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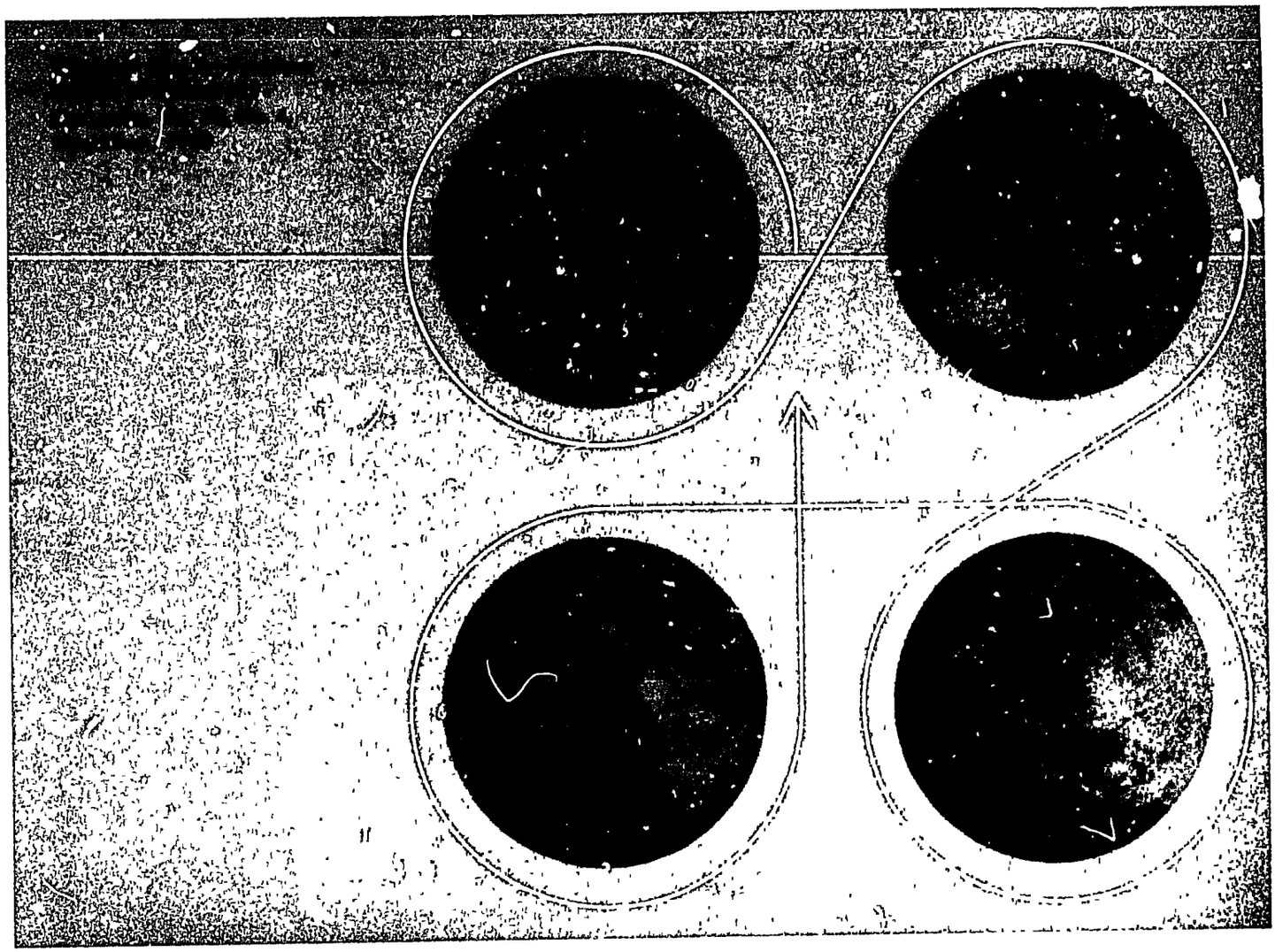

DETERMINANTS AND DEVELOPMENT IMPLICATIONS OF FOODGRAINS PRICES IN INDIA, 1949-1964

John W. Mellor
and
Ashok K. Dar

DEPARTMENT OF AGRICULTURAL ECONOMICS
NEW YORK STATE COLLEGE OF AGRICULTURE, A STATUTORY COLLEGE
OF THE STATE UNIVERSITY, AT CORNELL UNIVERSITY, ITHACA, NEW YORK

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BY

JOHN W. MELLOR AND ASHOK K. DAR

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Determinants and Development Implications of Foodgrains Prices in India, 1949–1964*

JOHN W. MELLOR AND ASHOK K. DAR

A price index for foodgrains in India for the period 1949–1964 is estimated as a function of a set of real demand and supply variables and the money supply. More than 80 percent of the variation in the foodgrain price index is associated with variation in these independent variables. The upward trend in foodgrains prices is associated primarily with expansion of the money supply. There is little evidence of government foodgrain price policy having affected the trend of relative agricultural prices. The coefficient on the lagged supply–demand variable suggests that year-to-year changes in farmers' storage stocks are an important determinant of foodgrains prices in any one year. The implications of these findings to the relation between agricultural and industrial growth, monetary and fiscal policy, and agricultural price and buffer-stock policy are discussed.

CONTEMPORARY growth theory treats the relative price of foodgrains as one of the most important determinants of savings and investment rates in both the industrial and the agricultural sectors of low-income countries. Rising foodgrains prices directly depress savings and investment rates in the industrial sector by forcing up money wages with consequent depression of profits [3, 8, 10, 12]. Rising foodgrains prices also increase urban political unrest, directly and indirectly force government expenditures for increased money wages, and decrease the availability of government funds for fostering industrial growth. In contrast, in the agricultural sector, rising foodgrains prices increase the profitability of farm investment and the income pool from which agricultural savings may be drawn [11]. Despite this key role, little empirical study has been made of either the relative movements of foodgrains prices over the course of time or of the determinants of these movements.[1] There remains considerable controversy, but little empirical evidence, concerning the influence on foodgrains prices of production changes as compared to the influence of speculative activities in private trade, farmers' storage activities, and government policies [1, 9, 19].

This article examines the movement of foodgrains prices in India during the period from 1949-50 to 1963-64. India provides relatively good sta-

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[1] As an exception, see Lewis and Hussain [7].

JOHN W. MELLOR *is professor of agricultural economics and* ASHOK K. DAR *is a research associate, both at Cornell University.*

tistical data, is in an early stage of economic development with a high proportion of national income and employment in the agricultural sector, has an economy of sufficient size to make domestic economic policy relatively important as compared to externally generated policies, and has over the past two decades followed a number of different policies on foodgrains prices.

The period of 1949-50 to 1963-64 is one for which relevant statistical data are available, with relatively constant definitions throughout. Perhaps most important for statistical measurement, this period contains series of years with differing fluctuations in most of the relevant variables, a situation which reduces errors arising from correlation of the variables with each other and with time.[2]

The Estimated Equation for Foodgrains Prices

The estimated equation thought to be best specified for the purposes of this study is (with standard errors in parentheses)

$$P_t = 41.48 + \underset{(0.08)}{0.56}(D - S)_{t-1} + \underset{(0.80)}{2.25}(D - S)_{t-2} + \underset{(0.35)}{2.06}M_t \quad (R^2 = 0.83)$$

where

P_t is the index of foodgrains prices (1952-53=100) at wholesale markets in the first week of April of year t;

D is the estimated aggregate real demand for foodgrains for the year commencing July 1, in millions of long tons;

S is the estimated aggregate supply of foodgrains for the year commencing July 1, in millions of long tons;

$t-1$ is the year commencing July 1 preceding April 1 of the year t;

$t-2$ is the year commencing July 1 of the year preceding $t-1$; and

M_t is the total money supply with the public, as defined by the Reserve Bank of India, in the first week of April of year t, in billions of rupees.

The dependent variable, price of foodgrains (P_t), is defined as the index of foodgrains prices in the first week of April, because by April the preceding rainy-season harvest is several months past and the dry-season harvest is sufficiently well along so that traders and merchants have a good idea of the current year's production. No basis for predicting the weather for the next rainy-season crop exists by April, although such basis begins to develop in May as the monsoon commences in parts of India. Thus, in April there is no knowledge of the size of the next season's crop but good knowledge of the size of the preceding year's crops. Prices at

[2] Before 1949-50, disruptions of partition, war, and depression reduce the relevance of analysis to contemporary problems; after 1963-64, various price regulations and evasion of those regulations reduce the validity of published data.

almost any other time of the year represent a constantly shifting blend of changing expectations concerning the level of production.[3]

The expression $D-S$ is defined for each year as the gap between aggregate real demand and supply based on the change in demand and supply from the base year, 1949-50. It reflects changes in domestic production, imports, and government storage stocks on the supply side, and population and real income growth on the demand side.

Supply (S) is expressed for each year in long tons, as the sum of the three supply sources for which data are available—domestic production, imports, and changes in government-held stocks (Table 1). There are no data for changes in privately held stocks, so they are not included in the measurement. As will become apparent later, the lagged variable representing the gap between demand and supply reflects changes in private stocks.

Aggregate demand (D) is taken as equal to supply in the base year 1949-50. Aggregate demand in subsequent years is calculated by using D in 1949-50 as a base and adjusting for population change and change in per capita income, which are considered to be the major factors that shift demand (Table 1). In calculation of aggregate demand, the income elasticity of demand for foodgrains is assumed to be 0.5; this figure is based on analysis of the Indian National Sample Survey and other sources [14, 16]. Given this method of calculation, the gap between demand and supply ($D-S$) is by definition zero in the base year 1949-50. That year is generally regarded as a year of normal weather.[4] The observations used and the calculated values of S, D, $D-S$, and M are shown in Table 1.

Inclusion of the money-supply variable (M) allows study of its separate effect. In an alternate equation, the money-supply variable was dropped and money income was substituted for real income in the calculation of demand. In that equation the R^2 was 0.45, as compared to 0.83 in the preferred equation. Likewise, in the alternate equation the appearance of the same strong money influence in both the $D-S$ variable for $t-1$ and for $t-2$ caused the correlation coefficient between the two variables to be 0.55, whereas in the preferred equation it was only 0.20.

Comparison of Estimated and Reported Prices

When we use the above equation, for only 4 of the 13 years does the estimated price deviate more than 5 percent from the reported price (Fig.

[3] The choice of April price is consistent with Working's hypothesis as initially tested under United States conditions and further tested by Lele under the conditions of sorghum pricing in India [6, 20]. In contrast to the R^2 of 0.83 with the above equation, when foodgrains prices (P_t) were redefined as the average price for the crop-year July 1 to July 1, instead of as April prices, the R^2 dropped to 0.42.

[4] In fact, the weather in 1949-50 was probably somewhat more favorable than normal and hence the "gap" is shown as zero in a somewhat better than average year for agricultural production.

Table 1. Estimates of aggregate demand and supply factors for foodgrains, India, 1949-50 to 1963-64

(1) Years	(2) Population	(3) Per capita income[a]	(4) Aggregate demand[b] (D)	(5) Production[c]	(6) Imports	(7) Change in government stocks[d]	(8) Aggregate supply[e] (S)	(9) Gap between demand and supply[f] ($D-S$)	(10) Index of cereal prices[d]	(11) Index of pulse prices[d]	(12) Index of foodgrains prices[g]	(13) Money supply[d]
	millions	*Rs.*	*million long tons*						*1952-53 = 100*			*billion Rs.*
1949-50	357.5	251	53.7	50.4	3.7	+0.4	53.7	0.0	91	79	85	—
1950-51	363.4	248	54.2	45.7	4.7	+0.5	49.9	+4.3	103	102	103	18
1951-52	369.6	250	55.4	46.1	3.9	+0.6	49.4	+6.0	96	88	95	18
1952-53	376.1	256	55.9	51.3	2.0	−0.5	53.8	+2.1	96	93	96	18
1953-54	382.9	266	59.2	60.0	0.8	+0.2	60.6	−1.4	89	74	87	18
1954-55	390 2	268	60.6	58.8	0.6	−0.7	60.1	+0.5	68	48	65	19
1955-56	397.8	268	61.7	57.6	1.4	−0.6	59.6	+2.1	89	74	87	22
1956-57	405.8	276	63.9	60.2	3.6	+0.8	63.0	+0.9	101	74	97	23
1957-58	414.3	267	64.2	55.4	3.2	−0.2	58.8	+5.4	97	82	95	24
1958-59	423.3	280	67.2	66.4	3.8	+0.4	69.8	−2.6	99	95	98	25
1959-60	432.7	279	68.6	66.1	5.1	+1.4	69.8	−1.2	104	89	102	27
1960-61	442.0	293	71.8	69.7	3.4	−0.1	73.2	−1.4	99	88	97	29
1961-62	450.5	294	73.3	69.0	3.6	+0.3	72.3	+1.0	103	94	102	30
1962-63	459.1	293	74.5	67.8	4.5	0.0	72.3	+2.2	107	103	106	33
1963-64	468.1	300	76.9	68.4	6.2	0.0	74.6	+2.3	124	134	126	37

[a] Measured in constant prices of 1948-49.
[b] Estimated as follows:
Aggregate real demand in period $t = L_t\{Q[1+(\Delta Y/Y)]^b\}$,
where
L_t is population in period t,
Q is per capita consumption in 1949-50,
Y is per capita real income in 1949-50,
ΔY is increase in per capita real income by period t, and
b is income elasticity of demand for foodgrains.
[c] For human consumption only, estimated at 87.5 percent of production; 12.5 percent is allowed for feed, seed, and waste.
[d] April data.
[e] Sum of columns 5, 6, and 7.
[f] Column 4 minus column 8.
[g] Estimated as the weighted average of cereals and pulses.

Sources: Government of India [4] and Reserve Bank of India [18].

1A). The substantial deviation in 1954-55 appears to result from the fact that in two consecutive years unusually good crops had a cumulative effect in depressing prices. This effect is understated by the form of equation used. Speculative influences may have reinforced this effect. In 1958-59 and 1959-60, it is probable that introduction of state trading in foodgrains caused abnormal marketing and storage patterns [5].

With the money supply held constant, there is either no trend or perhaps a slight downward trend in the estimated price of foodgrains (Fig. 1*B*). Conversely, one can say that the upward trend in the actual prices of foodgrains in this period is due, not to an enlarging gap between supply and demand, but to expansion of the money supply. Particularly in the 1960's, money supply expanded substantially in response to problems of both defense and development. A nonparametric test demonstrated that foodgrains prices probably declined slightly relative to all other prices during this period.[5] In contrast, according to the same nonparametric test, all agricultural prices, including industrial raw material crops, vegetables, and livestock products, in addition to foodgrains, held an essentially constant relationship to nonagricultural prices during this same period.[6] Thus, a relative price increase for nonfoodgrains agricultural commodities somewhat more than balanced the small relative decline in foodgrains prices. As can be seen from Table 1, showing imports, and Figure 1*D*, showing estimated prices without imports, the role of imports in the trend of foodgrains prices has been essentially neutral except perhaps for the last two years of the series.

The data show that, during the period studied, relative growth rates of the agricultural and nonagricultural sectors have been consistent with a stable relationship of agricultural and nonagricultural prices. This is, of course, not to say that this consistency has been either planned or optimal or that it has been maintained at all times within that period. Indeed from 1955 to 1959 and from 1960 to 1964, foodgrains prices increased as a result of more rapid growth in demand than in supply (Fig. 1*B*). Conversely, from 1952 to 1959 and from 1959 to 1960, foodgrains prices declined as supply grew more rapidly than demand. These contrasting movements are consistent with the hypothesis that unbalanced growth between agriculture and nonagriculture will be self correcting [10, pp. 73–79]. In years in which demand for foodgrains was increasing more rapidly than supply, the consequent rise in agricultural prices caused increased money wages; it also lowered incentive to invest in the nonagricultural sector and reduced funds available for such investment, thereby slowing expan

[5] Using the method of ranking each observation, the computed total score was +8 and the rank correlation coefficient was 0.1. For a fuller discussion see Mellor and Dar [13].

[6] The computed total score was —2 and the rank correlation coefficient was —0.02

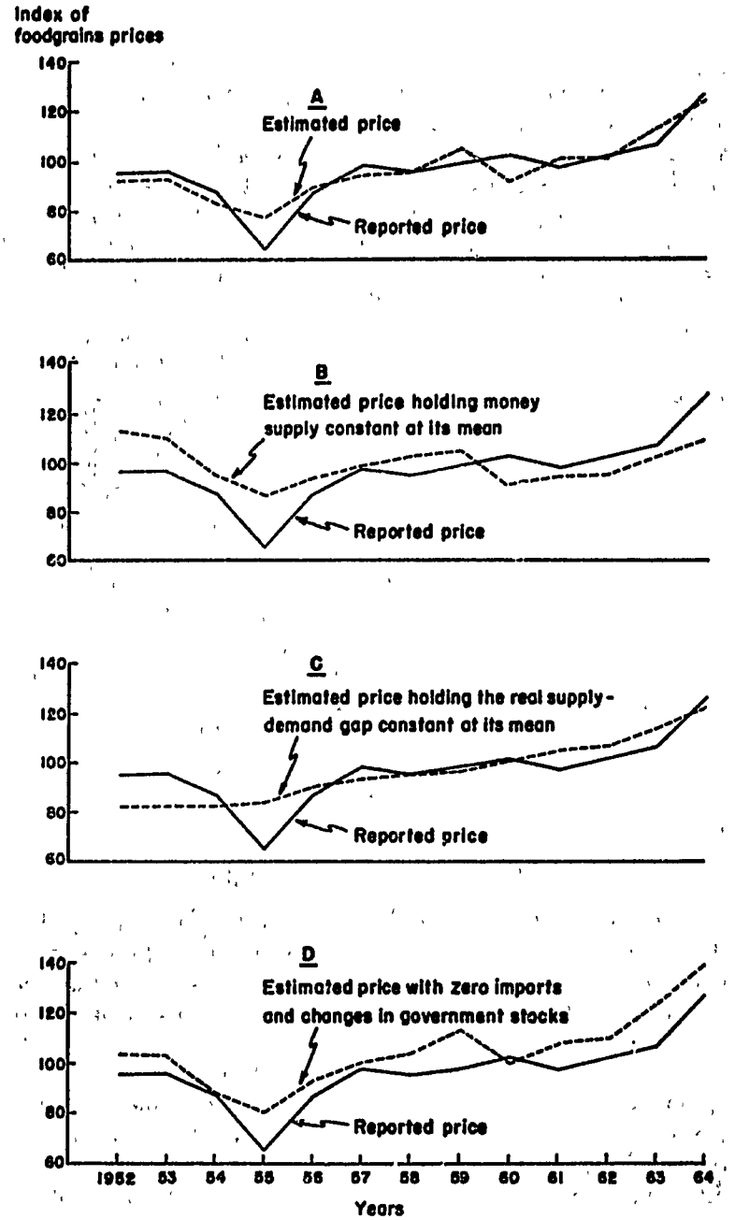

Figure 1. Comparison of reported with estimated April foodgrains prices, India, 1951–1964

Source: Reported prices from Table 1; estimated price in 1*A* computed from the price equation in the text; estimated price in 1*B*, 1*C*, and 1*D* computed from the same equation, but with the specified variables held constant as stated.

sion of the nonagricultural sector. Conversely, when agricultural production grew more rapidly than demand, the consequent decline in agricultural prices provided incentive and funds for increased investment in the nonagricultural sector. More rapid growth in agricultural production would presumably have allowed faster average growth rates in the nonagricultural sector, with consequent greater expansion in the demand for agricultural commodities. It is noteworthy that, in this argument, relative movements in agricultural prices are the indicators and not the cause of success or failure in the agricultural sector.

The tendency for sharp fluctuations in agricultural production and for runs of successively declining and rising production calls for care in making judgments about the success of agricultural development policies. For the periods of relatively low production, such as 1955 to 1959, 1960 to 1963, and 1965 to 1967, unjustified conclusions about the deleterious effects of imports and domestic price policy may be drawn. For the periods of high production, such as 1953 to 1955, 1959-60, and 1964-65, even more unjustified conclusions may be drawn as to the effectiveness of production policy. The two situations together divert attention from policies encouraging production-increasing technological change and towards policies of price regulation and restriction of trade and food aid.[7]

The close fit of the estimated prices to reported prices supports the assumption that, for the period 1949–1964, the reported prices closely reflect actual market conditions. Presumably there would be a much larger random error in the equation if the reported prices were randomly reported or were fixed prices of wide and varying disparity from black market prices.

Farmer Stocks of Foodgrains

Government storage stocks are known and enter the price equation explicitly. No data are available for private stocks. Although it is generally assumed that traders do not carry significant quantities of grains from one year to another, there is disagreement about whether farmers do so. On the one hand, it is argued that farmers are too poor and too indebted to store grain from one year to another, and that in any case it is normally not profitable to do so. On the other hand, it is argued that stocks do provide protection against future bad crop years, that the farmers who produce the bulk of marketed supply have ample financial power to hold stocks, and that such storage may, at least in some years, be highly profitable.

In the price equation presented here, the substantial coefficient of the $D-S$ variable for the lagged year, $t-2$, suggests that year-to-year change in farmer-held stocks is of considerable importance in determining annual

[7] There has been a good deal of controversy on these matters [1, 9, 19].

foodgrains prices. Apparently, in a year of very large crops there is substantial storage and carry-over to the next year; thus, prices are depressed less in the year of a big crop and more in the year following. Conversely, in a year of very small crop normal carry-over stocks are drawn down, reducing the immediate effect of the poor crop on prices. This situation provides a stabilizing effect on prices, unless there are successive years of crop failure or bumper production, in which case prices react sharply, as they did in 1954-55 and 1966-67.

The coefficient of the $D-S$ variable for $t-2$ suggests occasional annual changes in on-farm carry-over stocks of as much as four or five million tons (Table 2). A large proportion of total foodgrains production is stored on the farms where it is produced and consumed. Thus, the modest percentage increment to normal post-harvest storage stocks which these figures suggest is a much larger proportion of total marketings. This element of leverage is important in explaining storage and price behavior.

Table 2. Estimates of net changes in private foodgrains stocks, India, 1952 to 1964

Years	Estimated with $(D-S)_{t-2}$ held constant[a]	Estimated on the assumption that equation error is due to changes in private stocks[b]	Sum of the two estimates
	millions of long tons		
1952	+3.3	+1.3	+4.6
1953	+4.8	+1.3	+6.1
1954	+1.2	+1.8	+3.0
1955	−2.8	−5.3	−8.1
1956	−1.0	+0.9	−0.1
1957	+0.6	+1.3	+1.9
1958	−1.0	—	−1.0
1959	+4.1	−2.7	+1.4
1960	−3.9	+4.9	+1.0
1961	−1.6	−1.3	−2.9
1962	−2.6	+0.4	−2.2
1963	−0.4	−3.1	−3.5
1964	+0.8	+0.9	+1.7

[a] Calculated by estimating prices from the price equation with the $(D-S)_{t-2}$ term held constant at its mean. The difference between the derived estimates and the original estimates of yearly prices is assumed to be due to changes in stocks in the $(D-S)_{t-2}$ term. The change in private stocks needed to give this change in price is estimated by subtracting the equation with $(D-S)_{t-2}$ constant at its mean from the equation as originally presented, and solving for the value $(D-S)_{t-2}$.

[b] Calculated as above, but assuming that the difference between the estimated and reported prices is entirely due to misestimation of the $(D-S)_{t-2}$ term.

In the equation presented here, the coefficient for $D-S$ in $t-2$ suggests that increase or decrease in private storage is determined entirely by the previous year's crop.[8] However, the much larger standard error for $t-2$

[8] In an alternate equation which included a $D-S$ variable for $t-3$, the regression coefficient for this variable was 0.01, with a standard error of 0.8.

than for $t-1$ suggests that farmers vary their storage decisions less systematically according to the size of crop than this equation implies. Indeed, it seems likely that a substantial portion of the error in the price equation is due to faulty specification of this variable. Table 2 presents the changes in storage stocks implied in the assumption that the equation error is due entirely to changes in private stocks.

If data were available for a longer period of years, a more complex and accurate description of farmers' storage activities might be provided. However, the variation in carry-over stocks may have an important random element. Insofar as this is true, price behavior in any one year would be exceedingly difficult to predict. The policy implication is that one must either (1) take measures which provide substantial public control of markets through holdings of public stocks, or (2) undertake a degree of measurement and regulation of private stocks that is probably impossible even with respect to the traders, let alone the much larger number of farmers, or (3) be prepared for some price instability that is based on naïve speculation in addition to basic consumption and production factors. In the longer run, a program of farmer education and collection and dissemination of accurate price and storage information would be helpful.

The rise in farm incomes and the even greater expansion in credit available to farmers which have accompanied the social and economic changes of the past two decades have increased the ability of farmers to hold stocks. If farmers are naïve speculators, less informed concerning broad supply and demand changes than the traditional trading community, an increase in their holding capacity may lead to less stable markets and price relationships. In other words, one of the concomitants of agricultural development may be forces leading to greater instability of market prices. These forces may increase the value of effective price stabilization and market information schemes in the context of agricultural development.

In the study of farmers' storage activity, it is important to remember that a substantial proportion of aggregate foodgrains production and, to an even greater extent, of the total marketable surplus is produced on a minority of farms [15] Thus, it is not inconsistent to find the majority of farmers with completely depleted stocks prior to a new harvest, while at the same time an amount equal to, say, 5 percent of total production and of course a much larger percentage of total marketings is carried over to another year on the farms of the 10 to 20 percent of the farmers with the larger holdings.

It is interesting to note that our foodgrains price results are in sharp contrast with most lagged models, which show progressively smaller coefficients for each successively more distant year. In a similar equation for industrial raw material crops, including such crops as oilseeds and cotton,

a more normal pattern was observed, each successively earlier year, $t-1$, $t-2$, $t-n$, having a progressively smaller coefficient [2]. In the case of industrial raw material crops, farmers apparently sell essentially the entire crop in the year produced. It is reasonable to assume that the results for foodgrains are typical of a crop involving storage for home use, which represents a high proportion of total production, with the consequent leverage effect described above.

The Effect of Money Supply on Foodgrains Prices

The upward trend in foodgrains prices is largely accounted for by the trend in the money-supply variable (Figs. 1*B* and 1*C*). The coefficient for the money-supply variable is difficult to interpret—in part, because the variable is naïvely defined. The most interesting interpretation of the coefficient suggests that the increased money income associated with expansion of the money supply has an implicit income elasticity of demand substantially lower than the 0.5 assumed for calculating the demand effects of real income changes.[9] The pattern of government deficit spending and of private expenditure financed by expanded bank deposits may have significantly shifted income distribution towards higher income groups with lower income elasticities of demand. Such an assumption is consistent with the impression that Indian economic expansion has so far emphasized high investment and low employment activities.

The more investment policy is oriented towards expanded employment of unskilled laborers with low incomes, the more income will be distributed towards persons with high income elasticities of demand for food and the more pressure there will be on food supplies.The converse applies to investment policy oriented towards imported capital goods and the skills of higher-income persons. Looked at from a different perspective, rapid increase in agricultural production and the ready availability of imported food on concessional terms allows an investment policy which is heavily employment-oriented. PL 480 supplies, coupled with a strong employment-oriented investment policy, need have little effect on food prices, because the supply effect of PL 480 can be largely balanced by the demand effect of increased employment of persons with low income and

[9] Calculated at the mean, the coefficient on the money-supply variable implies that a 1-percent increase in the money supply increases the price index of foodgrains by 0.53 percent. Assuming that money income expands proportionately with money supply, then a 1-percent expansion of money income will increase the price index by 0.53. As will be seen later, interpretation of the coefficients for the $D-S$ variables provides a price flexibility coefficient of -1.83. Taking demand and supply changes of the same size as interchangeable and the assumed income elasticity of demand as 0.5, a 1-percent increase in real income will increase the price index by 0.92 percent. The coefficient 0.53 is nearly 60 percent of 0.92, consistent with an income elasticity of demand of 0.3 for foodgrains based upon money income as compared to 0.5 assumed in the real-income calculations.

hence high income elasticities of demand for food. The balance of these forces can be determined by public policy. More generally we may say that because of wide differences among income classes in income elasticities of demand for food, changes in income distribution can be as important as changes in average income in determining growth in the demand for food and the resulting pressure on food prices.

The money-supply variable may serve as a proxy for various trend factors. Perhaps, most plausibly, there has been a downward trend in the income elasticity of demand for foodgrains rather than the constant level assumed in the demand estimates. In an empirical sense, if such a decline were related to the upward trend in availability of consumer goods, it would probably correlate with the expansion in the money supply. If a downward trend in income elasticity were associated with rising real incomes, then the correlation with the money supply would not be as close. It is also possible that there is an upward bias in the real-income estimates used, which is corrected by a trend factor associated with money income.

The significant conclusion from this analysis of the money-supply variable is that there are one or more important factors which influence prices of foodgrains in an important manner and which are as yet little understood. These may include the effect of changes in income distribution, particularly as affected by development policy itself, secular changes in income elasticities, or other factors. This is an interesting and potentially important area for further inquiry.

Foodgrains Imports

Subtraction of foodgrains imports from the calculation of supply in the price equation provides the estimated price shown in Figure 1*D*. Without imports, foodgrains prices in India during the period studied would have been about 10 percent higher on the average, with a range from about 3 percent to 14 percent higher. Although there is not clear evidence of an upward trend in imports during the period studied, there has been some tendency for fluctuations in imports to dampen fluctuations in domestic prices.

An alternative formulation of the price equation which excluded imports from the measure of supply provided an equally good fit and similar coefficients to those in the equation presented. Comparison of the two equations confirms a lack of trend effect from imports.

Estimation of Price Elasticity of Demand

A price elasticity of demand can be calculated from the price equation[10] by first deriving a price flexibility coefficient which combines the coeffi-

[10] The method used is that described by Nerlove [17].

cients of $D-S$ for $t-1$ and $t-2$. The coefficient of 2.81 is converted to a price flexibility coefficient[11] by taking the average demand and average price index and deriving the price flexibility coefficient of -1.83. This figure is interesting in itself, suggesting that a 1-percent change in demand will change the price index by 1.8 percent. An estimate of the price elasticity of demand of -0.55 is derived by calculating the inverse of the price flexibility coefficient. This figure is consistent, as suggested by the Slutsky-Schultz relation [12, pp. 28–29], with the assumed value of 0.5 for the income elasticity of demand, and an assumption of a very low substitution elasticity. These estimates appear to be reasonable in the context of the Indian economy and lend support to the credibility of the specification of the price equation used and to the meaningfulness of the coefficients derived in this study.

Conclusions

For the period from 1949-50 to 1963-64, it is possible to explain over 80 percent of the variation in foodgrains prices in India with a measure of variations in the gap between supply and demand and in the money supply. The upward trend in foodgrains prices during the period is largely associated with expansion of the money supply, whereas the fluctuations from year to year are largely associated with weather-induced fluctuations in production. Changes in foodgrains imports account for little of the trend movement and serve to dampen slightly the year-to-year fluctuations around the trend.

Expansion of the money supply, through its effect on money income, has apparently increased the demand for foodgrains less than would an equivalent increase in real income, suggesting that expansion of the money supply in India has been associated with redistribution of income towards higher-income consumers. Further inquiry is needed into the effect of changing income distribution on the demand for foodgrains and the resultant interaction between employment and income policy on the one hand and food supply programs and food prices on the other.

Farmers apparently increase storage stocks substantially in years of large crops and draw them down in years of small crops. This practice dampens price fluctuations unless there are two or more successive years of large or small crop, in which case the price changes are very large. The relatively large standard error for the lagged demand–supply variable suggests that farmers' storage decisions are not highly predictable and provide a major source of error in estimating future price levels. Since farmers' storage decisions are so important to price determination, it would be useful to study this matter more carefully.

[11] The sign change arises from the "gap" variables being expressed as $D-S$ rather than $S-D$.

References

[1] DANTWALA, M. J., "Incentives and Disincentives in Indian Agriculture," *Indian J. Agr. Econ.* 22(2):1–25, April–June 1967.

[2] DAR, A. K., "Domestic Terms of Trade and Economic Development of India," Ph.D. thesis, Cornell University, 1967, University Microfilms, Ann Arbor, Michigan.

[3] FEI, JOHN C. H., AND GUSTAV RANIS, *Development of the Labor Surplus Economy, Theory and Policy*, Homewood, Ill., Richard D. Irwin, Inc., 1964.

[4] India, Government of, Ministry of Food and Agriculture, Directorate of Economics and Statistics, *Bulletin of Food Statistics*, New Delhi, 1952–1967.

[5] ——, *Report on an Enquiry into the Pace and Pattern of Market Arrivals of Foodgrains*, New Delhi, 1959.

[6] LELE, UMA J., "Market Integration: A Study of Sorghum Prices in Western India," *J. Farm Econ.* 49:147–159, Feb. 1967.

[7] LEWIS, STEPHEN R. JR., AND S. M. HUSSAIN, "Relative Price Changes and Industrialization in Pakistan, 1951–1964," Project for Quantitative Research in Economic Development, Center for International Affairs, Harvard University, 1966, mimeo.

[8] LEWIS, W. ARTHUR, "Economic Development with Unlimited Supplies of Labor," *The Manchester School* 22:139–191, May 1954.

[9] MASON, EDWARD, *Economic Development in India and Pakistan*, Occasional Papers in International Affairs, No. 13, The Center for International Affairs, Harvard University, 1966.

[10] MELLOR, JOHN W., *The Economics of Agricultural Development*, Ithaca, N.Y., Cornell University Press, 1966.

[11] ——, "The Functions of Agricultural Prices in Economic Development," *Indian J. Agr. Econ.* 23(1):1–21, Jan.–March 1968.

[12] ——, "Towards a Theory of Agricultural Development," in *Agricultural Development and Economic Growth*, ed. Herman M. Southworth and Bruce F. Johnston, Ithaca, N.Y., Cornell University Press, 1967, pp. 21–60.

[13] MELLOR, JOHN W., AND ASHOK DAR, "Change in Relative Prices of Agricultural Commodities, India, 1952-53 to 1964-65," *Agricultural Situation in India* 22:1241–58, Jan. 1968.

[14] MELLOR, JOHN W., AND UMA J. LELE, "Alternative Estimates of the Trend in Indian Foodgrains Production During the First Two Plans," *Economic Development and Cultural Change* 13:217–232, Jan. 1965.

[15] NARAIN, DHARM, *Distribution of the Marketed Surplus of Agricultural Produce by Size-Level of Holding in India, 1950-51*, Delhi, Asia Publishing House, 1961.

[16] National Council of Applied Economic Research, *Long Term Projections of Demand for and Supply of Selected Agricultural Commodities: 1960-61 to 1975-76*, New Delhi, 1962.

[17] NERLOVE, M., *The Dynamics of Supply*, Baltimore, Johns Hopkins Press, 1958.

[18] Reserve Bank of India, *Monthly Bul.*, Bombay, 1952–1967.

[19] SCHULTZ, T. W., *Economic Crisis in World Agriculture*, Ann Arbor, University of Michigan Press, 1967.

[20] WORKING, HOLBROOK, "A Theory of Anticipatory Prices," *Am. Econ. Rev.* 47:188–199, May 1958.