

Farmers' Response to Wheat Prices in Nepal

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Introduction

In a predominantly agricultural economy the overall rate of growth depends to a very large extent on the rate of growth in agriculture. In Nepal, achievements in the agricultural sector will continue to be a determining factor in the achievements of plan targets for many years to come. The success or failure of programs of agricultural development, in turn, depends decisively on the way farmers react to such programs, since it is ultimately the farmer who makes the final decision concerning the allocation of land and other resources for particular crop enterprises.

In a free market economy price policy can be considered as one of the most effective instrument to farmers' decision regarding land allocation. In this short research paper farmers' response to wheat price is considered for the wheat-land allocation in five development regions of Nepal separately. The data used are given in the appendix A.

Theoretical Framework

Following adaptive expectation model is considered.

$$Y_t = \beta_0 + \beta_1 X_t^* + U_t \dots\dots\dots (1)$$

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Where,

Y_t = Derived (planned) wheat cultivated area in year t

X_t^* = Expected Price in year t

U_t = Error term satisfying all classical assumptions

This model postulates that the planned output (demand for cultivated area) in year t is a function of expected (in the sense of anticipation) price in that year.

One peculiar characteristic of agricultural production is that farmers have very little control over the output and hence the planned output, and the realized output are rarely the same in any particular production period. It is this discrepancy between planned and realized output and non-availability of any kind of data about planned output except the acreage sown under a particular crop that leads to approximate planned output, to which the supply function actually refers by acreage (planted or harvested). It is true that this approximation is far from ideal. But not much can be done except to take acreage actually sown as the best proxy for planned output.

On the other hand expectational variable X^* is also not directly observable. Let us propose the following hypothesis about how expectations are formed:

$$X_t^* - X_{t-1}^* = \gamma (X_t - X_{t-1}^*) \dots \dots \dots (2)$$

Where γ , such that $0 < \gamma < 1$, is known as the coefficient of expectation.

What equation (2) states is that expectations are revised each period by a fraction of the gap between the current value of the variable and its previous expected value. This would mean that expectations about price are revised each period by a fraction γ of the discrepancy between the price observed in the current period and its anticipated value in the previous period.

Equation (2) can also be written as:

$$X_t^* = \gamma X_t + (1 - \gamma) X_{t-1}^* \dots \dots \dots (3)$$

This shows that the expected value of price in year t is a weighted average of the actual value of the price in year t and its value expected in the previous year with weights γ and $1 - \gamma$ respectively.

If $\gamma = 1$

$X_t^* = X$

It means that anticipated price is equal to actual price and that expectation are realized immediately and fully, that is, in the same year.

On the other hand if $\gamma = 0$

$$X_t^* = X_{t-1}^*$$

It means that expectations are static.

Both cases are the extremes. γ is unknown but lies somewhere between 0 and 1.

Substituting the value of X_t^* from 3 to 1, we get,

$$Y_t = \beta_0 + \beta_1 [\gamma X_t + (1-\gamma) X_{t-1}^*] + U_t$$

or, $Y_t = \beta_0 + \beta_1 \gamma X_t + \beta_1 (1-\gamma) X_{t-1}^* + U_t \dots \dots \dots (4)$

If model 1 is true for the period t, it also should be true for period t-1

Hence,

$$Y_{t-1} = \beta_0 + \beta_1 X_{t-1}^* + U_{t-1} \dots \dots \dots (5)$$

Multiplying both sides by (1- γ) and subtracting them from 4, we get,

$$Y_t = \gamma \beta_0 + \gamma \beta_1 X_t + (1-\gamma) Y_{t-1} + U_t - (1-\gamma) U_{t-1}$$

or, $Y = \alpha_0 + \alpha_1 X_t + \alpha_2 Y_{t-1} + V_t \dots \dots \dots (6)$

Where,

$$\alpha_0 = \gamma \beta_0$$

$$\alpha_1 = \gamma \beta_1$$

$$\alpha_2 = 1-\gamma$$

$$V_t = U_t - (1-\gamma) U_{t-1}$$

Thus, if α 's can be estimated from equation 6, β_0 , β_1 and γ will all be known. But equation 6 is an autoregressive model. So this model is not suitable for ordinary least square technique to apply directly. The reason is two fold: the presence of stochastic explanatory variable and the possibility of serial correlation. If we assume that the original disturbance term U_t satisfies all the classical assumptions, V_t will be serially correlated. The presence of autocorrelation may not be detected by Durbin-Watson d Statistic. Durbin-Watson statistic is biased towards non-autocorrelation assumption in the autoregressive models. The computed d value in such models generally tends towards 2 which is the value of d expected in a truly random sequence.

However, for large sample, the presence of autocorrelation may be detected by Durbin h statistic given by,

$$h = \left(1 - \frac{1}{2}d\right) \sqrt{\frac{N}{1 - N \widehat{\text{Var}}(\alpha_2)}}$$

Where,

d = Conventional Durbin-Watson statistic

N = Sample size

$\widehat{\text{Var}}(\alpha_2)$ = Variance of Coefficient of Y_{t-1} in the ordinary least square regression.

Under the no autocorrelation hypothesis (i. e. $H_0: d=2$), h follows the standardized normal distribution. The statistic h is then tested as standard normal deviate; thus if $h > 1.645$ one would reject the hypothesis of zero autocorrelation at the 5 per cent level. But it is to be noted that this is only a large sample test and nothing is known about its small sample properties. Also note that the test

breaks down if $N \widehat{\text{Var}}(\alpha) \geq 1$.

The presence of autocorrelated disturbance makes ordinary least square estimators inefficient. It is, therefore, important to test for autocorrelation and if found present it is necessary to correct for it. In the presence of autocorrelation the t -tests of the significance of coefficients and F -tests of the significance of the entire regression will in general be invalid.

Also since Y_{t-1} appears in the model as an explanatory variable it is bound to be correlated with V_t (via the presence of U_{t-1} in it). When the error term is correlated with the explanatory variable, the ordinary least square estimator is no longer consistent, and the bias will persist even with a large sample.

However, if we find a "proxy" called Instrumental Variable for Y_{t-1} which is highly correlated with Y_{t-1} but is uncorrelated with V_t we can get consistent estimator (there may be a small sample bias however). Liviatan suggests X_{t-1} as the Instrumental Variable for Y_{t-1} . We shall also use here Y_{t-1} and X_t itself will serve as Instrumental Variable for X_t .

Returning to the reduced form model 4, if Y represents the column vector of dependent variable Y_t for all N observations.

X : the matrix of original k explanatory variables including constant term ($k=3$ in our case) for all N set of observations

Z: the matrix of instrumental variables including constant term for all N set of observations

α : the row vector of k coefficients

U: the column vector of error terms for all N observations. The model (6) can be written in matrix form as,

$$Y = \alpha X + U \dots \dots \dots (7)$$

Then the instrumental variable estimator of α is given by,

$$b = (Z' X)^{-1} Z' Y \dots \dots \dots (8)$$

And its asymptotic variance is given by

$$\text{asy var } (b) = s^2 (Z' X)^{-1} (Z' Z) (X' Z)^{-1} \dots \dots \dots (9)$$

Where,

$$s^2 = \frac{(Y - Xb)' (Y - Xb)}{N - K} \dots \dots \dots (10)$$

Analysis and Interpretation of the Regression Results

Eastern Development Region

The estimated reduced form equation is¹:

$$Y_t = -6056.75 + 5467.15 X_t + 0.95 Y_{t-1}$$

(-0.29) (0.72) (2.21)

$$R^2 = 0.69 \quad F = 10.23 \quad d = 2.04 \quad h = \text{Undefined}$$

The model as such is a good fit, F value is significant at 5% level of significance. The model explains 69 per cent of the total variation in Y_{t-1} . The individual t-statistics for coefficient of Y_{t-1} is also found significant at 5% level. There is a positive price impact. However, the coefficient is not statistically significant. The correlation coefficient between Y_{t-1} and X_{t-1} is $\gamma = 0.50$ only.

The coefficient of expectation, γ , is found to be 0.0545, which is near zero. That is, expectations are almost static. Farmers are not expecting the price to rise significantly. This leads elasticity of price on supply of land for cultivation unobservable.

Central Development Region

The estimated reduced form equation is,

1. The figures in parenthesis here in subsequent equations are t-values of the coefficients.

$$Y = -0.50094.10 + 2505.57 X + 1.30 Y_{t-1}$$

$$(-0.78) \quad (0.58) \quad (2.72)$$

$$R^2 = 0.70 \quad F = 10.59 \quad d = 1.59 \quad h = \text{Undefined}$$

This model is also a good fit with significant F—statistic at 5% level and it explains 70% of the total variation in Y. The individual t-statistic for the coefficient of Y_{t-1} is also found significant at 5 level even though the correlation coefficient between Y_{t-1} and X_{t-1} is low ($r=0.3720$). There is a positive price impact. However, the coefficient is not statistically significant.

Turning to look at the coefficient of expectation it appears to be equal to -0.30 which is contrary to the proposed hypothesis developed earlier (see equation 2). The negative value of the coefficient cannot reasonably be explained. At most the coefficient can be thought of with value zero. That would be the case of static expectation. That is, farmers in central development region also are not expecting price to rise significantly. This again leads price elasticity on supply of land under wheat cultivation unobservable.

Westren Development Region

The estimated reduced form equation is,

$$Y_t = -7582.37 + 3706.47 X_t + 1.04 Y_{t-1}$$

$$(-0.43) \quad (1.18) \quad (3.47)$$

$$R^2 = 0.96 \quad F = 114.58 \quad d = 2.0 \quad h = \text{Undefined}$$

The model as such is a very good fit with F- statistic highly significant at 5% level or significance and it explains 96% of the total variation in Y_t . The individual t-statistic for the coefficient of y_{t-1} is also significant at 5% level of significance. But the correlation coefficient between Y_{t-1} and X_{t-1} is low ($r=0.2651$ only).

There is a positive price impact. However, the coefficient is not statistically significant.

As in the case of central development region, here also the expectation coefficient turned out to be negative, though very near to zero ($\gamma = -0.04$). Negative coefficient cannot reasonably be explained. At most the coefficient can be thought to be zero. This would be the case of static expectation. That is, the farmers in Western Development Region also are not expecting price to rise year to year significantly. This again leads price elasticity on supply of land under cultivation unobservable.

Mid Western Development Region

The estimated reduced form equation is,

$$Y_t = 45007.98 + 2670.72 X_t + 0.01 Y_{t-1}$$

(0.06) (0.02) (0.0005)

$$R^2 = 0.03 \quad F = 0.12 \quad d = 0.18 \quad h = \text{undefined}$$

The model is very poor fit, it explains only 3 per cent of the total variation in Y_t . Neither F— statistic nor individual t— statistic are significant. The correlation between Y_{t-1} and X_{t-1} is also very low ($r = 0.1282$).

Though there is a positive price impact, nothing can be said confidently about the farmer's expectation on price, nor on the elasticity of price on supply of land under wheat cultivation in Mid—West Development Region.

Far West Development Region

The estimated reduced form equation is,

$$Y_t = 15987.77 + 8169.19 X_t + 0.10 Y_{t-1}$$

(0.39) (0.77) (0.07)

$$R^2 = 0.24 \quad F = 1.41 \quad d = 0.58 \quad h = \text{undefined}$$

For Far West Development Region also the model is thus a poor fit which could explain only 24 per cent of the total variation in Y_t . Neither F— statistics nor individual t—statistics are significant.

Here also though there is a positive price impact nothing can be said confidently about the farmer's expectation on price, nor on the elasticity of price on supply of land under wheat cultivation in Far—West Development Region.

Conclusion

Except in Mid—West Development region and Far—West Development Region the models appear to be quite good. But because farmers appear to expect no change in the wheat price from one year to another, price elasticity of land under wheat cultivation is also found unobservable.

The presence of auto correlation could not be tested. Durbin — Watson d statistic is bias toward 2 in the autoregressive model, and Durbin — Watson statistic is also found inapplicable because of the large variance present in the instrumental variable estimator of α_2 , the coefficient of explanatory dependent lagged variable. When instrumental variable does not possess a very high correlation

with the explanatory variable for which instrumental variable estimator may be unduely large.

The analysis, thus, has tilted more on the methodological side than on the results. However, the exercise is not merely the mess of models either. It is a clear indication that either the pricing policy of the government was not approximate during the period under study or the farmers had no sense of reaction in the price mechanism of the free market system; or there may still be another situation that the data are not telling the true story at all. There are limitations from the side of analyst also. This is a time series statistical analysis at macro-level. The use of macro level data has made it obligatory to assume that all the farmers within the area covered by this study necessarily has expected the future prices to move in the same direction. The use of same national prices average for all the development regions has also tried to cancel out the forces to price changes within and between development regions.

Appendix 4

Price and Area Under Wheat Cultivation in Nepal

Year	Price per Kg.	Area Under wheat Cultivation (in ha)				
		EDR	CDR	WDR	Mid WDR	Far-WDR
1971/72	1.66	28761	83773	48999	44250	33400
1972/73	2.29	35594	92786	50272	44935	35801
1973/74	2.47	37905	99052	53554	45964	37450
1974/75	3.11	46350	104261	57932	44639	37677
1975/76	2.51	49943	138713	58586	43130	38172
1976/77	2.17	55092	144160	65213	45012	38403
1976/77	2.46	55940	149040	73450	48170	39640
1978/79	2.17	56430	139960	75290	52600	31900
1979/80	2.16	60340	141890	77250	54380	33000
1980/81	2.37	46510	151840	78350	65220	39320
1981/82	2.41	60290	148790	88050	67790	46870
1982/83	2.63	76810	184570	96190	66140	58600

Source: Food and Agricultural Marketing Services Department, HMG/ Nepal.

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