CHAPTER 8

The Measurement of Changes in Demand: Deflation

The pioneer quantitative price analysts, from Moore on, had difficulty in dealing with changes in the position of the demand curve.

If the position of the demand curve remains constant, it is easy to determine the elasticity; one simply plots the price data against the production data in an ordinary scatter-diagram, and draws in the demand curve through the dots. But in actual life, demand curves constantly shift their position—sometimes only to a small extent, but sometimes violently. These shifts in demand curves scatter the intersection points all over the scatter-diagram, so that the dots do not fall on a single negatively sloping line; they may even cluster around a positively sloping line, or show no tendency to cluster around any line at all.[1]

This caused the early price analysts a good deal of trouble. They were well aware that the demand for most of the products they were working with showed an upward trend with the passage of time, resulting from the steady increase in population if from nothing else. They knew that rising trends in prices and production both, such as are shown by the data for many commodities in the United States from 1893 to 1914, may be strong enough to convert a normal negative relation between prices and production to the appearance of a positive relation on a simple price-production chart; or at the least, it may obscure the normal negative relationship. Accordingly, they used two or three methods to take these rising trends into account. They recast their data in the form of ratios or percentages of the preceding year's data, or expressed them as ratios of their trends (usually straight line or slightly curved trends fitted by the method of least squares).[2]

[1] E. J. Working, "What Do Statistical 'Demand Curves' Show?" *Quarterly Journal of Economics*, XLI, February, 1927, pp. 212–35.

[2] "In the older type of statistical study of demand, the chief purpose was the determination of 'the demand curve,' or in some cases the more limited purpose

DEFLATING PRICES

After World War I, economists became acutely conscious of the changes in demand associated with inflation and deflation. For a time they attempted to take these changes into account by "deflating" the original prices by an index of the general price level. Most economists used this deflating procedure with misgivings.[3] They knew that changes in demand could take place (in fact were taking place from 1933 to 1939) without causing much change in the commodity price level. They knew, furthermore, that even if changes in demand were always associated with changes in the commodity price level, there was no reason to believe that these changes were associated in 1 to 1 ratio. The ratio was just as likely to be 1 to 0.8, or 1 to 1.5, or some other figure; and furthermore, it was likely to differ from one price level to another.[4]

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of determining the percentage decrease in demand corresponding to a 1 per cent increase in price (elasticity of demand). From the standpoint of such studies all factors other than price were regarded as 'disturbing factors' whose effect should be eliminated. Various devices invented for performing this elimination included the method of trend ratios, of link relatives, and of first differences. On the whole this older type of study proceeded on the assumption that changes in demand due to factors other than price were of a gradual nature due to changes in habit, customs and the growth of population. Under the assumptions it appeared to be desirable to remove the effects of trends.

"But by 1934 it is more and more being recognized that the use of a trend in statistical analysis of economic relationships is a confession of ignorance of some of the important factors involved or is a desire to discuss these factors without identifying them." Charles F. Roos, *Dynamic Economics,* Principia Press, 1934, pp. 4 and 14.

[3] Henry Schultz, in his *Theory and Measurement of Demand,* University of Chicago Press, 1938, devotes most of pages 149 and 150 to a discussion of the shortcomings of deflation, but finally adopts it because it reduces the number of variables. He then compares his results with those based on undeflated data in an appendix.

[4] "The rationale of this sort of 'deflation' (to remove the effects of changes in the general price level) is not clear: either the statistician adheres to the quantity theory in a form that even Jean Bodin would not accept, or else he believes that some, perhaps most, of the monetary disturbance is somehow removed.

"The former alternative cannot charitably be attributed to anyone; the latter alternative seems to me to rest on a rather futile hope. Monetary changes come about through changes in the monetary funds of individuals within a community. The nature and extent of these monetary changes depend largely on who gets the 'money,' when it is received, and how and when it is spent. Only by examining the detailed structure of monetary relationships it is possible to isolate the effects of monetary policy on specific demand curves. And even if this is possible, the resultant demand curve is applicable to future periods only if detailed forecasts of monetary policy are also made. It is not surprising that blanket 'deflation' of prices does not improve the statistical demand curve, judged even by statistical criteria." George J. Stigler, "The Limitations of Statistical Demand Curves," *Journal of the American Statistical Association,* XXIV, September, 1939, pp. 472–73.

SHORTCOMINGS OF DEFLATING

The shortcomings of this deflating procedure (and of the mathematical trend fitting procedure also) were illustrated even in the meticulous work of Henry Schultz, in his monumental *Theory and Measurement of Demand.* He fitted trends to the data for the annual per capita consumption of corn (corrected for size of crop and real, i. e., deflated price) for three periods of time, the last one being 1915–29, excluding the war years of 1917 to 1921. The straight line trend in this last period[5] shows a sharp decline, and Schultz regarded this decline in the demand for corn as the most important finding in his corn chapter.

Actually, however, the downward slope of the trend results almost entirely from the inclusion of the two prewar years, 1915 and 1916, with the postwar years, 1922 to 1929. The whole price level for corn shifted suddenly downward during the postwar deflation in 1920. If 1915 and 1916 are left out, as they should be (since they belong to the prewar period), the postwar trend of the demand, from 1920 on, is practically horizontal.[6]

By calculations based upon the later year, 1934, Schultz attempted to check the accuracy of his conclusion that the trend had declined. These calculations confirmed his conclusion. But it is a curious fact that this check was itself erroneous, and instead of revealing his previous error, merely covered it up. The 1934 data "confirmed" Schultz's results merely because his deflator was inaccurate. The Bureau of Labor Statistics index of the general wholesale commodity price level in December, 1934, had fallen to 75 (base, 1926=100). It is well known that when the general price level changes, the accompanying percentage changes in prices at the farm are greater than the percentage changes in the general price level, because of the comparative fixity of middleman's charges between producer and retailer. This is shown by the fact that while the Bureau of Labor Statistics index of the general level of prices was 75 in December, 1934, the index of the prices of farm products at the farm was 62 (base in both cases, 1926=100). The general relation between the two series for the period 1921 to 1938 is shown in Figure 38 to be 1 to 1.5.

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[5] Schultz, *op. cit.*: Figure 42, p. 258; Figure 43, p. 259; and Figure 47, p. 268.

[6] For a discussion in greater detail, *see* Geoffrey Shepherd, *Demand Curves: Elasticity, Shifts, Rotation, Shape,* Document No. 1219, American Documentation Service, Washington, D. C. Paper presented at the Cowles Commission Conference on Econometrics, Colorado Springs, Colorado, July, 1939, by the present author.

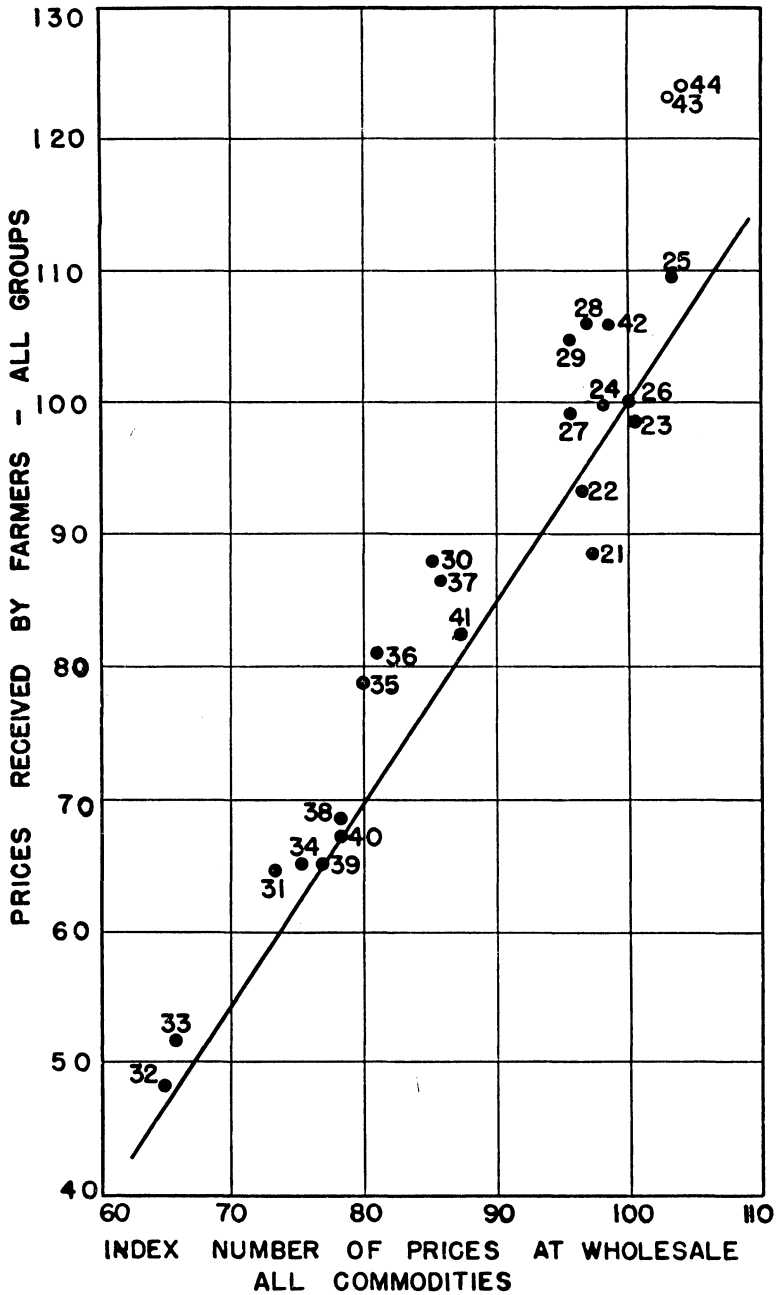


FIG. 38.—Relation between the index of prices received by farmers and the Bureau of Labor Statistics index of all commodity prices at wholesale, 1922–44. (Source, *Statistical Abstracts of the United States, 1944–45,* USDC, p. 417.)

The price of corn in 1934 was lower than a 1 to 1 relationship with the general price level, not because the trend of the demand for the corn had declined, but because the general price level had declined during the depression and this had caused a greater than proportional decline in corn prices. The second error happened to be in the same direction as the first. If the general price level in 1934 had been *higher* than in 1926, the deflated price of corn would have been higher than the size of the crop would have indicated, and this would have seemed to indicate a rise in the trend of the demand for corn. But this would have been just as erroneous as the downward trend which Schultz believed he had found.

The general price level may be used as a deflator for corn prices, without leading to this sort of error, if its movements are first "inflated" by the actual relation between those movements and the movements in the price of corn. An analysis of corn prices, in which the Bureau of Labor Statistics index of the general price level at wholesale is used as a separate variable, shows that corn prices are related to the general price level in the ratio not of 1 to 1, nor even of 1 to 1.5 (the relationship shown in Figure 38), but of about 1 to 1.7. Corn is farther from the consumer, economically speaking, than the average of the products used in the farm products price level index. If the investigator wishes to divide his corn price series through by the index of the general price level, he should multiply that index throughout by 1.7 and subtract 70 from the products, and use that index to deflate his corn prices, in order to do the job properly.[7] The correlation between corn supplies per animal unit and corn prices deflated by the index of the general price level is 0.79; when the same index is "inflated" as described above, the correlation rises to 0.93. This is shown graphically in Figure 39.

DEVELOPMENTS IN THE 1930's

In spite of the shortcomings of the early methods for removing the effect of trends and fluctuations in demand, a good deal of use-

[7] This, of course is still not a satisfactory procedure. It is only one step better than deflating by the original general price level directly. It assumes that the changes intervening between the corn producer and the general wholesale market (itself an ambiguous term) remain fixed when the general price level changes, not only for a year or two, but for periods five or ten years long. This is not true. Some of the important changes, such as railroad freight rates, change only slightly, and only after a period of years; but many other charges give way more readily. I do not know of any simple arithmetical method for taking this into account. The problem is not solved even by using the general price level as a separate variable instead of as a deflator; the same difficulties remain.

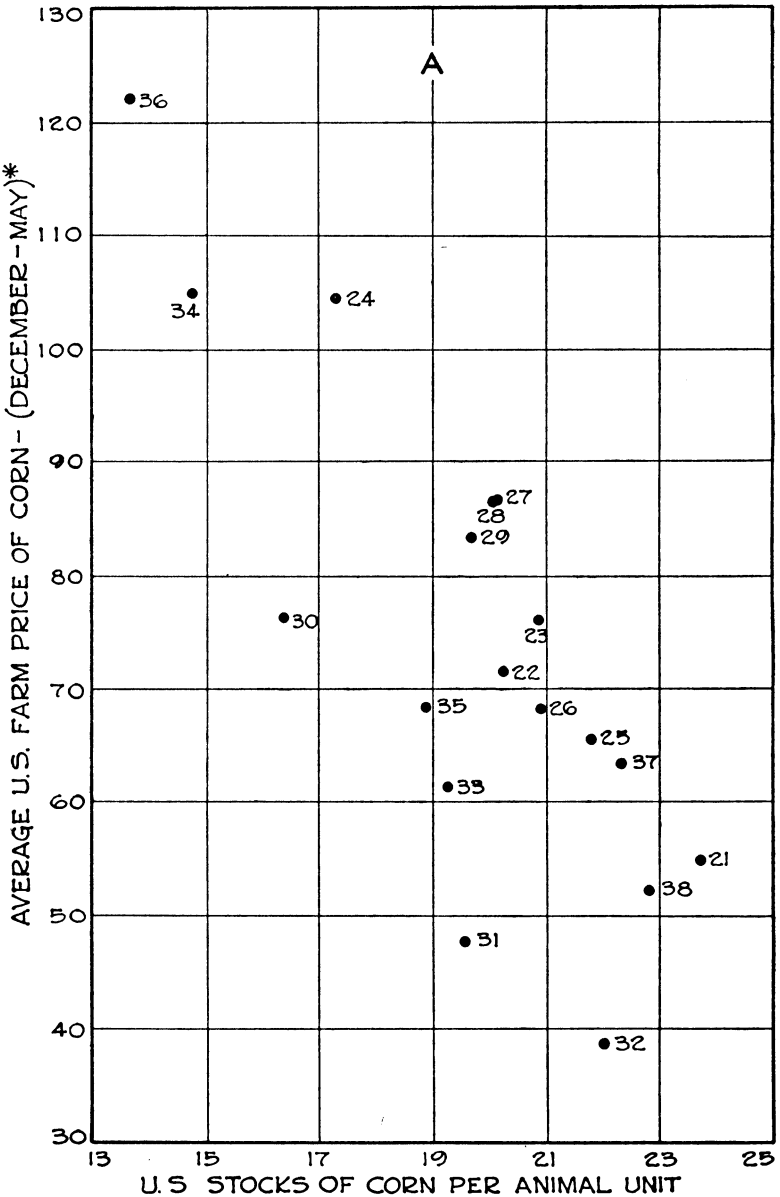
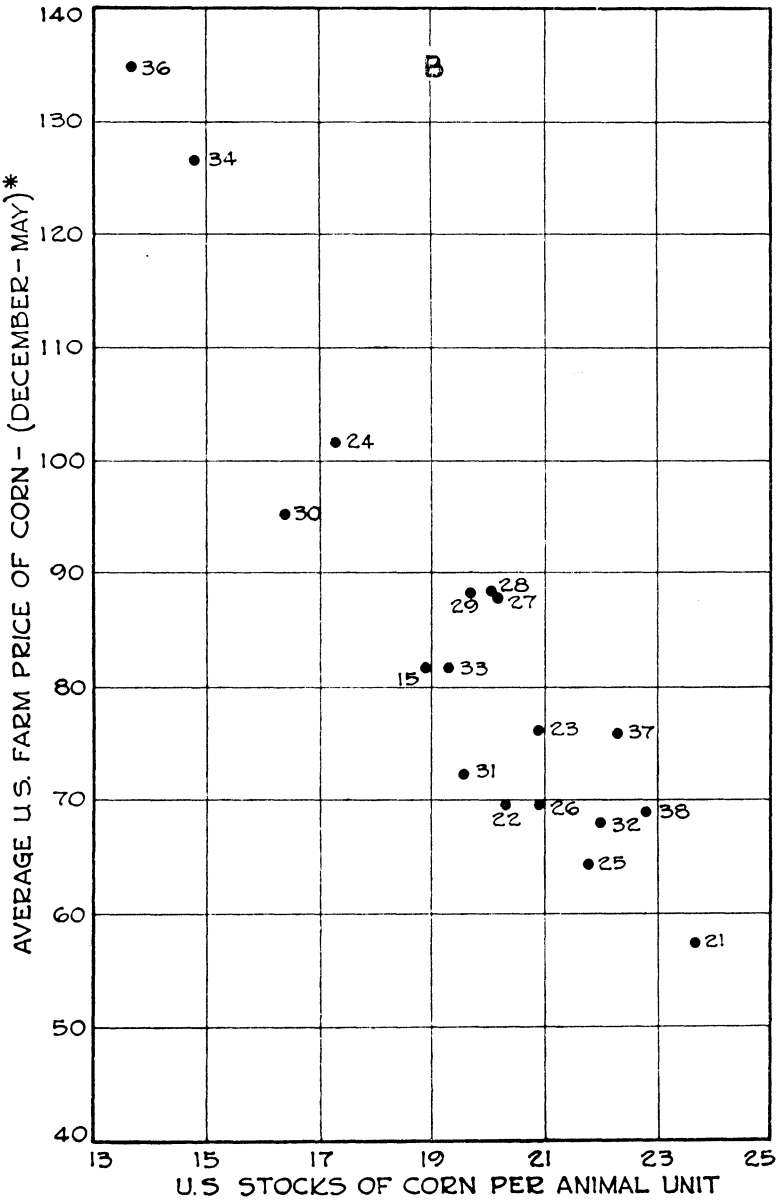


FIG. 39.—Relation of United States stocks of corn per animal unit, December 1, to the average United States farm price of corn, December–May, deflated by (A) the Bureau of Labor Statistics index of the general level of wholesale prices, and (B) that index multiplied by 1.7, minus 70, 1922–38.


B
AVERAGE U.S. FARM PRICE OF CORN - (DECEMBER - MAY)*
U.S STOCKS OF CORN PER ANIMAL UNIT
140
130
120
110
100
90
80
70
60
50
40
13
15
17
19
21
23
25
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ful work was done during the 1920's with their aid. Then several forces combined to bring about a change. They were (1) the popularization of multiple correlation methods, (2) the development of labor-saving mechanical calculating machines and graphic methods, and finally (3) the onslaught of the great depression in 1929. The overwhelming importance of changes in demand became clear; economists realized that trends could not only rise, they could flatten out, and violently fall. No longer could trends be easily fitted as straight lines. And even if properly curved lines could be fitted, and the trend thus "removed," economists began to realize that they did not want to "remove" one of the main characters in the cast; they wanted to measure it, not in order to throw it away, but in order to include its influence in the analysis.

Furthermore, as the depression deepened, the disparity in the rates at which different prices fell became more and more striking, and the inaccuracy of deflating price series (or inflating them, as the process actually became) by division by an index of the general price level, or any other over-all index, became more and more apparent. The necessity of measuring changes in demand directly, and using that measure as a separate variable, became clear, and the spread of the use of labor-saving computing machinery and graphic methods made the use of additional variables in multiple correlation studies easier. The lengthening of the postwar series with the passage of time also permitted the use of larger numbers of variables. Today, therefore, many price analysts prefer not to fit trends or deflate prices in their analytical price studies, but to use some measure of changes in demand as a separate variable.

TWO KINDS OF CHANGES IN DEMAND

But this has not solved the problem of measuring changes in demand; it has merely revealed it more clearly. The problem thus revealed is: What variable or variables should be used to measure (in the earlier terminology, "remove") changes in demand?

This problem consists of two parts:

(1) What variable or variables should be used to measure changes in demand affecting all commodities over the country as a whole, the sort that take place when the country swings from prosperity to depression and back? This kind of change can be referred to as a change in the general demand.

(2) What variable or variables should be used to measure

changes in demand for the specific commodity being investigated, independent of changes in the general demand which affect all commodities? This kind of change can be referred to as a change in the specific demand for the commodity.

These two kinds of changes in demand are discussed in order below.

1. CHANGES IN GENERAL DEMAND

The first kind of change in demand itself consists of two elements, which may be referred to as (a) monetary, and (b) physical or real.

The index of the general price level, used as a separate variable, "removes" only the changes in demand that express themselves in the general price level. Are there not other changes in general demand which do not show up in the general price level? From 1922 to 1929, industrial production and payrolls rose 34 and 29 points respectively; this certainly would seem to indicate that demand also increased. Yet over the same period the general price level did not rise; it fell 1.4 points. This low correlation between industrial production and the general price level is not an isolated case. The relation between the two variables over the whole period from 1925 to 1940 is shown in Figure 40. If the dots for the worst depression years, 1932–33, were omitted, the correlation would be practically zero.

Perhaps the general price level measures only what has been called monetary changes in demand, while indexes of production measure physical or real changes in demand.[8] Without going into the distinction between these two measures at length here, we may say that either concept (and either measure) is valid. Over periods of time when both the general price level and the total industrial production change markedly, both should be used, or reasons for using only one should be specified.

Another measure, total national income, takes both kinds of changes in general demand into account. This is not always recognized. Some observers believe that the country was less well off in 1939 than it was in 1929 (even though more goods were being produced in 1939 than in 1929) because the total national income in 1939 was lower than it was in 1929.[9] But the national income alone

[8] E. J. Working, "Indications of Changes in the Demand for Agricultural Products," *Journal of Farm Economics*, XIV, No. 2, April 1932, p. 240.

[9] Leonard Ayres, *The Cleveland Trust Company Business Bulletin*, The Cleveland Trust Company, Vol. 21, No. 9, September 15, 1940, p. 4.

does not tell how well off a nation is, otherwise Germany during its inflation period after World War I would have been fantastically wealthy. It is what the income will buy that counts.

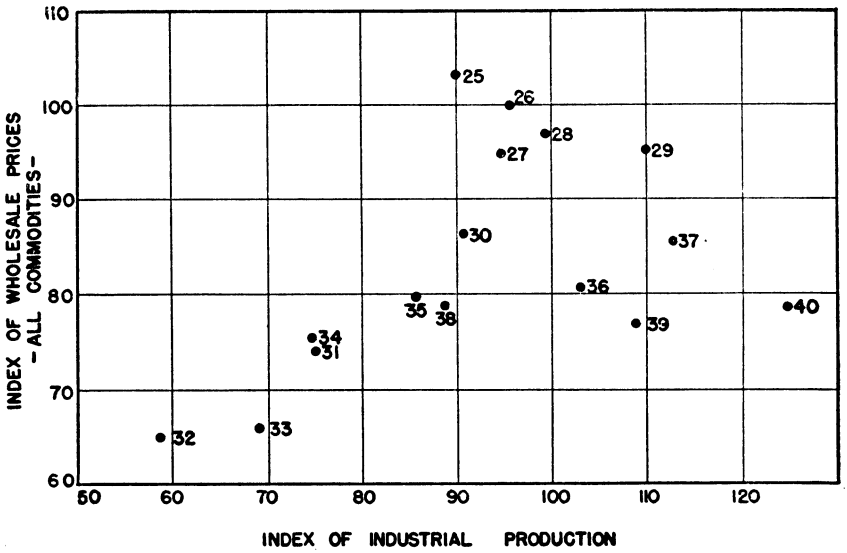

FIG. 40.—Relation between the Bureau of Labor Statistics index of all-commodity prices at wholesale and the Federal Reserve Board index of industrial production, 1925–40. (*Source, Statistical Abstracts of the United States, 1944–45,* USDC, pp. 417, 496.)

Another measure of demand that combines monetary and real elements is the index of the income of industrial workers. This is more sensitive than the total national income. It is less representative of the country as a whole than the total national income, but it may reflect changes in the demand for farm products more accurately, since some other components of the national income (dividends, for example) go chiefly to people whose incomes are large and whose demand for farm products does not change much with changes in their incomes.

2. SPECIFIC CHANGES IN DEMAND

An analysis that is based on general demand factors only is deficient in two respects: (a) The connection between the general change in demand and the price of the particular commodity is not direct; there may be a good deal of loose play between the two. (b)

Changes in the demand for the particular product only—what may be called specific changes in demand—are left out of account.

Specific changes in demand are more concrete and definite than the general changes in demand discussed in the preceding section. For example, whenever the price of livestock rises, Cornbelt farmers are willing to pay more per bushel for corn to feed to that livestock. This may be regarded as causing the demand curve for corn to rise. Whenever the number of livestock increases, farmers need more corn to feed them. This may be regarded as causing the demand curve for corn to shift to the right.

A rough price analysis for a specific commodity can be made by taking into account only those general changes in demand for all commodities represented by changes in the general price level. A more thorough analysis should include some additional factors representing changes in specific demand. It would be possible to deflate the price series for these other factors by dividing it through in turn by each of these other factors. But the shortcomings of the deflating procedure when only one deflator is used would be multiplied if several deflators were used; the errors resulting from the true relationships not being 1 to 1 would cumulate. A much better procedure is to use the method of multiple correlation analysis, which enables the investagator to determine what each of the true relationships is. The standard mathematical methods of multiple correlation are well described in many statistics textbooks. The more recently developed graphic method is explained in the next chapter.