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Milk Production Response in Pakistan

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Abstract

In third world countries, where the level of mechanization in agriculture is low, livestock rearing is mainly for draught purpose. On the other hand, the use of animals for draught purpose is low in developed countries owing to the high level of farm mechanization and the animals are mainly reared for the consumption of meat and milk. Milk production in Pakistan is an important enterprise for over five million households owning buffaloes and cattle. Supply response of livestock has been undertaken mostly in developed countries. In developing countries livestock farming is not done on a large scale basis. This study is an attempt to obtain the best estimates of the response of milk producers while making a decision about production allocation of milk in Pakistan. The main objectives of the study are: (1) to test whether Pakistani milk producers respond to price movements (2) to estimate the elasticities of production with respect to milk producers: (a) relative price (b) credit and lagged production (c) to make a comparison of short-run and long-run price elasticities with that of developed and underdeveloped countries (d) to identify policy measures. The study is based on secondary data at the Pakistan level and covers a period of 31 years, starting from 1971-72 to 2002-03. Marc Nerlove's (1958) partial adjustment lagged model is used for the study. The result of the analysis reveals that in the process of making the production decisions for milk production, all the variables (relative price, credit availability and lagged milk production) are equally important.

The results of the study indicate a positive response of milk resource allocation to relative price. This means that the producers can find it possible to make adjustments on production allocation under milk through the manipulation of the price of milk and its competing products.

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Introduction

Livestock is an important sector of agriculture in Pakistan, and accounts for 39 percent of agricultural value added and about 9.2 percent of the GDP (2002-03). From time immemorial livestock rearing has been given much importance not only in developing countries but also in developed countries. In third world countries, where the level of mechanization in agriculture is low, livestock rearing is mainly for draught purpose. On the other hand, the use of animals for draught purpose is low in developed countries owing to the high level of farm mechanization and the animals are mainly reared for the consumption of meat and milk.

Milk production is a major part of agriculture in Pakistan. More specifically, it is an important enterprise for over five million households owning buffaloes and/or cattle. The net foreign exchange earnings from livestock were to the tune of Rs.51.5 billion in 2001-02, which is almost 11.4 percent of the overall export earnings of the country. The importance of the role of livestock in the rural economy may be realized from the fact that 30-35 million of the rural population is engaged in livestock raising having household holdings of 2-3 cattle/buffalo and 5-6 sheep/goat per family, deriving 30-40 percent of their income from it. The livestock production includes milk, beef, mutton, poultry meat, wool, hair, bones, fats, blood, eggs, hides and skins.

In 2002-03, the total milk production from buffaloes/cows was 27811 thousand tons. Out of this production 55 percent was consumed as fresh milk. The per capita monthly consumption of fresh milk was 7.00 litres in 2001-02. The per capita availability of milk was 83.14 kgs per annum.

Producer prices in most United States fluid milk markets are regulated by either federal milk marketing orders or state milk control programs. Thus, any price change should be evaluated, at least partially, for its impact on the quantity of milk produced. Estimates of the responsiveness of milk production to price changes provide useful information for administrators who try to provide an adequate supply of milk to consumers and at the same time maintain a “reasonable” balance between milk production and consumption.

During the last few decades, many quantitative studies of milk production response in developed countries have been conducted. In a well known paper, Brandow (1958), used single equation regression analysis to estimate supply relationships for milk produced in the United States. Halvorson (1955), also using single equation Ordinary Least Squares, estimated milk production per cow as a function of the milk-feed price ratio, hay production, and cow numbers and found production to be highly price inelastic. In another study, Halvorson (1958), using a Nerlovian distributed lag model, estimated by Least Squares the short-run and long-run price elasticities of United States milk production to be in the range of 0.15 to 0.30 and 0.35 to 0.50, respectively. For both periods the Nerlove formulations explain more of output variation than the static model. A notable difference in price elasticities and output adjustment coefficient is apparent for the later time period. Producers, Halvorson argued, became more price responsive and quicker at adjusting output as the stabilization programs of the 1930s took root. Beef prices also seemed to have gained in importance. Halvorson concluded that the Kinked Response hypothesis, while not disproven by these results, was somewhat shaken and that further analysis in this regard was required. Although much of this work has incorporated current and/or lagged prices as key variables explaining short and long-run production response, it has been limited to specifying non-flexible price lag structures. This implicitly assumes that the greatest increase in output from a price increase is forthcoming in the first period. However, if monthly time periods are considered, a linear programing analysis suggests that this is a highly questionable assumption.

Chen, Courtney and Schmitz (1972) in their study were particularly interested in identifying the pattern of past price effects on current output. They hoped to formulate lag distribution for prices that would show greater flexibility than a Nerlove partial adjustment formulation. They postulated that (quarterly) milk output was a function of the ratio of the producer's price for milk to the average price of protein - enhanced dairy feed lagged one year, technology, and a dummy variable standing for the particular quarter and compared this with a Nerlove Method that omitted technology and included lagged output. They estimated milk production response for both a polynomial and a geometrically declining distributed lag price structure. Although the coefficients of determination were marginally higher when technology was included, the authors felt there was no strong basis to prefer one specification over another. In comparison they said that the cumulative elasticity for all eight periods is 2.53, almost identical to the long-run elasticity calculated from the Nerlove formulation. They argued that distributed lag analysis is better when a quarterly supply analysis is desired. Buckwell (1982), adapted a theory of farm size demonstrated by Kislev and Peterson (1982), to model milk production behavior in England and Wales. Burton (1984), used a model of UK dairy sector to determine simultaneously herd size, number of culls, replacement heifer price, and milk price. In a recent study, Chavas and Kraus (1990), developed a dynamic model of a dairy cow population and milk supply response and applied it to the US Lake States.

The authors also calculated dynamic supply elasticities and found the response of supply to market prices to be very inelastic in the short-run.

Supply response of the livestock study has been done mostly in developed countries. A majority of them are for Canada, USA, UK and Australia. The reason behind this is that livestock farming in these countries is done on commercial basis. In developing countries livestock farming is not done on a large scale basis.

In Pakistan there are only two studies which analyze the determinants of milk production. Anjum, Raza, Walters and Krause (1989) estimated a simple two equation simulation model for milk production. The model includes one price equation which is explained by per capita production and per capita income. The other equation aims at explaining changes in milk production with the help of changes in the retail price of milk. Their concluded price elasticity of milk was 0.7 in the short-run. Akmal (1993) in his study of milk production response for Pakistan used a dynamic model of milk supply response.

More specifically, lags of explanatory variables are introduced within the context of Polynomial Distributed Lag Model and one period lag of the dependent variable within the context of the Stock Adjustment model. They considered only three explanatory variables, real wholesale price of milk deflated by consumer price index, real credit availability and time. Due to the limited number of observations he did not include input prices. The response function had been estimated for lag lengths of 6 through 8 year periods. The estimates of long-run elasticities indicate that milk production response in Pakistan has been inelastic to changes in milk price and credit availability in the short-run as well as the long-run. Estimates of aggregate price elasticity range between 0.3 through 0.6.

This study of "milk production response" is an attempt to include more explanatory variables than Akmal's study. The earlier two studies in Pakistan did not include beef price as an independent variable in their model. We know that increase or decrease in beef price will effect the dependent variable (milk production). The omission of this variable can seriously bias the estimated coefficients.

Keeping in view the limitations of the previous investigation especially on Pakistan, this study is an attempt to obtain the best estimates of the response of milk producers while making a decision about production allocation of milk.

Specifically, this study attempts to explain the production allocation behavior of milk producers in terms of their responsiveness to price and non-price factors.

The main objectives of the study are:

1. To test whether Pakistani milk producers respond to price movements.

2. To estimate the elasticities of production with respect to milk producers: (a) price (b) credit (c) beef price (d) time and (e) lagged production.

3. To make a comparison of short-run and long-run price elasticities with that of other developed and under-developed countries.

4. To identify policy measures in respect of price, credit, and beef price, so that milk production can be increased.

Data Sources

To build an economic model on the objectives given above, it is necessary to have adequate data relating to the production of milk and the said stimuli in order to make a quantitative assessment possible. The study is based on secondary data at the Pakistan level. It covers the time period starting from 1971-72 to 2002-03 for which published data on production, price, credit and beef price were available from the *Pakistan Economic Survey*, published by the Government of Pakistan, *Pakistan Statistical Yearbook* published by the Government of Pakistan and *Agricultural Statistics of Pakistan* also published by the Government of Pakistan. After losing one year due to lagged milk production the data cover a period of 31 years spanning 1972-73 to 2002-03.

Mathematical Model and Estimation Process

The milk production farmers/producers decisions play an important role in agriculture, but the transformation process involved in it, depending as it does on a number of uncontrolled natural inputs and human labor, is more unpredictable than in industry. The producer allocates his production of milk, depending upon his expected revenue from them. It is very seldom that they are able to make hundred percent adjustment while responding to various economic factors. Lagged price of milk and its competing variable is available to milk production farmers/producers. This indicates that producers do not have to form any expectations about future output prices, but they might experience some institutional constraints in the procurement of requisite inputs (nutritional feed, and water) in such a case. Under such conditions the partial adjustment lagged model is considered appropriate for milk producers and is widely used by researchers like Halvorson (1965), Chen, Courtney and Schmitz (1972), Gardner (1962), Gardner and Walker (1972), Jones (1961), and Buttimer and MacAirt (1970) to measure the milk producer's behavior. So the basic model used in this study is the Nerlove partial adjustment lag model [Nerlove (1958)].

Since the milk producers have lagged price of livestock they can easily formulate their production. Assuming that the desired production is linearly related to the price of milk, a typical specification comes up as follows:

$$Q^*_t = a + b\,P_{t-1} + U_t \qquad (1)$$

where Q^*_t is desired or long-run production and P_{t-1} is the lagged price of milk. Since the desired production Q^*_t is an unobservable variable, the Nerlove formulation suggests that it can be specified as:

$$Q_t - Q_{t-1} = \beta\,(Q^*_t - Q_{t-1})\quad 0 < \beta < 1 \qquad (2)$$

The current supply then is:

$$Q_t = Q_{t-1} + \beta\,(Q^*_t - Q_{t-1}) \qquad (3)$$

β is the coefficient of adjustment, which accounts for the forces which cause the difference between the short-run and long-run supply price elasticities. $Q_t - Q_{t-1}$ is the actual change and $Q^*_t - Q_{t-1}$ is desired or long-run change. The first equation is a behavioral relationship, stating that the desired production of milk depends upon the relative prices in the preceding year. The second equation states that the actual production of milk in period t is equal to the previous actual production of milk plus a proportion of the difference between desired milk production in period t and actual milk production in t-1. This hypothesis implies that milk producers cannot fully adjust their actual production to the desired production in response to changes in explanatory variables due to constraints such as physical buffalo/cow conditions, low quality of nutritional feed, and habitual production patterns of milk farmers. 'β' is therefore, an indication of how fast the milk producers are adjusting themselves to their expectations. The value of 'β' close to zero would mean that the producers are slowly adjusting to the changing prices and yield etc. The value of 'β' close to one would mean that the milk producers/farmers are quickly adjusting to the changing levels of prices and yield, etc. almost instantaneously. When adjustment is perfect, β=1. In the real world however, the value of 'β' lies between 0 and 1.

Relations with equation (1) and (2) give the reduced form which eliminates the unobserved variable (Q^*_t) by an observed variable (Q_t).

$$Q_t = A + B P_{t-1} + C Q_{t-1} + V_t \qquad (4)$$

Equation(4) provides a simple version of the partial adjustment model and the parameters of this model can be estimated using OLS if the original Ut's are serially uncorrelated (Gujrati, 1995). There are also other Autoregressive models other than the partial adjustment model such as Koyck and Adaptive expectation. In the Koyck model as well as the adaptive expectations model the stochastic explanatory variable Y_{t-1} is correlated with the error term V_t. If an explanatory variable in a regression model is correlated with the stochastic disturbance term, the OLS estimators are not only biased but also not even consistent. Therefore estimation of the Koyck and Adaptive expectation models by the usual OLS procedure may yield seriously misleading results. The partial adjustment model is different, however. In this model V_t of equation (4) is βU_t. Therefore if U_t satisfied the assumptions of the classical linear regression model such as zero mean value of U_t, no autocorrelation between the U's, homoscedasticity or equal variance of U_t, and zero covariance between U_t and X_t, so will βu. Therefore, OLS estimation of the partial adjustment model will yield consistent estimates although the estimates tend to be biased (in finite or small samples)[1]. Although Q_{t-1} depends on U_{t-1} and in spite of all the previous disturbance terms, it is not related to the current error term U_t. Therefore, as long as U_t is serially independent Q_{t-1} will also be independent or at least uncorrelated with U_t, thereby satisfying an important assumption of OLS, namely, non-correlation between the explanatory variable(s) and the stochastic disturbance term (Gujrati, 1995). The reduced form would basically remain the same if we include more independent variables than the ones included in equation (4). Equation (4) is the basic frame of our model, but more explanatory variables are included in the model. The model will be in log form. The logarithmic form provides estimates of short-run and long-run supply elasticities directly.

Using the adjustment lag model as the basic frame for analysis, the response relationship in the study will be estimated with the following short-run equations:

$$\text{Log } Q_t = \log C_0 + C_1 \log RP_{t-1} + C_2 \log CRDT_{t-1} + C_3 \log Q_{t-1} + \log V_t \qquad (5)$$

[1] For proof see J. Johnston, Econometric Methods, 3rd edition.

$$\text{Log } Q_t = \log C_0 + C_1 \log RP_{t-1} + C_2 \log CRDT_{t-1} + C_3 \log Q_{t-1} + C_4 \log RBP_t + \log V_t \quad (6)$$

$$\text{Log } Q_t = \log C_0 + C_1 \log RMGP_{t-1} + C_2 \log CRDT_{t-1} + C_3 \log Q_{t-1} + \log V_t \quad (7)$$

Q^*_t = Desired or long-run production of milk which will be different from planned production in the period due to the partial accounting of producer's expectations in the planning.

Q_t = Milk production in year t,

RP_{t-1} = Milk price, deflated by consumer price index in year t-1,

$RMGP_{t-1}$ = Milk price with respect to ghee price in year t-1,

$CRDT_{t-1}$ = Credit[2] provided to the dairy sector in year t-1,

Q_{t-1} = Production of milk in t-1,

RBP_t = Beef price deflated by consumer price index in year t,

Vt = Error term in year t,

β = Coefficient of Adjustment

In the relative price ratio variable, input prices or best substitute price of milk (price of protein-enhanced dairy feed) should have been used in the denominator. The data on input prices of milk (for example fodder price and concentrates price) and protein are not available.

We have estimated the equations using Ordinary Least Squares (OLS) method with all the variables in their log-linear form. The log form of the function was chosen because it yielded consistently better results with respect to signs, values and levels of significance of the regression coefficients. Besides, the logarithmic forms also provide ready-made estimates of short run elasticities.

Because of the presence of lagged values of the dependent variable on the right hand side of equations (5), (6) and (7), the Cochrane - Orcut technique was employed in the Ordinary Least Square regression procedure in order to account for possible autocorrelation problems.

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[2] Credit provided by Agricultural Development Bank of Pakistan is being used because total credit provided to the dairy sector is not available.

The long-run elasticities were calculated by using the short run elasticities.

$$\text{Long-run price elasticity} = \frac{\text{Short-run elasticity}}{\text{Coefficient of adjustment}}$$

Whether the model suffers from the auto-correlation problem or not, it can not be tested by using the DW d-statistics, since the model includes a lagged dependent variable in the set of regressors. In the presence of a lagged dependent variable (lagged production for example) in a regression equation, the DW d-statistics is likely to have reduced power and is biased toward the value 2. [Durbin (1970) and Nerlove (1966)]. For such an equation, Durbin suggested an alternative test statistic known as Lagrange Multiplier Test or the h-statistic, defined as;

$$h = \left(1 - \frac{1}{2} d \sqrt{\frac{n}{1 - n\hat{v}(\hat{c}_3)}}\right)$$

where,

$\hat{v}(\hat{c}_3)$ = least squares estimate of variable C_3

d = usual DW d-static

n = number of observations

Under the null hypothesis of no autocorrelation, 'h' is asymptotically normal with zero mean and unit variance. The test statistic can also be used to test the hypothesis of no serial correlation against first-order-auto-correlation, even if the set of regressors in an equation has higher order lags of the dependent variable. However if $\hat{v}(\hat{c}_3) > \frac{1}{n}$, it cannot be computed (Green 1990). Cochrane-Orcutt iterative process was applied where the existence of auto-correlation was detected. "Intercorrelation of variables is not necessarily a problem unless it is high relative to the overall degree of multiple correlation" (Klein 1962). If there are strong interrelationships among the independent variables, it becomes difficult to disentangle their separate effects on the dependent variable. If there are more than two explanatory variables, it is not sufficient to look at simple correlations. Thus the term "Intercorrelations" should be interpreted as multiple correlation of each explanatory variable with the other explanatory variables. Thus, by the 'Klein' rule multicollinearity would be regarded as a problem if $R^2_y < R^2_i$, where R^2_y $x_1.x_2.x_i$ and $R^2_i = R^2_{xi}$. other x's. With the non-experimental data, it would be impractical to ascertain a priori that the multicollinearity problem among the explanatory variables is not severe. Therefore, a categorical test of intercorrelations among the explanatory variables is conducted and results are presented in Appendix Table 1.

Analysis of the Results

The results of the regression analysis of equations 5, 6, and 7 are presented in Table 1. Due to the presence of multicollinearity and autocorrelation in equations 6 and 7 (see Table 1 and Appendix 1) their results were further calculated. It is evident from Table 1 that the variables that are included in equation 5 of the model are capable of explaining 99 percent of the variation in the production of milk, which is indicated by the high value of R^2. The results of the multicollinearity indicated that there was no serious problem of multicollinearity (Klein rule) in equation 5. Since $\hat{v}(\hat{c}_3)$ is $< \frac{1}{n}$, the computation of the 'h'-statistic is possible. The computed Durbin's h-statistic ($<\pm 1.645$) indicates no serial correlation, hence, the null hypothesis was accepted in favor of the absence of serial correlation. Equation 5 is preferable to Equations 6 and 7 because of the highly significant coefficients, no multicollinearity and autocorrelation and higher R^2 values (0.99) as compared to insignificant or low degree of significance, presence of multicollinearity and autocorrelation and lower R^2 values (0.68 and 0.59). Our subsequent analysis is, therefore, based on the results of Equation 5.

Relative Price

The impact of the economic incentives on milk production is found to be significant, as is evident from the significant positive impact of relative price (Table 1). The variable is significant at the 1 percent level. This means that producers of milk in Pakistan do respond to economic incentives, the milk price has potential to increase milk production. A given price change has the highest effect on production.

Credit

A given change in credit availability has a larger impact on milk production in the earlier period because the variable is significant at the 5 percent level. The elasticity is very low (0.1). Low credit elasticity is perhaps due to the fact that only a small fraction of total milk production comes from the dairy sector which utilizes credit facilities.

Milk Production

The elasticity estimates of lagged milk production is found to be positive and significant at the 1 percent level. The magnitude of the coefficient of this variable is 0.876, indicating a low rate of adjustment on the part of producers.

The Delayed Adjustment and Short-Run and Long-Run Price Elasticity

As our model is based upon Nerlove's adjustment hypothesis, it will be interesting to know how far the estimated equation for actual milk production supports this argument. The rapidity with which the producers adjust the production of milk in response to movements in factors discussed above, is seen from the numerical values of the coefficient of adjustment (β). The coefficient of adjustment is found to be 0.124, indicating that production was influenced more by technological and institutional rigidities and that price inducement operated slowly and gradually only. The value is within the assumed range of zero to one. As is obvious, the long-run elasticity with respect to the relative price is higher than short-run elasticity, which is indicative of the long-run adjustment of milk production. This also means that milk producers of Pakistan have more time to adjust their production of milk in the long-run than in the short-run.

Table-2: Price Elasticities for Some Developed and Developing Countries

Country	Period	Price Elasticity		Source
		Short-Run	Long-Run	
Pakistan	1971-2001	+0.258	+2.081	Our Estimates
Pakistan	1971-89	+0.298	–	Muhammad Akmal
United States	1927-57	+0.42	+1.35	Jones
United States	1941-57	+0.18 to +0.31	+0.15 to +0.89	Halvorson
United States	1953-68	+0.38	+2.54	Chen, Caurtney and Schmitz
Australia	1947-64	+0.19	+0.42	Powell and Gruen
Ireland	1951-68	+0.25 to +0.30	–	Bultimer and MacAirt
United Kingdom	1958-64	+0.17 to +0.23	+0.27 to +105	Jones
United Kingdom and Wales	1948-58	+0.0.13	+1.42	Gardner and Walker

Comparison of Price Elasticities of Milk in Some Developed and Developing Countries

To make a relative comparison of Relative Price elasticities of milk production obtained, we present Table 2 along with the elasticities of production estimated by other researchers in some developed and developing countries. The result indicates that our estimated milk production elasticity in the short-run and long-run compares favorably with Muhammad Ali (Pakistan) and Chen *et al.* (United States) estimates. The only study in Pakistan by Muhammad Akmal has not calculated the long-run elasticity. Our study is the only study which calculated the long-run elasticity of milk production in Pakistan.

Conclusion and Policy Suggestions

To test the hypothesis relating to the factors influencing the producers' production allocation, the Nerlove adjustment lagged model has been used. The result of the analysis reveals that in the process of making the production decisions for milk production, all the variables (relative price, credit and lagged milk production) are equally important. The producers in Pakistan responded positively and significantly to relative price. This means that a given price change has the highest effect on production. This also means that milk price has the potential to increase milk production. A given change in credit availability has larger impact on milk production in the previous period. This also means that as credit availability increases the livestock farmers will purchase more buffaloes in milk and will extend their herd size. Low credit elasticity is perhaps due to the fact that only a small fraction of total milk production comes from the dairy sector which utilizes credit. Milk lagged by one year is found to be positive and significant at the 1 percent level. The coefficient of adjustment is found to be 0.124, indicating that production was influenced more by technological and institutional rigidities and that price inducement operated slowly and gradually only. As is obvious, the long-run elasticity with respect to the relative price is higher than short-run elasticity, which is indicative of the long-run adjustment of milk production. This also means that milk producers in Pakistan have more time to adjust in the long-run than in the short-run. Our estimated milk production elasticity in the short-run and long-run compares favorably with Mohammad Ali (Pakistan) in the short-run and Chen *et al.* (United States) estimates in the short-run and long-run.

The results obtained in this study lead to important implications that seem to be relevant from the point of view of policy implications.

First, the results of the study indicate a positive response of milk resource allocation to relative price. This means that the producers can find it possible to make adjustments on production allocation under milk through the manipulation of price of milk and its competing products. In order to bring about an effective adjustment in production allocation, the prices announced for milk and other dairy products should carry a long-run guarantee. This policy will not only enable the producers to plan their production programmes better but might also help to correct the inter-commodity imbalance to some extent. To increase milk production the following measures are suggested.

a) Establishment of milk production cooperatives.

b) Providing mobile veterinary medical facilities.

c) Dairy farming should be encouraged in the private sector with adequate credit facilities. Introduction of good quality milch animal breeds with longer milking periods and also higher milk yields is necessary. This will greatly help to overcome the existing milk shortage in the country. The farmers may also be motivated to venture into milk production enterprises along with farming. Modern artificial insemination facilities be extended to larger areas for breeding better milch animals.

d) A little less than three fourths of the total milk supply is produced within the city boundary at the spot under un-economical and insanitary conditions. On account of the high cost of maintenance of dry animals, good milch cattle are consequently sold to be slaughtered at the end of their lactation. This results in decrease in the number of milch animals and creates the problem of adulteration due to reduced supply. This slaughtering should be legally stopped since it discourages urban milk production. It is also suggested that good milch breeds should be marked so that they may not be slaughtered. The milch animals should also be well-fed. To reduce the high cost of feeding milch animals, fodder production for the cities of Pakistan should be expanded and an adequate fodder supply be maintained throughout the year.

e) Bulls of good pedigree be maintained in adequate number and breed improvement programs rigorously followed through artificial insemination.

f) The breeders should be encouraged to maintain adequate number of good milch animals instead of maintaining large number of low quality animals.

Second, the results of the study indicate positive and significant impact credit facilities on milk production. The credit facilities to milk producers should be extended to maintain better dairy herds and facilitate marketing of larger milk supplies.

Indirectly the study also indicates that a proper distribution of milk plays a vital role in milk supply.

Appendix Table – 1

Test of Multicollinearity of the Explanatory Variables (By Klein's Rule) Used in the Regression Analyses of Milk Production

Equation No.	Total R^2	Partial R^2 (Each Explanatory Variable as a Dependent Variable)					
		Relative Price of Milk Consumer Price Index	Relative Price of Milk to Ghee	Credit	Milk Production	Relative Price of Beef to Consumer Price Index	Comment on Severe Correlation
5	0.99	> 0.47	–	> 0.59	> 0.35	–	No severe correlation
6	0.88	–	< 0.90	> 0.38	> 0.41	–	Price of milk and ghee are severely correlated
7	0.59	> 0.56	–	> 0.53	> 0.43	< 0.63	Price of beef and CPI are severely correlated

Note: Each explanatory variable used as dependent variable, in turn, on other explanatory variables (according to the model type of the Table Equation). If the partial R^2 is greater (>) than the actual R^2, then there is harmful multicollinearity of the variable on the other variables. Conversely, (i.e. R^2 total > R^2 partial), the collinearity problem is not serious (see Maddala, 1977). The associated symbol of the explanatory variables indicates whether the multicollinearity problem is severe or not (> on the left indicate less than the total R^2, < on the left indicates greater than the total R^2.) All the variables are in natural logarithms.

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