, Amemiya Prediction Criterion and out of sample forecast accuracy measured by Root Mean Square Error are used. Adjusted R^2 proposed by Theil (1971) is a better measure for model choice compared to R^2 as it is not influenced by the number of independent variables used in the regression. However, as in the case of R^2, it does not include consideration of the losses associated with choosing an incorrect model. The Prediction Criteria developed by Amemiya (1980) based on unconditional mean square prediction error overcomes this problem (for details see Judge et al., 1982).

Out-of-sample forecast performance is the acid test especially for models developed for forecasting purposes. Here forecast is made in an ex-ante fashion and is evaluated using Root Mean Square Error[7]. It is important to note that the reliability of this measure is subject to a sufficient number of forecasts available for evaluation.

The best fit model thus selected will be considered as closely resembling farmers expectation process. For the purpose of identifying ideal model for expectation of price, acreage is replaced by the actual price realised as dependent variable for each one of the above expectation model, and estimated without lag acreage. The model is selected based on the same criteria[8]. From these estimation we examine whether the best models in both cases are the same. If they are the same then we can conclude that farmers expectation model is the best model. If not, we will analyse the extent to which farmers expectation can be improved.

Production of Chilly

As mentioned before we have selected chilly crop in this study, since chilly growing farmers decisions can be assumed to be guided mainly by the market conditions. Chilly, is grown as green chilly in almost all parts of the country for household uses, but it is grown as red/dry chilly mainly in the states of Andhra Pradesh, Karnataka, Maharastra and Tamil Nadu. These four states contributed about 63 per cent of the area and 68 per cent of the production in the country (1987-88). Chilly is a long duration crop

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[7] Other techniques such as Theils U_1 and U_2 and contingency table can also be used.

[8] It should be noted that the expectation process influences the type of relationship between current price and its past values, through the supply.

extending to almost two seasons. It is grown both as a winter as well as summer crop. The summer crop is mostly supplied as green chillies, while the winter crop is supplied in the form of red or dry chilies. The winter crop commences from July-August and harvesting is completed in February-March. The crop starts flowering from the month of November and the pods are ready for harvest from December onwards, and the harvest continues till February. Almost all the dry chilly produced is marketed.

Data and Methodology

Time series data on area under chilly and the monthly wholesale price indices (base :1970-71 = 100) were collected for the time period from 1949-50 to 1988-89 from wholesale price indices. Since annual aggregate prices are needed for estimation of the equation the question arises as to which of the several alternative aggregate price indices such as crop year aggregate, financial year aggregate or only a part of the year aggregate prices, should be considered. We have used 4 types of aggregate level prices which are computed using monthly wholesale price indices as follows

1. Average wholesale price index for the financial year i.e., April to March (FYPI).
2. Average wholesale price index for the crop year i.e., July to June (CYPI)
3. Average wholesale price index for six months since the commencement of harvesting of the previous chilly crop i.e., January to June (HSPI)
4. Average wholesale price index for four months after the previous chilly crop is completely harvested i.e., March to June (AHPI)

The rationale behind computing the average wholesale price index for these different time period is to identify the price indices that influence most the farmers expectation. Financial year price indices aggregates the after harvest prices of the two period previous crop, crop year prices would include the prices prevailing during last crop season, the average for the months January to June indicates the average price prevailing during the whole harvest season of the previous crop and the average for the months March to June indicates the price prevailing after the harvest of the previous crop.

An examination of the pattern of movements of aggregate indices for the period from 1949-50 to 1987-88 (Fig.1) revealed that there are two distinct pattern in price movements during this period. They are first, period (FP) from 1949-50 to 1965-66, and the second period (SP) from 1966-67 to 1987-88. Since we wanted to evaluate the out-of-sample forecast performance of the models we considered data up to 1981-82 for estimation of model for the purpose of the model selection. Two data sets were considered here :the second period consisted data for the period from 1966-67 to 1981-82, (15 observations) and the whole set (TP) with 33 observations i.e., from 1949-50 to 1981-82. Based on the theoretical models presented before the following models were estimated using the two data sets, separately.

$L_t = f(L_{t-1}, A_{t-1})$ .. Classical/Naive [CN]

$L_t = f(L_{t-1}, A_{t-1}, A_{t-1} - A_{t-2})$ .. Extrapolative [EX-I]

$L_t = f(L_{t-1}, A_{t-1}, (A_{t-1} - A_{t-2})/A_{t-2})$ .. Extrapolative [EX-II]

$L_t = f(L_{t-1}, A_{t-1}, A_{t-1}(A_{t-1} - A_{t-2})/A_{t-2})$ ..Extrapolative Expectation [EX-III]

$L_t = f(L_{t-1}, A_{t-1}, A_{t-2}, A_{t-3})$ .. Adaptive Expectation [AE]

$L_t = f(L_{t-1}, A_t)$ ..Implicit Expectation [IE]

$L_t = f(L_{t-1}, A_{t-1}, A_{t-2})$ .. Rational Expectation [RE-I]

$L_t = f(L_{t-1}, A_t, A_t - A_{t-1})$ .. Rational Expectation [RE-II]

$L_t = f(L_{t-1}, (A_{t-1} + A_{t-2} + A_{t-3})/3)$ .. Moving Average [MA]

Since EX-I and RE-I are derivable from one another only EX-I is estimated. To find the best prediction model the above models were estimated using data up to 1981-82 and forecast is made for the year 1982-83. Then by updating these data by including 1982-83[9] data, the models were re-estimated and forecast is done for 1983-84. This process of updating, estimation and forecast is repeated up till 1987-88. The best prediction models were selected by comparing with the computed root mean square errors of forecasts of individual models. Based on the adjusted R^2, amemiya prediction criteria and root mean square error the best fit models were selected. The selection reliability of the estimated equation is also judged by examining the t values and Durbin-Watson statistics.

For the purpose of identifying the ideal model the actual price received is used as the dependent variable in the above models and were estimated without lag acreage for all the four set of average wholesale price indices. Models IE and RE-II could not be estimated as the current dependent variable appears as independent variable. The best fit model was selected based same criteria as above.

RESULTS

The eight models presented before are estimated with 4 different Aggregate Level Wholesale Price Indices, viz., FYPI, CYPI, HSPI and AHPI, and 2 data sets. First set is for the total period (TP) from 1949-50 to 1881-82 and second period (SP) from 1966-67 to 1881-82. The estimation is also done with and without dummy variable (X_1 and X_2) for cycles. Thus a total of 128 models were estimated with acreage as dependent variable.

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[9]These models were estimated using 2 dummy variables as the graph was indicating 3 year cycle. However, the coefficients were not significant.

For the total period model EX-II has outperformed all other models for all the indices in terms of all the criteria, i.e., R^2, APC and RMSE (table 1). There is no clear indications of the next best model. Some models are better in terms of R^2 and APC while others are better in terms of RMSE. For example RE is better in terms of R^2 and APC for all but CYPI. Therefore, clear ordering of models is difficult. However, the worst model seem to be IE for all but FYPI. Among the EX-II models for all the indices, the model for CYPI outperforms others. This model has two coefficients highly significant and the third one significant at 10 per cent level and have expected signs (table 5). The next best model is for HSPI in which case all the coefficients are significant at 5 per cent level. This indicates that EX-II model is used by the farmers to form price expectation and crop year is the most relevant period used.

An examination of the model for the second period indicates that there is no single model which dominates on all the criteria for all the indices (table 2). In the case of HSPI, RE is the best model in terms of R^2, APC and RMSE. For FYPI, CN performs better in terms of R^2 and APC and EX-II does better in terms of RMSE. However, for CYPI, EX-II performs better on R^2 and APC and slightly worse than EX-I in terms of RMSE. For AHPI, EX-III performs better in terms of R^2 and APC and RE in terms of RMSE. Overall, EX-II model of CYPI seem to be performing better than other models. This again demonstrates that EX-II is an appropriate model to capture farmers expectation process and crop year is the most relevant period at the aggregate level. The model estimates indicate that the coefficients have correct sign and one coefficients is highly significant, whereas other two are significant at higher levels (table 5). In the second period also IE performed worse in almost all the cases. Therefore, such form should be avoided while incorporating expectations in models. The performance of rational expectation models were discouraging.

Ideal Model

To find out the 'Ideal Model,' actual price is used as dependent variable. Here RE and IE could not be estimated as the functional form did not permit such estimation.

For the total period AE outperformed all other models on all criteria for all indices (table 3). There was no clear indication of the worst model. The overall best model is AE for CYPI. The estimated model suggests that the coefficients had correct signs and two of them highly significant and the other significant at 10 per cent level (table 6). This suggests that ideal model to be used is AE and crop year as the relevant time period. EX-II which is the actual model used performs poorly compared with AE. This suggests that farmers can use AE to predict the price and thus improve the accuracy substantially.

In the second period, however, it is difficult to identify an ideal model that performs better for all situations (table 4). In the case of HSPI and AHPI, CN is better in terms of R^2 and APC, but EX-II is better in terms of RMSE. In the case of FYPI, MA performed better in terms of R^2 and APC and EX-II in terms of RMSE. For CYPI, AE performed better in terms of R^2 and RMSE and again EX-II in terms of RMSE. Therefore, considering RMSE as a criterion the actual model used by farmers, that i.e., EX-II performs better in all cases. However, in terms of R^2 and APC, CN, MA, and AE models perform well. This suggests that farmers expectation process may not be inefficient especially in terms of forecasting accuracy in the recent years. Though by switching to CN or AE the R^2 and APC can be improved while the forecast efficiency will go down.

Conclusions

The study aimed at identifying the actual expectation model used by the chilly growers in India and identifying the ideal model to examine how actual model used by farmers compares with the ideal model. The results strongly indicate that farmers use extrapolative model-II to form expectation of prices at the aggregate level. This is consistent with previous literature (Turnovsky, 1970). As far as the ideal model is concerned for the total period as a whole adaptive expectation model performs very well. However, when only latest observations are considered no single ideal model could be identified. Nevertheless, the extrapolative model used by farmers performed well in terms of forecast accuracy for all indices.

The results of this study suggests that while modelling farmers expectation, extrapolative -II type model should be used especially at the aggregate level. Since other studies have also found this model superior it is quite possible the decision makers often use this model. The relevant time to get aggregate annual price is crop year. Further results on other crops could probably shed more light on the form of expectation process.

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Table 1: R2, DW, APC and RMSE for Models with Acreage as Dependent Variable for the Period 1949-50 to 1981-82

Price Indices	Type of Models	R2	DW	APC	F	RMSE
HSPI	CN	0.75	1.75	2359.47	47.03	48.10
HSPI	EX-I	0.76	1.77	2419.58	31.84	45.74
HSPI	EX-II	0.80	1.61	1933.53	42.11	37.67
HSPI	EX-III	0.75	1.74	2471.12	30.99	45.06
HSPI	AE	0.74	1.80	2581.35	21.44	47.68
HSPI	IE	0.65	2.18	3394.69	26.31	90.41
HSPI	RE	0.77	1.86	2275.52	35.48	53.79
HSPI	MA	0.69	1.98	2912.58	32.78	74.38
FYPI	CN	0.71	1.97	2755.88	38.25	60.06
FYPI	EX-I	0.71	2.08	2860.33	25.55	50.61
FYPI	EX-II	0.78	2.22	2215.20	35.61	43.17
FYPI	EX-III	0.72	2.13	2742.58	27.03	55.89
FYPI	AE	0.72	2.18	2738.58	19.85	53.51
FYPI	IE	0.70	2.07	2905.43	36.68	68.92
FYPI	RE	0.73	1.87	2684.87	28.65	60.06
FYPI	MA	0.67	2.01	3067.14	30.44	79.56
CYPI	CN	0.74	1.80	2482.62	44.00	53.88
CYPI	EX-I	0.75	1.92	2462.93	31.12	48.55
CYPI	EX-II	0.83	2.04	1709.81	48.80	37.04
CYPI	EX-III	0.74	1.91	2425.71	31.74	60.36
CYPI	AE	0.75	1.97	2462.74	22.77	55.95
CYPI	IE	0.67	2.11	3129.32	30.02	83.47
CYPI	RE	0.74	1.85	2548.02	30.69	55.38
CYPI	MA	0.68	1.99	3019.85	31.13	77.24
AHPI	CN	0.73	1.84	2576.68	41.88	45.34
AHPI	EX-I	0.72	1.85	2750.54	26.93	46.64
AHPI	EX-II	0.76	2.00	2364.15	32.80	43.75
AHPI	EX-III	0.73	1.73	2662.49	28.12	51.93
AHPI	AE	0.70	1.88	2928.83	18.15	45.19
AHPI	IE	0.64	2.20	3467.90	28.38	94.30
AHPI	RE	0.75	1.99	2495.69	31.53	50.97
AHPI	MA	0.68	1.98	2965.27	31.95	71.68

Note: HSPI = Harvest Season Price Index
FYPI = Financial Year Price Index
CYPI = Crop Year Price Index
AHPI = After Harvest Season Price Index
CN = Classical /Naive Expectation
EX = Extrapolative Expectation
AE = Adaptive Expectation
IE = Implicit Expectation
RE = Rational Expectation
MA = Moving Average Expectation

Table 2: R2, DW, APC and RMSE for Models with Acreage as Dependent Variable for the Period 1966-67 to 1981-82

Price Indices	Type of Models	R2	DW	APC	F	RMSE
HSPI	CN	0.46	1.67	2272.82	7.37	33.73
HSPI	EX-I	0.42	1.64	2571.09	4.59	33.97
HSPI	EX-II	0.46	1.42	2378.63	5.30	34.69
HSPI	EX-III	0.42	1.71	2584.32	4.56	34.64
HSPI	AE	0.37	1.67	2906.64	3.25	39.21
HSPI	IE	0.17	1.94	3482.37	2.55	63.91
HSPI	RE	0.50	1.67	2228.81	5.93	31.57
HSPI	MA	0.40	1.93	2527.36	5.98	62.06
FYPI	CN	0.40	1.81	2540.10	5.91	42.33
FYPI	EX-I	0.35	1.84	2855.24	3.67	36.98
FYPI	EX-II	0.43	1.88	2509.26	4.82	35.52
FYPI	EX-III	0.36	1.83	2841.23	3.79	36.32
FYPI	AE	0.39	2.07	2828.57	3.41	43.73
FYPI	IE	0.26	1.97	3131.96	3.57	58.02
FYPI	RE	0.36	1.77	2838.00	3.80	42.19
FYPI	MA	0.36	1.95	2679.37	5.27	69.58
CYPI	CN	0.44	1.68	2356.60	6.88	35.10
CYPI	EX-I	0.41	1.71	2621.91	4.44	30.41
CYPI	EX-II	0.50	1.80	2197.45	6.07	31.09
CYPI	EX-III	0.41	1.67	2618.69	4.45	33.95
CYPI	AE	0.42	1.85	2683.98	3.74	43.10
CYPI	IE	0.21	1.97	3339.14	2.94	63.78
CYPI	RE	0.40	1.68	2655.22	4.33	37.08
CYPI	MA	0.35	1.92	2712.21	5.13	66.08
AHPI	CN	0.36	1.81	2684.65	5.24	36.13
AHPI	EX-I	0.32	1.76	2999.90	3.38	39.06
AHPI	EX-II	0.31	1.82	3059.09	3.23	36.27
AHPI	EX-III	0.40	1.63	2635.99	4.39	41.23
AHPI	AE	0.28	1.84	3361.79	2.43	44.89
AHPI	IE	0.16	1.91	3521.60	2.45	62.66
AHPI	RE	0.39	1.88	2711.68	4.16	26.90
AHPI	MA	0.34	1.90	2778.66	4.88	59.93

Note: HSPI = Harvest Season Price Index
FYPI = Financial Year Price Index
CYPI = Crop Year Price Index
AHPI = After Harvest Season Price Index
CN = Classical /Naive Expectation
EX = Extrapolative Expectation
AE = Adaptive Expectation
IE = Implicit Expectation
RE = Rational Expectation
MA = Moving Average Expectation

Table 3: R2, DW, APC and RMSE for Models with Actual Price as Dependent Variable for the Period 1949-50 to 1981-82

Price Indices	Type of Models	R2	DW	APC	F	RMSE
HSPI	CN	0.65	1.89	964.79	59.76	107.12
HSPI	EX-I	0.64	1.92	1057.24	27.57	108.69
HSPI	EX-II	0.64	1.95	1054.88	27.66	107.47
HSPI	EX-III	0.64	1.95	1054.41	27.68	107.70
HSPI	AE	0.69	2.17	943.00	22.38	60.96
HSPI	MA	0.58	1.35	1193.25	41.28	79.35
FYPI	CN	0.56	2.03	1271.02	40.55	87.00
FYPI	EX-I	0.56	1.91	1350.90	19.86	88.84
FYPI	EX-II	0.55	2.00	1379.92	19.14	132.70
FYPI	EX-III	0.56	1.96	1329.75	20.40	97.82
FYPI	AE	0.61	1.98	1253.66	15.94	52.86
FYPI	MA	0.59	1.65	1219.75	43.41	71.01
CYPI	CN	0.65	1.84	1012.56	59.18	97.37
CYPI	EX-I	0.64	1.82	1114.22	27.22	99.56
CYPI	EX-II	0.64	1.83	1110.51	27.36	96.85
CYPI	EX-III	0.64	1.83	1112.38	27.29	98.50
CYPI	AE	0.72	1.88	893.57	25.81	55.72
CYPI	MA	0.63	1.44	1099.65	51.15	73.51
AHPI	CN	0.67	2.22	894.00	64.90	108.63
AHPI	EX-I	0.67	2.07	959.07	30.79	110.18
AHPI	EX-II	0.66	2.19	974.17	30.10	109.16
AHPI	EX-III	0.67	2.02	936.23	31.89	109.48
AHPI	AE	0.68	2.18	928.28	21.94	57.44
AHPI	MA	0.65	1.54	955.83	55.92	83.62

Note: HSPI = Harvest Season Price Index
FYPI = Financial Year Price Index
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AHPI = After Harvest Season Price Index
CN = Classical /Naive Expectation
EX = Extrapolative Expectation
AE = Adaptive Expectation
MA = Moving Average Expectation

Table 4: R2, DW, APC and RMSE for Models with Actual Price as Dependent Variable for the Period 1966-67 to 1981-82

Price Indices	Type of Models	R2	DW	APC	F	RMSE
HSPI	CN	0.34	1.71	1806.34	8.59	100.07
HSPI	EX-I	0.30	1.80	2011.21	4.21	100.86
HSPI	EX-II	0.29	1.79	2037.52	4.07	63.71
HSPI	EX-III	0.29	1.78	2039.82	4.06	101.28
HSPI	AE	0.34	2.11	1986.22	3.61	102.97
HSPI	MA	0.20	1.61	2183.29	4.69	81.18
FYPI	CN	0.15	1.76	2262.15	3.62	80.86
FYPI	EX-I	0.09	1.74	2554.37	1.74	84.21
FYPI	EX-II	0.09	1.78	2554.47	1.74	53.96
FYPI	EX-III	0.11	1.79	2501.33	1.91	91.66
FYPI	AE	0.13	1.86	2582.13	1.72	86.67
FYPI	MA	0.18	1.60	2169.99	4.37	72.50
CYPI	CN	0.27	1.62	1868.71	6.47	88.28
CYPI	EX-I	0.21	1.64	2113.77	3.05	89.33
CYPI	EX-II	0.21	1.62	2124.19	3.00	55.67
CYPI	EX-III	0.21	1.62	2124.18	3.00	92.44
CYPI	AE	0.35	1.78	1855.68	3.63	92.83
CYPI	MA	0.23	1.37	1973.07	5.39	102.13
AHPI	CN	0.31	2.00	1621.37	7.81	103.22
AHPI	EX-I	0.26	1.97	1840.99	3.64	104.83
AHPI	EX-II	0.26	2.00	1842.73	3.63	60.19
AHPI	EX-III	0.27	1.92	1817.23	3.77	105.09
AHPI	AE	0.25	2.12	1952.15	2.71	105.48
AHPI	MA	0.26	1.48	1753.54	6.16	85.40

Note: HSPI = Harvest Season Price Index
FYPI = Financial Year Price Index
CYPI = Crop Year Price Index
AHPI = After Harvest Season Price Index
CN = Classical /Naive Expectation
EX = Extrapolative Expectation
AE = Adaptive Expectation
MA = Moving Average Expectation

Table 5: Best Fit Regressions Results for Different Price Indices at Different Time Periods

Price Indices	Time Period	Intercept	X1	X2	X3	X4	R2	DW	APC	RMSE	F	Model
HSPI	SP	407.63 (3.26)	0.40 (2.30)	0.56 (2.06)	-0.40 (-1.40)	-	0.50	1.67	2228.81	31.57	5.93	RE
FYPI	SP	362.17 (2.27)	0.46 (1.97)	0.44 (1.28)	-	38.41 (1.36)	0.43	1.88	2509.26	35.52	4.82	EX-II
CYPI	SP	279.96 (1.73)	0.56 (2.41)	0.46 (1.41)	-	54.02 (1.64)	0.50	1.80	2197.45	31.09	6.07	EX-II
ASPI	SP	379.58 (2.71)	0.45 (2.30)	0.42 (1.30)	-0.43 (-1.24)	-	0.39	1.88	2711.68	26.90	4.16	RE
HSPI	TP	186.02 (2.55)	0.67 (5.33)	0.58 (2.34)	-	50.96 (2.86)	0.80	1.61	1933.53	37.67	42.11	EX-II
FYPI	TP	202.46 (2.52)	0.65 (4.81)	0.48 (1.71)	-	63.85 (2.98)	0.78	2.22	2215.58	43.17	35.61	EX-II
CYPI	TP	170.54 (2.36)	0.70 (5.73)	0.45 (1.77)	-	85.56 (3.85)	0.83	2.04	1709.81	37.04	48.80	EX-II
ASPI	TP	168.65 (1.87)	0.71 (4.65)	0.45 (1.45)	-	61.91 (2.10)	0.76	2.00	2364.15	43.75	32.80	EX-II

Note: X1 = L_{t-1}; X2 = A_{t-1}; X3 = A_t-A_t-1; X4 = $(A_{t-1}-A_{t-2})/A_{t-2}$; where L_t = Acreage and A_t = Price Indices
TP = Total Period (1949-50 to 1981-82); SP = Second Period (1966-67 to 1981-82).
EX = Extrapolative Expectation
RE = Rational Expectation

Table 6: Best Fit Regressions Results for Different Price Indices at Different Time Periods with Actual Price as a Dependent Variable

Price Indices	Time Period	Intercept	X2	X4	X5	X6	X7	R2	DW	APC	RMSE	F	Model
HSPI	SP	40.47 (1.55)	0.67 (2.72)	5.35 (0.32)	-	-	-	0.29	1.79	2037.52	63.71	4.07	EX-II
FYPI	SP	50.41 (1.59)		-	-	-	0.64 (2.09)	0.18	1.60	2169.99	72.50	4.37	MA
CYPI	SP	32.52 (1.11)	0.75 (2.48)	-	-0.47 (-1.34)	0.54 (1.89)	-	0.35	1.78	1855.68	92.83	3.63	AE
ASPI	SP	44.15 (1.65)	0.65 (2.55)	-1.20 (-0.05)	-	-	-	0.26	2.00	1842.73	60.19	3.63	EX-II
HSPI	TP	7.88 (0.78)	0.90 (4.94)	-	-0.39 (-1.60)	0.48 (2.42)	-	0.69	2.17	943.00	60.96	22.38	AE
FYPI	TP	7.74 (0.66)	0.61 (2.94)	-	-0.08 (-0.31)	0.47 (2.22)	-	0.61	1.98	1253.66	52.86	15.94	AE
CYPI	TP	5.04 (0.51)	0.86 (4.52)	-	-0.43 (-1.72)	0.61 (3.10)	-	0.72	1.88	893.57	55.72	25.81	AE
ASPI	TP	8.28 (0.83)	0.71 (3.80)	-	-0.83 (-0.34)	0.37 (1.76)	-	0.68	2.18	828.28	57.44	21.94	AE

Note X2 = A_{t-1}; X4 = $(A_{t-1} - A_{t-2})/A_{t-2}$; X5 = A_{t-2}; X6 = A_{t-3}; X7 = $(A_{t-1}+A_{t-2}+A_{t-3})/3$; where A_t is Price Indices
TP = Total Period (1949-50 to 1981-82); SP = Second Period (1966-67 to 1981-82).
EX = Extrapolative Expectation
AE = Adaptive Expectation
MA = Moving Average Expectation

Figure 1:Movement of Annual Average