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THE NATURE OF PRICE FLEXIBILITY
AND THE DETERMINANTS OF RELATIVE
PRICE CHANGES IN THE ECONOMY

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DISCUSSIONS of price flexibility in the literature of economics are not all concerned with the same subject matter. Three quite different topics can be distinguished. The first two deal with the effects of price flexibility or inflexibility on the operation of the system as a whole; the third deals primarily with the nature and causes of price flexibility itself, and only secondarily with its consequences.

The first topic considers the effect of price flexibility or rigidity on the level of economic activity. Discussions in this area have frequently been concerned either with the analysis of the Keynesian and classical models[1] or with the development of certain other specific aggregative models. On the more empirical side, a great deal has been written about the effects which might have been expected to flow from greater price flexibility or greater price rigidity in specific historical instances. Much of both the theoretical and empirical work has been predominantly concerned with the flexibility of the wage rate and its repercussions on prices, output, and employment.

The second topic contemplates price flexibility from a long-run point of view. Interest in this area has been focused primarily on the efficiency of the economic system in allocating its resources— i.e. whether in the long run prices do tend to be determined by competitive forces. The literature in this area is not so extensive as that in the preceding area, perhaps because economists have, in recent years, been preoccupied more with problems of income and employment than with those of resource allocation.

The third category of price-flexibility literature is considerably less homogeneous with respect to final objectives than either of the two preceding groups. It is rather the common starting point which

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[1] See, for example, R. M. Bissell, Jr., "Price and Wage Policies and the Theory of Employment," *Econometrica*, July 1940; Oscar Lange, *Price Flexibility and Employment* (Cowles Commission Monograph 8, Principia Press, 1944); Don Patinkin, "Price Flexibility and Full Employment," *American Economic Review*, September 1948, pp. 543-564.

suggests the treatment of this segment as a unified body of literature. Writers in this area usually start from a consideration of the empirical fact that during economic fluctuations there is substantial variance in the relative price changes of different products and factors of production, and they propose to investigate the causes of this variance. Branching out from this starting point are a number of different definitions of price flexibility and a number of different analyses of causal factors.

It is this third topic with which this paper will be concerned. To the extent that this literature also attempts to evaluate the significance of existing price flexibility or inflexibility, it does have some relation to the first two topics, but the following discussion will not be primarily concerned with the effects of price flexibility on either the level of activity of the economic system or the efficiency of resource allocation. Attention will be focused on (1) an examination of definitions and measures of price flexibility in the literature, (2) a restatement of the problem of price flexibility in terms of traditional value theory and a discussion of the determinants of relative price changes, (3) an empirical investigation of relative price changes and price-cost interrelationships in various sectors of the economy, and (4) the application of the foregoing analysis to certain specific problems. The paper will be divided into four parts corresponding to this general outline.

Part 1 will examine the various definitions and measurements of price flexibility which appear in the literature. These concepts differ considerably, and no attempt will be made in this section to present a comprehensive picture of the entire literature; the focal point of the discussion will be the differences among the concepts, so that where one concept has been discussed by a number of writers only one or two of such writers will be mentioned.

Part 2 will attempt to evaluate the various definitions of price flexibility discussed in Part 1 in the light of a restatement of the problem in terms of the traditional theory of the firm. This discussion will be especially concerned with developing an analysis which will be applicable to existing empirical material. The section will have two parts: it will explore the nature of price flexibility itself, and, pursuing the question somewhat further, it will consider the determinants of relative price changes in the economy.

Part 3 will apply the analysis developed in Part 2 to the observed price behavior of various sectors of the economy, in an effort to explain why the relative price changes in the various sectors differ.

Since output prices for earlier stages of production become costs for later stages of production, the sectors will be classified as far as possible according to the flow of goods through the channels of production; the price-cost interrelationships in agriculture, agricultural processing industries, mining, mineral processing industries, and the distributive trades will be considered in turn. The analysis will not be primarily statistical, although use will be made of readily available empirical material.

Part 4 will test the theory of price behavior presented in Part 3 in yet another way. The behavior of various aggregative price indexes will be examined to see whether their general movement and relative differences can be explained readily in terms of the theory. First, the actual behavior of the components of the cost-of-living index will be examined to see whether their relative differences conform to what would be expected in terms of the theory of the determinants of price behavior. Secondly, the wholesale-price index will be similarly examined, and its general movements will be contrasted with those of the cost-of-living index. The process of analyzing these two price indexes necessarily raises the question of the meaningfulness of an aggregate index, given the systematic changes in the components which will occur if the postulated theory is found to be tenable. Finally, the index of real wages will be examined in the light of this theory of price behavior. Although it will not of course be possible in this brief analysis to offer a complete statistical test of the theory, it will be studied in relation to past statistical literature.

1. Definitions and Measurements of Price Flexibility in the Literature

IN THE mid-thirties, Gardiner C. Means published a statistical study[2] of price inflexibility in the American economy which stirred up considerable interest. A number of writers had been concerned with various aspects of this subject before that time, but none of their

[2] For the original study see Gardiner C. Means, *Industrial Prices and Their Relative Inflexibility*, S. Doc. 13, 74th Cong., 1st Sess., 1935. Parts of this original study and in some cases additional supplementary material are included in the following: Gardiner C. Means, "Price Inflexibility and the Requirements of a Stabilizing Monetary Policy," *Journal of the American Statistical Association*, June 1935, pp. 401-413; Gardiner C. Means, "Notes on Inflexible Prices," *American Economic Review*, Proceedings, March Supplement, 1936, pp. 23-24; *The Structure of the American Economy*, National Resources Committee, 1939, Part I, Chap. VIII, pp. 122-152; Saul Nelson and Walter G. Keim, *Price Behavior and Business Policy*, Temporary National Economic Committee (TNEC), Monograph 1, 1940, Chap. II, pp. 11-53 and Appendix I, pp. 165-241.

publications had had the explosive effects of Means's study. Means's chief interest was in pointing out the presence in the economy of inflexible administered prices, which, he claimed, had highly disruptive effects on the functioning of the economy and were largely responsible for the failure of *laissez faire*.[3] As proof of the existence of inflexible administered prices, Means presented a chart showing the results of a tabulation of the frequency of price change for 747 of the items included in the Bureau of Labor Statistics monthly wholesale-price index over a 95-month period from 1926 through 1933. The frequency distribution of the numbers of price changes for individual items was found to be *U*-shaped. To Means, this *U*-shaped distribution indicated that prices could be divided into two quite different types. The highly flexible prices grouped at one end of the distribution (i.e. prices which changed frequently) he interpreted as those which for the most part were market determined, and around which traditional economic analysis was built. The inflexible prices at the other end of the distribution (i.e. prices which changed infrequently) he interpreted as those which were administratively established and held for appreciable periods of time. Considering the frequency of price change as a measure of price flexibility thus enabled Means to satisfy himself that two quite different pricing systems existed: flexible prices, resulting from many forces continually interacting in that part of the economy in which markets existed; and inflexible prices, set by administrative action and held constant.

One of the first comments on Means's analysis of price inflexibility was that it did not and could not show whether the economy as a whole had been shifting from market to administered prices. It was suggested that the differences in the frequency of price change found by Means might be a normal phenomenon, and that the period examined was no different in this respect from previous periods. A number of writers[4] undertook to discover whether any evidence could be found that in recent periods an increasing proportion of prices had fallen into Means's "infrequent change" classification. For this purpose, distributions of the frequency of price

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[3] Means, *Industrial Prices and Their Relative Inflexibility*, as cited, p. 1.

[4] Don D. Humphrey, "The Nature and Meaning of Rigid Prices, 1890-1933," *Journal of Political Economy*, October 1937, pp. 651-666; R. S. Tucker, "The Reasons for Price Rigidity," *American Economic Review*, March 1938, pp. 41-54; E. S. Mason, "Price Inflexibility," *Review of Economic Statistics*, Vol. 20, 1938, pp. 53-64; Jules Backman, "Price Inflexibility—War and Post War," *Journal of Political Economy*, October 1948, pp. 428-437.

changes were made for periods as far back as 1837.[5] The proportion of items falling into the rigid category in different periods was not found to differ greatly and did not reveal a trend toward rigidity in the more recent periods. Furthermore, over the period 1890-1936 there was no trend in the actual changes observed in the component series for each year expressed as a percentage of the total changes which would have taken place if each series had changed each month during the year.[6] These negative results seemed to indicate that there was no adequate statistical basis for believing that the price system was becoming any more rigid than it had been in any previous period for which data were available.

The frequency of price change as a measure of relative price flexibility or inflexibility was quickly supplemented by the amplitude of price change. In his original presentation, Means had shown that the frequency of price change was highly correlated with its amplitude. However, he did not use amplitude as a measure of flexibility, but rather considered it an accompanying characteristic with further economic implications. Means demonstrated the relationship between the frequency and the amplitude of price change in two ways. First, he presented a conventional scatter diagram of the two variables, which showed the existence of a correlation. Then he separated the items in the BLS index into ten groups on the basis of their frequency of price change, and for each of these groups he drew up charts showing the distribution of amplitude of change. For those groups with relatively infrequent price changes, he found that the amplitude of change was relatively small.

This discussion of the relation of frequency of price change to amplitude of price change was continued by a number of other writers,[7] and the focus of interest quickly shifted to the amplitude of price change alone, on the ground that this element was theoretically more significant for the incidence of price distortion in the economy. But a simple distribution of the relative amplitude changes of the various items in the BLS wholesale-price index similar to that which Means had made for frequency of price change proved to be unhelpful, since the distribution usually came out unimodal[8] and so did not provide any convenient means of dis-

[5] Tucker, *op. cit.*, p. 43.

[6] Mason, *op. cit.*, p. 59.

[7] Mason, *op. cit.*; *The Structure of the American Economy*, as cited, *loc. cit.*; Nelson and Keim, *op. cit.*

[8] Mason, *op. cit.*, p. 61; *The Structure of the American Economy*, as cited, p. 128.

tinguishing between flexible and inflexible prices. With a unimodal distribution it was of course impossible to say what amplitude of price change represented true price flexibility. Therefore, although a great deal was written about price flexibility in terms of the amplitude of price change and its effect in distorting the price structure, it was not very successfully developed into a tool of analysis. In practice, the amplitude of price change was primarily used for the comparison of the relative flexibility of specific groups of commodities—that is, the flexibility of chemicals and drugs as a group compared with that of farm products as a group.[9] In this sense it was possible to speak of one group as more or less flexible than another, but Means's original concept, that of a "market" sector of the economy operating with perfectly flexible market prices, could not be explored by this method.

A third concept of price flexibility concerns the change in price per unit of a commodity relative to its change in quantity. A wealth of statistical material on the price-quantity behavior of various commodities and products has been provided by F. C. Mills[10] in his various studies of price behavior, but these actual statistical measures did not become a subject of discussion in the general price-flexibility literature. Instead, writers on this subject usually confined themselves to setting out lists of commodities or making scatter diagrams wherein the amplitude of price change and the amplitude of quantity change were shown explicitly. Means, for example, in his original study listed ten industries, for which he showed both the percentage drop in prices and the percentage drop in production.[11] As was the case in his use of the amplitude of price change, Means did not consider the price-quantity relationship to be a measure of price flexibility; rather he used it as a part of the description of the differences in the attributes of market and administered prices. Similarly, scatter diagrams of price-quantity relationships have been

[9] Mason, *op. cit.*, p. 62; *The Structure of the American Economy*, as cited, p. 132; Nelson and Keim, *op. cit.*, p. 30; Backman, *op. cit.*, p. 432.

[10] F. C. Mills: *The Behavior of Prices* (National Bureau of Economic Research, 1927); *Changes in Prices, Manufacturing Costs and Industrial Productivity, 1929-1934*, Bulletin 53 (National Bureau of Economic Research, 1934); *Prices in Recession and Recovery* (National Bureau of Economic Research, 1936); "Elasticity of Physical Quantities and the Flexibility of Unit Prices in the Dimension of Time," *Journal of the American Statistical Association*, December 1946, pp. 439-467; *Price-Quantity Interactions in Business Cycles* (National Bureau of Economic Research, 1946).

[11] Means, *Industrial Prices and Their Relative Inflexibility*, as cited, p. 8.

widely used in the literature to show similarities or differences in the reaction of prices of products having different attributes, for example the pattern of price-quantity reactions of concentrated versus nonconcentrated industries, and of durable versus nondurable goods.[12] Like the study of the amplitude of price change, the study of price-quantity reactions did not yield a meaningful definition of absolute price flexibility, but rather was used to establish differences in relative price flexibility.

A quite different measure of price flexibility was introduced into the discussion by J. T. Dunlop.[13] Employing Lerner's measure of the degree of monopoly, that is, the ratio of the gap between marginal cost and price to price (price minus marginal cost divided by price),[14] Dunlop proposed the change in the degree of monopoly as a measure of price flexibility. He argued that the degree of monopoly (thus measured) was more significant analytically than other existing measures of flexibility because of its relation to the determinants of output and employment. An increase in Lerner's degree of monopoly for a given commodity during a period of falling prices would mean that the marginal cost of the producer of the commodity fell faster than the price of the final output. A decrease in Lerner's degree of monopoly in such a situation would mean that marginal cost did not fall as fast as the price of the final output. Dunlop's measure thus attempts to relate the amplitude of the change in marginal cost to the amplitude of the change in price of the final output. His analysis of price flexibility thus differed from the preceding analyses in that it attempted to take into account the price-cost relationship within an industry. Where input prices and output prices move together, the price of the final good is said to be as flexible as costs. For the industries which he studied, Dunlop concluded that the degree of monopoly increased in the depression

[12] Willard L. Thorp and Walter F. Crowder, "Concentration and Product Characteristics as Factors in Price-Quantity Behavior," *American Economic Review*, February, Supplement, 1941, pp. 390-408; Jules Backman, "Price Inflexibility and Changes in Production," *American Economic Review*, September 1939, pp. 480-486; Nelson and Keim, *op. cit.*

[13] John T. Dunlop, "Price Flexibility and the Degree of Monopoly," *Quarterly Journal of Economics*, August 1939, pp. 522-533.

[14] A. P. Lerner, "The Concept of Monopoly and the Measurement of Monopoly Power," *Review of Economic Studies*, 1933-1934, pp. 157-175. In order that the gap between marginal cost and price divided by price shall be equivalent to the inverse of the elasticity of demand, and thus measure the degree of monopoly in Lerner's sense, it is of course necessary for the firm to be at the point of maximum profits so that marginal cost will equal marginal revenue.

447

of the thirties, i.e. that the cost elements fell faster than the prices of the finished goods.

Another analysis of price flexibility in terms of price-cost relationships was made by A. C. Neal in an effort to discover the importance of industrial concentration to price flexibility.[15] On the basis of changes in costs, Neal calculated for each of a number of industries for the period 1929-1933 what the price would have been if the overhead margin had been kept a constant absolute amount per unit of output. This calculated price he called the expected price. Actual prices that matched this expected price, he reasoned, could be considered flexible. It should be noted that there is a conceptual difference between Dunlop's and Neal's measures. Dunlop's measure of flexibility depended on the equality of *percentage* changes in costs and prices, whereas Neal's measure required that *absolute* changes in costs be exactly reflected in price, so that the dollar amount of the producer's overhead margin per unit of output would remain unchanged. Neal's study covered a much larger number of industries than had Dunlop's, and the close relationship which he found between his expected prices and the actual prices led him to believe that the differential price behavior among industries could be explained for the most part by differential direct cost behavior, rather than by concentration of industry.

More recently, Sho-Chieh Tsiang[16] has made yet another analysis of price flexibility that relies on price-cost relationships. Starting from Lerner's measure of the degree of monopoly, Tsiang further develops the idea that the percentage gross profit margin (total value of product minus prime costs expressed as a percentage of the total value of product) is an expression of the inverse of the elasticity of demand. In this respect, his approach is in fact a combination of those used by Dunlop and Neal. He follows Dunlop in that he singles out Lerner's degree of monopoly as a starting point, and as a result considers the percentage margin between price and marginal cost rather than the absolute margin used by Neal. On the other hand, Tsiang follows Neal in conceiving of the problem in terms of a margin concept, which Dunlop did not do. Tsiang is concerned with the computation of the gross profit margin for the

15 Alfred C. Neal, *Industrial Concentration and Price Inflexibility* (American Council on Public Affairs, 1942).

16 Sho-Chieh Tsiang, *The Variations of Real Wages and Profit Margins in Relation to the Trade Cycle* (Pitman, 1947).

aggregate of all United States manufacturing for the period 1919 to 1937. This aggregative analysis is in marked contrast with the interproduct and interindustry studies of price flexibility discussed above. With the term "price flexibility" thus interpreted, Tsiang found[17] that there was some evidence for the widely held view that the price system in United States manufacturing industries was becoming less flexible. On the basis of his data, he felt that there had been a persistent tendency since 1923 for the average gross profit margin in manufacturing industries as a whole to be negatively associated with the average unit prime cost, i.e. that there had been a persistent tendency for the average value per unit of output to change less than proportionally to the changes in average prime cost.

A number of other definitions of price flexibility have appeared in the general literature, but most of them have been incapable of application as tools of empirical analysis. Mason, in his survey of price flexibility, has given an excellent summary of these concepts.[18] He points out that price flexibility is often used in a normative sense, flexible prices being said to exist where actual price behavior coincides with desirable price behavior, on some definition of desirable.[19] In this context, prices would be considered rigid not because they change infrequently or fail to respond to changes in certain economic forces, but rather because they do not behave as they should behave if economic stability or some other desirable economic objective is to be achieved. Mason also[20] considers price flexibility in terms of the rate or degree of movement of a price in response to the changes in price-determining variables. As he indicates, however, if all the factors which influence prices were included in the list of price-determining variables, actual price movements would by definition be completely explained and there would be no such thing as either flexibility or inflexibility. For a concept of price flexibility to have any meaning, therefore, the analysis can include only some of the price-determining variables. To the extent that any of these definitions depend on either perfect knowledge of all price-making factors or on elaborate normative judgments, they are of course not relevant to empirical analysis.

[17] *Ibid.*, p. 85.
[18] Mason, *op. cit.*
[19] *Ibid.*, p. 57.
[20] *Ibid.*, p. 56. At this point Mason takes up Gunnar Myrdal's notion of price flexibility which would "group all prices statistically according to the speed with which they change under the influence of a changing impulse."

2. *The Concept of Price Flexibility and the Determinants of Relative Price Change*

DESPITE the large volume of literature on the subject of price flexibility, there has been no very significant cumulative development, and the majority of readers may well agree with R. S. Tucker[21] that the discovery of differences in price flexibility in the system is "no more important and no less ridiculous than the discovery by Molière's bourgeois gentilhomme that he had been speaking prose all of his life." If one were to take into account all of Jules Backman's factors and conditions which may affect price flexibility,[22] the subject might be found to be of such a complex institutional nature that it would defy any simple theoretical model. There are, furthermore, many quite serious criticisms, both theoretical and empirical, which can be made of much of the discussion in the literature. Before proceeding further, it will be useful to consider some of the criticisms.

One of the most serious questions regarding Means's *U*-shaped distribution of the frequency of price changes in the components of the BLS wholesale-price index was raised by Tibor Scitovsky.[23] He pointed out that the *U*-shaped distribution may be due only to the particular form in which the data happen to be available, and that the distribution of the number of *actual* price changes need not be *U*-shaped at all. His argument runs as follows.

Means's frequency distribution is based upon the changes which occur in the BLS monthly series. If the price of a commodity changes many times during a month, the BLS figure, which represents one monthly observation, obviously would not show it. Therefore, although there is no limit to the *actual* number of times that a price could have changed during the 95-month period studied by Means, the largest number of changes that can appear in the data is 94. In other words, the 94-change class interval would include all commodities from those which actually did change just once a month up to all those which changed daily (i.e. roughly 2,900 changes in the 95 months) or oftener. The lower frequencies of price change would be affected only slightly by shifting from a monthly to, say, a daily reporting of prices; a price with zero change throughout the period

21 Tucker, *op. cit.*, p. 54.

22 Jules Backman, "The Causes of Price Inflexibility," *Quarterly Journal of Economics*, May 1940, pp. 474-489.

23 Tibor Scitovsky, "Prices under Monopoly and Competition," *Journal of Political Economy*, October 1941, p. 681.

would have zero change regardless of the time interval between ob-
servations, and prices which changed only a few times in the 95
months would have months of zero change in which the daily
changes would also be zero. As the frequency of change increases,
however, Means's monthly observations would correspond less and
less to actual price changes, and at high frequencies it is quite ap-
parent that price changes would be greatly understated. On a daily
observation basis, the high-frequency end of the distribution would
be extended. The cases which now occur in the high-frequency area,
say from 80 to 94 monthly changes (181 cases), would be distributed
over all the frequencies from 80 to 2,850. There seems to be no ade-
quate reason to believe that the distribution would remain U-shaped,
although again a slight cluster might occur at the high frequencies
for the same reason—prices which changed more than once daily
would be lumped with those which changed only once daily. If, in-
stead of daily changes, all actual price changes were recorded for
each commodity, it seems reasonable that there would be a con-
tinuously decreasing number of cases, even at the very highest fre-
quencies of change.

By raising doubts about the validity of Means's U-shaped distribu-
tion, Scitovsky in effect destroyed much of the meaningfulness of the
dichotomy between rigid and flexible prices. Without a significant
cluster at the high end of the distribution, there is no adequate
criterion of perfect price flexibility, so that Means would be forced
back into the same position as the writers who discussed amplitude
of change: frequency of change can serve only as a relative measure,
and no judgment can be made on whether a price is or is not flexible.

There have been other criticisms of Means's basic data. A number
of them attack the assumptions in the use of the BLS wholesale-
price index. One such criticism points to the prevalence of quality
changes, with nominal price kept the same. For example, according
to the National Resources Committee,[24] during the depression a
shirt of quality and workmanship that originally sold for $1.95
could be purchased by the consumer for $1.69 or less. Yet the quoted
prices of shirts apparently remained rigid. Changes in price took
the form of changes in workmanship and style, rather than in the tra-
ditionally established wholesale price. Furthermore, Neal[25] has
pointed out that the BLS price quotations do not always include
all the discounts which sellers give their customers, so that the quoted

[24] *The Structure of the American Economy*, as cited, Part 1, Appendix 1, p. 182.
[25] Neal, *op. cit.*, pp. 40-42.

price may not be representative of the actual price. Thus, in the BLS quotations, salt and fertilizer prices remained stable at a time when in point of fact vigorous price competition existed in the form of exceptional discounts. In considering the validity of the BLS price data, the National Resources Committee[26] concluded that it was imperative to use caution whenever individual price series were involved. In analyses of price rigidity, they felt, it was essential that emphasis be placed upon broad and consistent relationships and that reliance upon small differences in absolute figures be avoided.

A theoretical criticism of Means's use of frequency of change as a measure of price rigidity and price flexibility was raised by D. H. Wallace.[27] He pointed out that in cases where no price-determining factor had changed, the price, by definition, should not change either, yet by Means's definition such a price would be considered rigid. Furthermore, by his definition a price might well be flexible even though it moved in the direction opposite from that which would have been indicated by normal price-determining forces. Means's measure is therefore not really relevant to an analysis of the economic forces in the system.

The use of amplitude as a measure of price flexibility is open to many of these same criticisms. It has already been pointed out that the amplitude of change of a price series gives no clue to the absolute flexibility or rigidity of the series; price flexibility in this sense is purely relative. Most of the studies of the amplitude of price fluctuation, furthermore, used the same BLS data which were used in the studies of frequency of change, and there is reason to believe that the difference between actual prices and prices quoted in the BLS index introduces a more serious distortion in amplitude than in frequency. In a period of depression, the divergence between actual and quoted price may increase cumulatively. Lloyd Reynolds[28] has shown that in a few cases there are major divergences. The drop in the price of aluminum from 1929 to 1933, for example, was reported as 5 per cent by the BLS, but according to census information it amounted in fact to 35 per cent. In the price of sulphuric acid, a zero drop reported by the BLS was a 12 per cent drop according to the Bureau of the Census. Further examples of disparities were

26 *The Structure of the American Economy*, as cited, p. 185.

27 D. H. Wallace, "Monopoly Prices and Depression," in *Explorations in Economics* (McGraw-Hill, 1936), p. 347.

28 Lloyd Reynolds, "Producers' Goods Prices in Expansion and Decline," *Journal of the American Statistical Association*, March 1939, p. 33.

cited by the National Resources Committee study.[29] Although these disparities are probably the exceptions rather than the general rule, they are nevertheless serious enough to raise questions about the suitability of the BLS data for any refined analysis. Finally, with amplitude as with frequency, it does not seem valid to consider a price inflexible just because it does not change, if there has been no change in price-determining factors. The fact that prices have different actual amplitudes of change does not mean that they are differentially sensitive to specific price-determining forces, yet this is how the findings on amplitude have often been interpreted.

Mills's price-quantity ratio has never seriously been proposed as a measure of price flexibility, in the sense that this term is under-stood in the literature; Mills himself considered it to be a descrip-tion of the general patterns of price-quantity movements. Given the demand curve, Mills's ratio is the reciprocal of the Marshallian elasticity of demand, but when both demand and supply schedules shift, the resulting coefficient is somewhat ambiguous. The more usual use of price-quantity relationships as a measure of price flexi-bility, as was indicated in Part 1, has been in terms of scatter dia-grams for different categories of goods, and to this use many of the objections raised with respect to amplitude and frequency also apply. When the BLS wholesale-price data are used, some of the price-quantity relationships which appear will be spurious. Furthermore, the price-quantity relationships again provide only relative and not absolute measures of price flexibility, and the measure obtained is not directly relevant to the question of the correspondence of price to price-making forces.

Dunlop's measure of price flexibility, as was noted above, repre-sents a considerable departure from the measures which had been used in other empirical studies. Unlike them, Dunlop's measure does set up an absolute criterion for a flexible price. By this cri-terion, prices are flexible when they move with costs. If price does not change when marginal cost is rigid, the price is stable but not necessarily inflexible. The fuller implications of this concept will be taken up later in this paper, but it will be useful at this juncture to consider some possible criticisms of the empirical side of Dunlop's work. To obtain marginal cost for an industry, Dunlop took (1) the National Industrial Conference Board index of average hourly earn-ings for the industry, and (2) the BLS wholesale-price index for one representative raw material for the industry, and weighted these ac-

[29] *The Structure of the American Economy*, as cited, p. 183.

cording to the respective importance of wages and materials in value of product in 1933, as given in the Biennial Census of Manufactures. The ratio of the change in marginal cost computed in this manner to the change in the BLS wholesale price he considered to be an approximation to Lerner's degree of monopoly, and thus a measure of the flexibility of prices. If the ratio was greater than 1 (i.e. if the change in computed marginal cost exceeded the change in the BLS price), the degree of monopoly would have increased, and prices would be inflexible. If the ratio was less than 1, the opposite would obtain. Dunlop made yearly comparisons for six industries for the period 1929 to 1935; and for eight industries (four of which were included in the first six) changes in the gap between marginal cost and price were shown through the phases of the cycle (1929-1933 and 1933-1936) rather than from year to year. Dunlop's statistical methods are thus certainly open to criticism. He used data from a variety of sources which employ different industrial classifications and have special unmatched definitions. Changes in average hourly earnings, furthermore, have been shown to be a rather poor indicator of changes in unit wage costs.[30] The use of one representative raw material for each industry (for example, the fall in the price of pig iron as an indicator of the decline in all raw-material costs in the steel industry) requires heroic assumptions. Reliance on the BLS wholesale-price data for both raw-material and finished-goods prices requires just that sort of dependence on the accuracy of individual series which the National Resources Committee advised against. And finally, in spite of Dunlop's conclusion that the gap between price and marginal cost widens in the depression, by his own analysis this was true in only four of the eight cases examined. However, Dunlop did recognize the limitations of his data, and he intended the article as a first approximation rather than a detailed statistical analysis of the problem. It is certainly true that he brought to the subject a completely new orientation, one which promised to be much more useful than previous approaches.

Neal's work bears a marked resemblance to Dunlop's. However, although Neal wrote some three years after Dunlop, there does not seem to be much evidence that he was in fact developing Dunlop's original ideas. Both Neal and Dunlop attempted to study the relationship between marginal cost and price, but Dunlop was interested

[30] Committee on Price Determination, Conference on Price Research, *Cost Behavior and Price Policy* (National Bureau of Economic Research, 1943), pp. 131-143.

in the percentage difference between marginal cost and price, while Neal was interested in the absolute difference. Statistically, Neal's study was very much the more comprehensive of the two. Neal analyzed a group of 106 industries from the Census of Manufactures data. Since he used matched data from one major source, his results probably have greater statistical significance than Dunlop's, and the census data are probably also more pertinent to the study of the effects of actual prices on producers' net receipts than are the BLS wholesale-price statistics. Neal derived an expected price for each industry by computing the price changes implicit in the direct costs of the industry and assuming a constant absolute margin over these direct costs. He then took the position that the extent to which his computed "expected" price was *correlated* with the actual price was a measure of the degree to which changes in direct cost could be used to explain changes in price. There is, however, one major objection to this procedure. Although the correlation between his expected price and the actual price was high, there was a systematic difference between the two: for the period 1929 to 1931, in 82 out of the 106 industries, Neal's expected price was higher than the actual price, and for the period 1929 to 1933 the same was true for 72 out of 84 industries. When the expected price exceeds the actual price, of course, the assumption of constant absolute margins is not in fact borne out by the data; in absolute terms margins for the majority of industries declined. But Neal was interested primarily in the subject of industrial concentration and its relation to price flexibility. so that when he had proved to his own satisfaction that the degree of industrial concentration was only a minor factor in price inflexibility he went no further. He considered only manufacturing in his study, and made no effort to see how the other parts of the economy—such as agriculture, mining, and the distributive trades—fitted into the analysis. He was thus not concerned with the question of why prices and costs actually did move differently from one another, but only with establishing that the reason was not related to concentration.

Tsiang used the same source as Neal for his statistical data; he analyzed the data on direct costs and value of product given in the Census of Manufactures. There were two major differences in his approach, however. First, Tsiang considered only four sets of data: the aggregated data for all United States manufacturing, and summary data for each of three broad industry groups—cotton textiles, paper and pulp, and iron and steel. This is in marked contrast to

the 106 industries studied by Neal. Secondly, instead of deriving estimates of expected value per unit on the basis of constant absolute margins and correlating the expected values with actual value per unit as Neal did, Tsiang derived percentage margins and analyzed their changes from period to period in relation to changes in direct costs. In other words, Tsiang was interested in the behavior of percentage margins as direct costs rise and fall.

The chief weakness of Tsiang's analysis lies in its aggregative nature; this becomes especially important when it is recalled that the differences in price and cost changes among the various industries are very great indeed. Tsiang did try one test of aggregation; he examined the gross-profit margins of four different groups of industries: capital goods, consumer goods, construction materials, and producers' supplies. Because the average gross-profit margins of these industries were all about the same in 1929, Tsiang concluded that the aggregate gross-profit margin for all United States industry would not be changed by a shift in the composition of industry due to differential rates of expansion and contraction over the cycle. However, many other types of aggregation difficulties might be encountered. Within an industry, for instance, it is quite possible that producers with large margins would have a different rate of expansion or contraction than producers with small margins. Rather than attempting to prove that the process of aggregation is legitimate by making various partial tests, it would be simpler to use somewhat less aggregated data and study the behavior of gross-profit margins at more homogeneous levels. In attacking the problem on such an aggregative level, furthermore, Tsiang also neglected any explicit discussion of the differential behavior of prices and costs in different industries.

Despite these criticisms, and despite the diversity of the approaches of the various writers discussed above, certain common elements do emerge. The major concern of all these economists is with the differences in the relative amplitude of price change in the economy during periods of economic fluctuation. Price flexibility as Means conceived it became a subject of study because it was obvious from even a casual examination that during periods of economic fluctuation the price behavior of some sectors of the economy was quite different from that of other sectors. Means would not have considered differences in the frequency of change significant if in terms of amplitude all prices had moved approximately together during the period 1926-1933.

The importance of economic fluctuations as a frame of reference for this consideration of price flexibility cannot be overemphasized. The writers in this group gave very little attention to the long-run type of flexibility mentioned at the beginning of this paper, nor did they concern themselves with the question of how changes in productivity are transmitted through the system in the form of higher wage rates for labor, increased profits for the producer, or lower prices for the consumer, or with the manner in which the secular growth or decline of an industry affects factor returns and prices in that industry. Instead, they were interested in trying to see to what extent differences in the short-run cyclical price behavior of the different sectors of the economy could be explained by the method of price fixing (market or administered), the degree of fabrication of the good (raw material or finished goods), the durability of the good, and other attributes which appeared to be related to differential price behavior. Dunlop, Neal, and Tsiang, for example, were interested in the extent to which the price changes of various industries in the manufacturing sector of the economy could be explained by changes in direct cost as the single determinant. Backman, on the other hand, listed a great many possible determinants of price and implied that he felt most price changes could be explained only in terms of a variety of determinants. Thus, in the context of the literature the study of price flexibility has been the study of the short-run determinants of price behavior in different sectors of the economy during periods of economic fluctuation.

A mere review of this literature, however, still leaves much to be desired. It is clear that the next step should be some consideration of the type of price behavior that might be expected under various assumptions, and an investigation of the extent to which this expected behavior corresponded to what actually took place. The remaining portion of Part 2 will therefore be devoted to the consideration of the major determinants of price. Parts 3 and 4 will then examine price data for the various sectors of the economy to see whether or not the differences in relative price change which are in fact found can be adequately explained in terms of these major determinants of price.

It has already been pointed out in the review of Mason's discussion of the various measures of price flexibility that a definition of price flexibility that took into account *all* the determinants of price would be meaningless. Divergence between actual and expected price in such a circumstance would not be an indication of price inflexi-

bility; rather it would simply indicate that some of the price-determining factors had inadvertently been left out of the analysis in the computation of the expected price. In other words, any concept of price flexibility, except a purely normative one, must be defined in a partial sense. A price can be called inflexible only if it does not change when an expected price computed on the basis of certain specified partial determinants changes. Before any analysis can be made, therefore, the specific determinants which are to be taken into account must be decided upon.

In traditional value theory, the major specific determinants of price are generally considered to be cost and demand. Economists have long recognized that cost and demand are not the only elements in price determination; such factors as expectations, the temperament of the producer, and even public opinion may have an effect on price, and in some instances inertia due to the difficulty of changing prices once they are set may be important. If we exclude all such factors in considering the determinants of individual prices, however, the term "price flexibility" can be given analytic meaning: to the extent that these excluded factors are in fact operative and seriously influence the actual price changes, prices can be considered inflexible or perverse. As a first approximation, therefore, prices will be considered flexible if they react as would be expected in response to changes in cost and demand conditions, inflexible if they do not change as much as would be expected, and perverse if they move in the direction opposite from that expected. As the analysis develops, certain modifications will be made in this definition.

The framework of traditional value theory can be used in developing the expected reaction of price to various types of change in cost and demand. The analysis will start by reviewing the price behavior of an individual firm or industry that is supposed to follow various types of change in costs and demand under the usual assumption of profit maximization in perfect competition and monopolistic competition; the problem of oligopoly will be considered briefly at the close of the discussion. For simplicity in studying price behavior under perfect and monopolistic competition, cost and demand changes will be considered separately. Two questions will therefore be distinguished: (1) how changes in demand would affect price, in a situation in which cost conditions do not change; and (2) how changes in cost would affect price, in a situation in which demand conditions do not change.

1. Under the principle of profit maximization, equilibrium price and output will occur where marginal cost equals marginal revenue, and the relation between marginal cost (which equals marginal revenue) and price (which equals average revenue) will be determined by the elasticity of demand. (This is the basis of Dunlop's use of Lerner's degree of monopoly as a measure of price flexibility.)

From this general observation it follows that if demand shifts but the *elasticity* of demand remains the same, the firm should, in order to maximize its profits, keep the same percentage markup over marginal cost and sell whatever it can at that price. With a horizontal marginal-cost curve, for example, even though demand falls drastically it would be in the interest of the firm to keep its price unchanged as long as costs do not change and the elasticity of demand remains the same. With a rising marginal-cost curve, a fall in demand without a change in elasticity would require a price drop proportional to the drop in marginal costs which would accompany the reduced level of output. Thus if the elasticity of demand does not change, a shifting level of demand would trace out a pattern of equilibrium prices above the marginal-cost curve and in fixed ratio to marginal cost at every point;[31] any change in marginal cost resulting from operation at a different level of output would be directly reflected in an equivalent percentage change in price.

If the elasticity of demand changes, the relation between price and marginal cost must also change. An increase in elasticity would narrow the range between price and marginal cost, and a decrease in elasticity would widen the range.

In a competitive industry, price is determined by the intersection of the industry demand curve and the industry marginal supply price. With a constant marginal supply price, any shift in demand would leave price unchanged. With a rising marginal supply price, a falling demand would trace out a falling pattern of equilibrium prices along the supply curve. With a falling supply curve that was compatible with competition (e.g. economies of scale external to this industry), a fall in demand would actually raise price.

In summary, then, for the individual firm faced with a sloped demand curve, a shift in demand which left elasticity unchanged would require a price change directly proportional to any change in

[31] If the marginal-revenue curve for the firm intersects the marginal-cost curve at a point where marginal cost is vertical (i.e. discontinuous), a fall in marginal revenue within this range with no change in the elasticity of demand would result in a fall in price and maintained output in the firm.

marginal cost resulting from movement along the marginal-cost curve. For a competitive industry, a shift in demand would move price along the marginal supply price curve. In either case, the ratio of price to marginal cost would change following a shift in demand only if the elasticity of demand also changed.

2. If demand is kept constant and cost is permitted to change, consideration of the elasticity of demand is again necessary. In the case of the individual firm faced with a sloped demand curve, a change in cost would be directly reflected in a proportional change in price if the elasticity of demand at the new point of equilibrium is the same as at the old. If with a movement along the demand curve demand becomes less elastic, and the marginal-cost curve is horizontal, an upward shift of the marginal-cost curve would result in a more than proportional price rise, and a downward shift would result in a less than proportional price fall. Any movement along the demand curve which increases elasticity would of course operate in the opposite direction.

Under competitive conditions, shifts in the marginal supply price schedule would lead to equilibrium prices which lie on the demand curve, and the equilibrium price would equal marginal supply price at every point.

Thus, when the elasticity of demand for the individual firm remains constant, and in all cases of pure competition, the equilibrium price will move directly proportionally with marginal cost. Price and marginal cost will diverge only when the elasticity of demand for the individual firm at the new point of equilibrium is different from that at the old. When demand becomes less elastic, a fall in marginal cost will not be matched by a proportional fall in price, and a rise in marginal cost will lead to a price rise which is more than proportional. The obverse would hold when demand becomes more elastic.

This analysis throws some light on the question of the relative price behavior of firms in monopoly and competition during economic fluctuations. As Scitovsky has pointed out,[32] the belief that prices are more variable under competition than under monopoly probably sprang from the fact that competitive producers tend to undercut one another's price in response to flagging demand and falling costs, while the monopolist in a similar situation *can* keep up his price. But, as Scitovsky says, the heart of the question is not whether the monopolist can maintain prices which are less variable

[32] Scitovsky, *op. cit.*, p. 663.

460

than those which would obtain under competitive conditions, but whether it is really in his interest to do so.[33] It has already been noted that under pure competition if the marginal supply price schedule is horizontal any change in factor costs would be directly reflected in price. For the individual firm faced with a sloped demand curve and a horizontal marginal-cost curve, price would not equal marginal cost but would move exactly with it, if the elasticity of demand did not change. The relevant question, therefore, is whether in economic fluctuations a fall in demand would be associated with an increase or a decrease in the elasticity of demand.

According to Harrod,[34] a fall in demand will make people more sensitive to price differences. In his view the imperfection of competition is due to habit, inertia, and lack of knowledge. The pressure of poverty is necessary to drive people to the trouble of avoiding waste; why, he asks, should a man in more comfortable circumstances make as much effort to find the cheapest market? "With an expanding income a man may slip by imperceptible stages into careless habits. A contraction recalls him to his senses. He is loath to relinquish enjoyments to which he has been accustomed and immediately begins to cast about for means of meeting adversity with the least inconvenience to himself. . . . He seeks to economize with the smallest possible loss in substantive utility."[35] Thus Harrod argues

[33] Tsiang, for example (*op. cit.*, pp. 23-24) observes that under imperfect competition the prices of individual products are more or less under the control of the individual producers. From this he suggests that a rise in demand need not imply a rise in market price, as is necessarily the case under perfect competition where the demand confronting each producer is horizontal. In this connection it should be noted, however, that if the elasticity of demand for the product did not change and if marginal costs were constant over the relevant range of output for the producer in imperfect competition, no change in price could be expected to occur with a rise in demand—that is, the reaction in imperfect competition would differ from the reaction in perfect competition only because of the assumed difference in cost structure.

To the extent that producers do not maximize profits in the short run, prices may move differently (more or less) from what would be expected on the basis of changes in costs and demand. In perfect competition producers may refrain from placing goods on the market or conversely may dump their stocks, thus producing prices different from what would be expected on the basis of change in current costs and demand. If producers in perfect competition feel that a drop in demand is temporary, goods may be held off the market, and prices will not drop as much as would have been expected in terms of the fall in demand and marginal costs in the individual plants.

[34] R. F. Harrod, "Imperfect Competition and the Trade Cycle," *Review of Economic Statistics*, May 1936, pp. 84-88.

[35] *Ibid.*, p. 87.

that demand will become more elastic in times of depression and less elastic as prosperity returns.

The validity of Harrod's argument has been questioned a number of times, and Galbraith has gone so far as to state the opposite. He says: "Where the decrease in demand is the result of depression an increase in elasticity may be considered improbable. People with decreased money incomes and increased concern for their economic security are less rather than more responsive to lower prices. Producers and consumers alike tend to postpone purchases of durable equipment."[36]

Of the two arguments, Harrod's seems the more persuasive. Galbraith has not given any reason why people who have increased concern for their economic security feel that they can afford to neglect price considerations. The fact that producers and consumers tend to postpone their purchases of durables has more to do with the level of demand than with its elasticity.

Whether or not Harrod is correct as a general rule, however, it is obvious that for different goods the elasticity of demand will be affected differently by economic fluctuations. A situation which increases people's price sensitivity between bread and potatoes may make the demand curve for train rides from New Haven to New York more inelastic by taking away from it a large portion of the rather elastic demand of those who travel for pleasure and leaving as the major element the rather inelastic demand of those who travel on business. Without much more knowledge of a great many more variables, it does not seem likely that the change in elasticity of demand to be expected in any particular instance can be predicted. It does not follow, therefore, that a monopoly would always have less variable prices during periods of economic fluctuation than would a purely competitive industry. Indeed, to the extent that Harrod's arguments are valid, in order to maximize profits the monopolist should have the more variable prices.

It is apparent from the discussion above that the determination of changes in elasticity for any individual producer might be very difficult (if not impossible). If change in the elasticity of demand is included as one of the factors determining the expected change in price, therefore, it would be impossible to compute the expected price behavior. Furthermore, under certain forms of industrial organization the change in the elasticity of demand is one of the key

[36] J. K. Galbraith, "Monopoly Power and Price Rigidities," *Quarterly Journal of Economics*, May 1936, p. 463.

factors determining the expected reaction of price to a change in cost. In assessing the flexibility of prices associated with various types of industrial organization, it is important not to include in the measure of expected prices elements which are implicitly correlated with a specific form of industrial organization, and the effect of a change in the elasticity of demand is just such an element. Under perfect competition, changes in the elasticity of demand for various products will not affect the expected price; it will remain equal to marginal cost. For the individual firm faced with a sloped demand curve, however, any shift in the elasticity of demand will cause the expected price to rise or fall faster or slower than marginal cost. The inclusion of changes in elasticity as one of the factors determining the expected change in price will therefore obscure the influence of industrial organization on price behavior.

For these reasons, the definition of price flexibility given above (page 458) will be modified so as to relegate changes in the elasticity of demand to the same category as changes in expectations, etc., discussed above on page 457. The expected change in price will be determined on the basis of the change in marginal cost only; a change in the elasticity of demand, like a change in expectations, will (if profits are maximized) result in what will be defined as price inflexibility. Perfect price flexibility will then be a situation in which price changes by the same percentage as marginal cost. If price moves less than marginal cost, the price is inflexible; if it moves more than marginal cost, it is excessively flexible; and if it moves in the opposite direction from marginal cost it is inversely flexible.[87]

Thus far, the discussion of price behavior has been couched entirely in terms of perfect and monopolistic competition, and the more complex area of oligopoly has not been considered. In an oligopolistic market, it would not necessarily be true that if profits are to be maximized the prices charged for a product will change in response to changes in the elasticity of demand and changes in marginal cost; that kinked demand curves can lead to price inflexibility has often been pointed out.[88] However, the determination of

[87] This definition corresponds to that implicit in Lerner's measure of the degree of monopoly, which both Dunlop and Tsiang used. Constancy in the percentage margin between price and marginal cost would indicate that prices and marginal costs moved by the same percentage.

[88] For a discussion of the possible role of the kinked demand curve and other oligopolistic influences, see George J. Stigler, "The Kinky Oligopoly Curve and Rigid Prices," *Journal of Political Economy*, October 1947, pp. 432-449, and Sho-Chieh Tsiang, *op. cit.*, pp. 69-74.

the effect of the exact conditions and assumptions under which an oligopolist is operating is not unlike the problem of change in the elasticity of demand in monopolistic competition. In the first place, the actual assumptions made by the different firms in an oligopolistic industry cannot be derived empirically, so that it is virtually impossible to establish any norm for expected price behavior in these instances. Furthermore, the very difference in behavior between firms in oligopoly and firms in perfect competition is an element which it would be interesting to measure. With the definition of price flexibility suggested above, the effects of oligopolistic conditions would tend to appear as price inflexibility, so that the importance of such an industrial organization in this respect could be assessed.

The following section will apply this definition of price flexibility to the various sectors of the economy. The statistics are purely illustrative. No attempt has been made to carry out a comprehensive empirical survey; such a study would absorb considerable resources and would involve extensive detailed analyses. Part 3 will only show what general indications do exist with respect to the empirical facts of price flexibility, and suggest the directions in which further work might proceed.

3. Cost, Price, and Output Behavior of Various Sectors of the American Economy, 1929-1932

THE depression of the thirties affords an opportunity for studying the reaction of different industrial sectors of the economy to a sharp and deep contraction in the level of income and demand. It is essential to confine this sort of analysis to short periods of time, in order to minimize the influence of such secular factors as technology, institutional change, and the growth and decline of industries. For this reason the empirical analysis in this section will generally be restricted to the period 1929 to 1932. For some sectors (agriculture and distributive trades) data for a few years after 1932 will be presented in order to throw some light on the relation of cycle to trend. For manufacturing, only 1929 and 1931 will be considered, since the basic source of data is the Biennial Census of Manufactures.

In the following presentation the flow of goods will be followed through the different stages of the production process, and in each stage the relationship among the changes in costs, prices, and output will be examined. The production of agricultural goods will be considered first, and then that part of manufacturing which is con-

464

cerned with the processing or fabrication of agricultural materials. A few of the major mineral products will then be examined, and from this the analysis will proceed to the manufacturing industries which utilize mineral products. Finally, finished goods will be followed through the distributive channels to the consumer. The exact form of the discussion will differ among sectors, depending on both the special problems arising in the particular sector and the nature of the available statistical material.

AGRICULTURE: FIELD CROPS

IN AGRICULTURE, any analysis of output and prices must take into account the special role played by variations in harvests. The effect of over-all economic fluctuations is overlaid on a pattern of good and bad harvests, so that an analysis of the effect of a fall in demand on price and output must take account of variations in crop size due solely to weather. No simple correction can be made to eliminate the influence of weather and predict what would have occurred under "normal" conditions. Even for years which can be considered "normal," the effect of previous abnormal years will be reflected in the level of stocks, and this in turn will influence prices. Rather than attempt a correction of agricultural price and output data, therefore, an indirect approach will be utilized. From an examination of the nature of cost conditions for various products, the reactions of farmers to economic fluctuations in terms of altered *inputs* will be predicted. Data on agricultural inputs will then be consulted to see how far the actual statistics agree with what would be expected.

In crop production, farmers generally provide much of the necessary labor themselves and receive as compensation the residual after other costs are paid. Hired labor is relatively unimportant; in 1929 it amounted to only 8.5 per cent of the gross cash income from marketings.[39] The farmer attempts to maximize his residual share, so that from the point of view of cost-output determination his own labor return becomes part of overhead, like his other fixed costs and the return on his capital. Marginal costs for the individual producer of agricultural crops involve primarily such things as seed, fertilizer, gasoline, twine, sacks, and small amounts of hired labor. Data for

[39] *Material Bearing on Parity Prices*, Dept. of Agriculture, 1941, p. 9, and *Income Parity for Agriculture*, Dept. of Agriculture, 1939, Part 11, Section 1, p. 5.

the year 1938[40] indicate that for most agricultural crops marginal costs would not be more than 15 to 20 per cent of total costs. Of course when the farmer reaches capacity, in the sense that all the land available to him is in full use, the marginal-cost curve will rise sharply, becoming discontinuous at this point. In the production of crops, therefore, the marginal-cost curve will be very low at points below full cultivation and will become vertical at the point of full cultivation. The farmer does produce at the point where marginal cost equals price: the vertically rising marginal-cost curve at full capacity will cut the horizontal demand curve at that point, so that it pays the farmer to produce as much as he can. With a fall in demand, the demand curve for the individual farmer will move downward, but it will still be horizontal, and unless demand should fall far enough so that price would be below the farmer's minimum marginal cost, it will still be in his interest to maintain capacity production. Even if the prices to the farmer of the elements going into marginal cost should change, the vertical portion of the marginal-cost curve will remain the same, so that regardless of changes in cost and demand the farmer will generally find it to his profit to cultivate his land fully.

Not only will the individual farmer maintain his output, but, in the face of a general fall in income and demand, marginal farmers will not leave the industry. Those marginal farmers who would if demand falls receive an inadequate residual return for their labor and fixed costs, should under normal conditions be attracted away from agriculture by superior opportunities elsewhere. But when there is a general fall in income and demand in the economy there are no employment opportunities elsewhere, and the farmer finds that he has little or no possibility of getting out of agriculture.

It seems reasonable to expect, therefore, that the number of acres harvested by farmers should not decline in the depression. Statistics on the total number of acres harvested by farmers and the acres of various crops harvested are given in Table 1.

The total quantity of crops harvested did not change appreciably in the sharp decline of income and demand from 1929 to 1932. Governmental restriction of production shows up in the year 1934. The statistics for individual crops show considerable variation, but it would be difficult to tell without further detailed analysis whether the variations are in fact due to changes in income and demand.

[40] *Agricultural Statistics, 1940.* Dept. of Agriculture, 1940, p. 568.

TABLE 1

Indexes of Acres Harvested of Various Crops, 1929-1939

Year	Total of 46 Crops	Corn	Wheat	Hay	Cotton	Oats	Barley	Potatoes
			Total Acres (thousands)					
			Indexes (1929 = 100)					
1929	356,989	97,805	68,332	55,728	43,232	38,153	13,526	3,019
1930	101	104	99	97	98	104	93	103
1931	100	109	91	100	90	105	83	115
1932	102	113	91	100	83	109	97	118
1933	93	108	78	100	68	96	72	113
1934	83	94	69	100	62	77	48	119
1935	94	98	81	100	64	104	91	117
1936	88	95	77	103	69	88	62	101
1937	95	96	102	98	78	93	74	105
1938	96	94	110	102	56	94	78	100
1939	91	91	85	105	55	87	93	100

Source: *Agricultural Statistics, 1940*, Dept. of Agriculture, pp. 541-542.

467

Some of the changes, such as the decline in cotton, are probably due to secular influences. Insofar as other crops are substituted for cotton, they too will show a secular influence. Furthermore, to the extent that farmers do react to differential price changes due to different weather conditions in various regions, the actual analysis becomes very complex. But it seems clear that the depression directly following 1929 did not cause farmers as a group to contract the total number of acres harvested.

As noted above, differences in the year-to-year yield of the various crops make it almost impossible to analyze the impact of changes in demand on price changes of agricultural goods. Nevertheless, an examination of the price indexes for the crops whose acreage is given in Table 1 can illustrate the general magnitude of the impact which the depression had upon these prices. These price indexes are shown in Table 2. It can be seen from this table that a price drop of 60 per cent was not unusual—the smallest price drop for any crop was 30 per cent, and even this was large compared with the acreage changes shown in Table 1.

AGRICULTURE: LIVESTOCK PRODUCTION

FARMERS who are primarily engaged in raising livestock may face a cost situation somewhat different from that described for the producers of field crops. To the extent that cattle are grazed on grasslands or the farmer grows his own feed, marginal cost still may be small relative to total value of product until full capacity is reached, becoming discontinuous at that point. However, if the farmer purchases his feed, marginal cost may be high relative to total value of product at all levels of output. The individual producer cannot afford to stay in business if the price of his output falls below his marginal costs, so that it might seem that price could not fall very far without causing a contraction in output. But according to the analysis of field crops presented above, the quantity of feed grown does not contract in depressions. The demand for feed is entirely derived from the demand for livestock, so that the price of feed will fall proportionally to the price of livestock. Any contraction in livestock production would immediately leave surplus feed which would drive the price of feed down until it would all be taken. Thus, taking into account the effects on the price of feed, the volume of livestock production would not be expected to contract in a depression, although of course there may be substitution among types of live-

468

TABLE 2

Indexes of Season Average Prices Received by Farmers, 1929-1939

(1929 = 100)

Year	Corn	Wheat	Hay	Cotton	Oats	Barley	Potatoes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1930	75	65	104	56	77	75	70
1931	40	38	74	34	51	61	35
1932	40	37	55	39	38	41	29
1933	65	72	67	61	80	81	63
1934	102	85	115	74	115	127	34
1935	82	80	64	66	63	70	45
1936	130	99	93	73	107	145	87
1937	65	93	75	50	72	100	40
1938	63	54	59	51	57	68	42
1939	70	65	65	54	71	82	52

Source: *Agricultural Statistics, 1940*, Dept. of Agriculture: column 1, p. 55; column 2, p. 10; column 3, p. 316; column 4, p. 108; column 5, p. 62; column 6, p. 74; column 7, p. 261.

stock, or perhaps even between some field crops and livestock. Table 3 gives the production of various kinds of livestock; from these figures it does not appear that the fluctuations in production in the period 1929-1932 were any more significant in magnitude than they were in other parts of the 1929-1939 period.

Agriculture, then, because of the nature of its marginal costs, would be expected to maintain its output in the face of a fall in demand, and this expected behavior is in fact borne out by the statistics on crops and livestock. The whole impact of a contraction in demand falls on price; price will decline until the full quantity produced can be absorbed by the economy.

MANUFACTURING: AGRICULTURAL RAW MATERIALS

MANUFACTURING plants that process agricultural raw materials are of course related to agriculture, but the nature of the relationship between price and marginal cost is quite different. In order to examine whether the price behavior of agricultural processing plants corresponds to what would be expected on the basis of changes in their marginal costs, it will be necessary to give attention to (1) the nature and shape of their cost functions, (2) the price changes in the elements of cost, and (3) the changes in their output prices.

1. Exact determination of the shape of the marginal-cost curve is not feasible for each individual industry. No reliable methods are at present available for measuring the shape of marginal-cost curves from empirical data.[41] However, another attack on the problem is possible. By making a simple arbitrary assumption about the nature of marginal cost, the process as a whole can be made operational, and any results which are derived can then be reconsidered in terms of possible alternative assumptions about the shape of marginal costs. For the purpose of the preliminary analysis, therefore, it will be assumed that marginal cost was constant over the relevant range of output, and that in the periods studied the technical coefficients of the input factors were also fairly constant. In this connection user cost of plant and equipment will be neglected, both because it is impossible to measure and because its influence on marginal costs is probably very minor. These assumptions imply that within relevant production ranges each additional unit of output would require a specific fixed amount of labor and materials

[41] Hans Staehle, "The Measurement of Statistical Cost Functions: An Appraisal of Some Recent Contributions," abstracted in *American Economic Review*, November Supplement, 1942, p. 349.

TABLE 3
Indexes of Livestock and Dairy Products, 1929-1939

Year	Cattle on Farms (1)	Cattle Slaughtered (2)	Calves Slaughtered (3)	Hogs on Farms (4)	Hogs Slaughtered (5)	Chickens on Farms (6)	Eggs (7)	Milk (pounds) (8)
			Total Number (thousands)					
1929	58,877	12,038	7,406	59,042	71,012	449,006	37,921,000	98,976,000
			Indexes (1929 = 100)					
1930	104	100	104	94	95	104	103	101
1931	107	100	108	93	98	100	101	104
1932	112	99	106	100	101	97	96	105
1933	119	108	114	105	103	99	94	106
1934	126	129	135	99	97	97	91	103
1935	116	122	129	66	65	87	88	103
1936	115	134	137	72	83	89	90	104
1937	113	127	136	72	76	94	99	104
1938	112	123	123	75	83	86	98	108
1939	113	120	119	83	93	92	101	110

Source: *Agricultural Statistics, 1940*, Dept. of Agriculture: column 1, p. 344; column 2, p. 359; column 3, p. 359; column 4, p. 364; column 5, p. 375; column 6, p. 461; column 7, p. 476; column 8, p. 428.

irrespective of the output level, and the relative changes in the prices of capital, labor, and materials would not in the short run cause significant substitutions among the input elements. At the end of the analysis, these assumptions will be reviewed by considering what effect other kinds of assumptions would have on the analysis.

2. With an assumed constancy of marginal cost and fixed relations among the input factors of labor and materials for incremental changes in output, it is possible to construct a price index of the change in marginal cost from available empirical materials, as follows. Under the given assumptions, labor and materials costs would have approximately the same relative importance in both marginal costs and average direct costs.[42] Therefore, if the price change in labor cost per unit and the price change in materials cost per unit were combined according to their relative importance in direct costs, an approximation of the price change in marginal cost should be obtained.[43]

3. The changes in output prices can best be computed from the same body of statistical data that was used to derive direct costs. It is more meaningful to consider value per unit of output than quoted prices. Such factors as shifts in the composition of output, the importance of discounts, and the existence of special prices for some customers will affect total receipts and so will be reflected in value per unit of output, whereas they might well be omitted in an analysis of quoted prices. In the census statistics, furthermore, the value of product which is recorded for an industry is from the same set of plant questionnaires that furnish the data on cost of materials and

[42] In the following discussion the term "direct costs" will be used to denote the census classifications of (1) wages paid to direct labor, plus (2) cost of materials used. Changes in average direct costs can be obtained by dividing the total change by an index of output change. It is assumed that these direct costs do not contain any overhead labor or materials costs. In Tsiang's terminology, these direct costs are referred to as prime costs.

[43] This procedure is somewhat similar to Dunlop's calculation of the price changes in marginal cost by using census weights for combining price indexes of wages and raw materials. The main difference between the two approaches is that instead of utilizing Dunlop's indexes for wage rates and raw materials, the present calculation derives average labor cost per unit and average materials cost per unit from the census statistics. In contrast with Dunlop's assumptions, it is interesting to note that Neal and Tsiang make the assumption that average direct cost is equal to marginal cost, and thus use the census statistics directly for computing the change in marginal cost. The actual statistical result achieved by this process is identical with the other method. However, it should be pointed out that their assumption that average direct cost equals marginal cost is overly restrictive, since for the process to be legitimate it is only necessary that the change in average direct cost be equal to the change in marginal cost.

wages paid. The use of a matched set of data makes more reasonable the assumption that the same industrial classifications, the same time period, and the same concepts of output were used in obtaining both costs and receipts. It was on this basis that the data in the Census of Manufactures were used to obtain approximations of the changes which took place in marginal cost, price, and output for various industries in the period 1929-1931.

Table 4 shows the percentage changes in labor cost per unit, materials cost per unit, direct cost per unit, value per unit, and out-

TABLE 4

Percentage Change in Unit Costs and in Output, Various Agricultural Processing Industries, 1929-1931

Industry	Labor Cost	Materials Cost	Direct Cost	Value	Output
	(per	unit)			
Flour	—15	—42	—41	—38	—9
Meat packing	—14	—35	—33	—33	—5
Butter	—25	—39	—39	—39	+2
Cane-sugar refining	0	—12	—11	—10	—13
Cotton goods	—13	—42	—32	—34	—22
Woolen and worsted goods	—12	—32	—27	—26	—19
Women's clothing	—24	—25	—25	—26	+3
Textile gloves	—16	—31	—27	—27	—33
Cloth hats	—18	—20	—19	—21	—40
Leather	—3	—37	—32	—30	—19
Leather boots and shoes	—13	—22	—20	—20	—16

Source: Cost and value data, *Biennial Census of Manufactures: 1933*, Bureau of the Census, pp. 42-44, 133-135, 380; output data, Solomon Fabricant, *The Output of Manufacturing Industries, 1899-1937* (National Bureau of Economic Research, 1940), pp. 385, 387, 395, 404, 427, 430, 436, 437, 457, 462, 474.

put for a number of manufacturing industries which process agricultural goods. Labor cost in this table relates to production workers only. The wage and salary payments made to administrative, sales, technical, office, and supervisory personnel (with the exception of working foremen and gang bosses) are all excluded. The output data given in Table 4 have been taken from Solomon Fabricant.[44] They may not be fully satisfactory for many industries; to the extent that the quality of a product changes while the unit in which output is measured does not change, the real output rate may be obscured. Fortunately, it is not crucial that the output indexes be truly valid. The major point of the analysis is to examine the *rela-*

[44] Solomon Fabricant, *The Output of Manufacturing Industries, 1899-1937* (National Bureau of Economic Research, 1940), Appendix B.

tive changes in labor cost, materials cost, and value per unit within each industry; the output index is used only to reduce the total figures to averages. The relationship among labor cost, materials cost, and value per unit will be the same regardless of the output index, since for any one industry the total figures are all divided by the same constant. The only reason for using an output index at all was to get some idea of similarities and differences among the different industries. Only if the output indexes possess a relatively high degree of validity will these interindustry comparisons be meaningful, and in any case very little accent should be placed on small differences among industries.

The industries shown in Table 4 were chosen because they involve the use of a number of different agricultural products, and also because they illustrate a number of different analytic points. The most outstanding findings which emerge from the table as a whole are that labor cost dropped less than materials cost in all instances, and that together these direct costs dropped by about the same percentage as price. Thus if the change in direct costs is taken to be an approximation of the change in marginal cost, price in the industries shown moved directly with marginal cost.

A more detailed examination of Table 4 brings out some additional points of interest. There is considerable variation among the industries in the extent of the drop in labor costs, and no simple explanation of the causes of such variation is apparent. Differential changes in wage rates or in the wage structure might account for some of the variation, but probably of equal importance are the differences in productivity changes among industries, the substitution of the owner's labor for hired labor in small firms (for example, the butter industry), the differential rate of contraction of firms having high labor costs compared with firms having lower labor costs, and finally the doubtful validity of the output index as an indicator of real output changes.

The variations among the industries in the changes in materials cost are somewhat more easily explained. The drop in materials cost is greatest for those industries that directly consume unprocessed farm products, and is less for those industries that utilize partly processed agricultural products. Thus, the drop in materials cost was substantial for flour, meat packing, butter, cotton goods, and leather, and somewhat less for women's clothing, textile gloves, cloth hats, and boots and shoes. The woolen and worsted industry is hard to classify because it is composed of a number of different sub-

industries, some of which supply various intermediate products to later processing stages, and so represents a mixture of plants at various stages of processing. Cane-sugar refining has been included to illustrate what happens in an agricultural processing industry when materials prices are less variable. Most cane sugar for refining is imported, and since this import price did not drop as much as the prices of other agricultural materials the price of refined sugar did not drop as much as the prices of the other processed agricultural goods shown.

A separate examination of the drop in labor costs and the drop in materials costs is not sufficient to account for all the variations in final goods prices in the various industries. The relative importance of labor and materials in the production process must be taken into account, in order to give an accurate appraisal of the change in direct costs. The significance of this point is well illustrated by a comparison of the butter and the cotton industries. The percentage drop in labor costs for the butter industry (25 per cent) was considerably greater than it was for the cotton industry (13 per cent). The drop in materials costs was about the same for the two industries (butter, 39 per cent; cotton, 42 per cent). Because of the greater importance of labor in the cotton industry, the output price of cotton goods dropped somewhat less (34 per cent) than it did for butter (39 per cent). Materials were so much more important than labor in the butter industry that the output price of butter changed by exactly the same percentage as did materials.

Finally, there are significant differences in the degree to which prices (value per unit) dropped in the various industries shown in Table 4; these differences can all be explained adequately in terms of (1) the changes in labor costs and materials costs and (2) the relative importance of labor and materials in the production process. The higher the degree of fabrication, the more important labor becomes in relation to materials and the more closely will price change follow the change in labor cost. The prices at which processed agricultural goods are sold to distributors, therefore, will depend in large part on how highly they are fabricated before they are ready for the consumer. The variations in relative price changes even within the agricultural processing industries are not inconsiderable. Excluding cane-sugar refining, the drop in finished-goods prices in Table 4 ranges from 20 per cent for boots and shoes to 39 per cent for butter. But, insofar as output prices shown in Table 4 do tend to move with cost, they can all be called flexible, despite the fact

475

that the amplitude of change differs considerably from industry to industry.

As noted above, the use of the change in direct cost per unit as an indicator of the change in marginal cost involves the assumptions of constant marginal costs and a lack of substitution among capital, labor, and materials in the period under study. It will be useful at this juncture, therefore, to examine the effects of different assumptions about marginal cost upon the analysis.

If the marginal-cost curve, instead of being constant, were upward sloping (i.e. marginal cost increasing with increases in output) the drop in direct costs shown in Table 4 would be an understatement of the actual drop in marginal costs. Under such circumstances, instead of the roughly equivalent movement of marginal costs and prices indicated in Table 4 by the change in direct costs and prices, marginal cost would in fact generally have fallen more than prices, so that according to the definition of price flexibility adopted above prices would be somewhat inflexible. Conversely, if marginal costs were downward sloping (i.e. marginal costs decreasing with increasing output) the fall in direct costs shown in Table 4 would overstate the actual drop in marginal costs, and prices would be overly flexible.

In assessing the suitability of the assumptions made earlier with respect to the probable shape of the marginal-cost curves for the industries shown in Table 4, the following points should be borne in mind. For a good many industries, it does not seem reasonable to expect that the amount of materials required per unit of output should vary in any manner except directly with output—especially, for example, in such industries as flour, butter, and cane-sugar refining. In these industries, too, labor costs are not a very large proportion of direct costs, so that any variation in the amount of direct labor required per unit of output as output increases would have relatively little influence on the level of marginal cost. And in certain other industries, it may be true, as Reynolds has suggested for cotton textiles,[45] that the fixed factors which are usually assumed to be indivisible are in fact highly divisible. Many plants are made up of batteries of similar machines, each of which can be operated as an independent unit. If the machines are of equal efficiency, the putting into use of successive units need not involve any increase or decrease in marginal cost. Finally, shifts in the marginal-cost func-

[45] Lloyd G. Reynolds, "Relations Between Wage Rates, Costs, and Prices," *American Economic Review*, March Supplement, 1942, pp. 275-301, esp. p. 277.

tion due to technological changes are somewhat less likely to have taken place in the downswing period under consideration (1929-1931) than in other periods. All things considered, an attempt to arrive at more realistic assumptions about the shape of the marginal-cost function (and technological change) in many of the agricultural processing industries would probably result in refinements which would be matters of detail rather than of consequence. This would not be true in every case, but it would be true in the majority of cases.

MINING

THE minerals industries present yet a different set of problems. Unfortunately, in this sector any analysis is seriously hampered by the lack of adequate data. The various types of mining, furthermore, cannot be treated as one homogeneous group in the way agricultural crop production was. Each particular branch of the mineral industry has its own peculiarities.

In coal mining, labor cost is even more important than it is in most manufacturing industries. For the year 1929, labor costs represented about 60 per cent of the value of the product in both the anthracite and bituminous industries.[46] Materials costs amount to about 15 per cent of the value of the product. It is difficult to find data showing how materials costs changed from 1929 to 1932 or what materials were used, but very probably few if any direct products of agriculture were involved. To the extent that materials used were highly processed goods, their costs should change in about the same way as labor costs. And in any case, since labor costs constitute 80 per cent of the total direct cost in coal mining, a relatively small error would be introduced by assuming that total direct costs moved about the same way as labor costs. The data in Table 5 have been drawn up on this assumption. This table shows that prices and labor costs did move together for the period 1929-1932, a period in which production of coal was cut back sharply.

The data on iron-ore production are difficult to interpret because of the vertical integration of the industry. Quoted prices of iron ore did not change at all throughout the depression, but even though these unchanging prices did nominally appear on the books of vertically integrated firms, their significance may be questioned. The separation of the accounts of the operation of iron-ore mining from

[46] *Abstract of the Fifteenth Census of the United States*, Bureau of the Census, 1933, p. 583.

the production of steel within the same firm is of necessity an arbitrary procedure, and the resulting statistics represent imputations which are irrelevant from the point of view of the total profits of the firm.

TABLE 5

Indexes of Labor Cost and Value per Unit in the Extractive Industries, 1929-1932

Industry	(1929 = 100)		
	1930	*1931*	*1932*
Anthracite coal:			
Labor cost per unit	102	95	82
Value per unit	98	95	84
Output	94	81	68
Bituminous coal:			
Labor cost per unit	95	86	71
Value per unit	95	87	72
Output	87	71	58
Crude petroleum:			
Labor cost per unit	97	73	56
Value per unit	94	51	68
Output	89	84	78
Metalliferous mining:			
Labor cost per unit	104	90	84
Value per unit	90	78	73
Output	75	50	26

Source: *Statistical Abstract of the United States, 1939,* Dept. of Commerce, p. 340; *Statistical Abstract of the United States, 1940,* Dept. of Commerce, pp. 784, 791, 804.

The production of petroleum and nonferrous metals differs from coal production in that the differing richness of deposits is a very important factor. No generalization can be made about cost curves in either industry. Some oil wells or mines utilize low-grade deposits and have relatively high marginal costs in the form of labor and some materials. Other wells or mines are much richer, having very low marginal costs and yielding considerable rent. With a fall in demand, high-cost producers will be forced to abandon operations completely, while the low-cost producers can continue to operate. This situation is well illustrated by the Michigan copper-mining industry. In 1929, the yield of copper per ton of ore was 24.5 pounds; in 1930, 25.4 pounds; in 1931, 33.1 pounds; and finally in 1932, 47.6 pounds.[47] Similarly, output per man-hour in the production of crude pe-

[47] *Mineral Resources of the United States, 1931,* Geological Survey, 1934, Part 1, p. 246; and *Minerals Yearbook, 1932-33,* Bureau of Mines, p. 146.

478

troleum was 35 per cent[48] greater in 1932 than it was in 1929, and in lead and zinc mining it was 68 per cent greater.[49] High-yield deposits thus account for a relatively larger share of the total output of the industry when demand falls. The cost curves of a high-yield producer are very much like those of a farmer. Marginal costs are relatively low, becoming discontinuous (i.e. vertical) at capacity production. With a fall in demand, a high-yield mine, in order to maximize *present* income, should continue full production; although price has fallen, price would still be equal to marginal cost.[50] In considering how price should move relative to *direct* cost actually incurred with a fall in demand, however, one would expect price to come closer to direct cost, since direct cost actually incurred lies on the portion of the curve just before the vertical rise. Thus, the fall in price would tend to be greater than that in actual direct cost. Exact prediction of the movement of price relative to direct cost would require engineering knowledge of the difference in the richness of deposits in the industry and economic knowledge of the structure of the industry. The data for petroleum and metalliferous mining in Table 5 show that, as would be expected in these industries, if the change in labor cost is again taken as an index of the change in direct costs prices fell faster than direct costs.

It will be apparent that this discussion of the mineral industries has in fact been concerned with the shape of the supply curves in the various industries. For coal mining and probably also for quarrying, the abundance of deposits of roughly similar productivity leads to supply curves for these products that are almost horizontal for a wide range below capacity production. If costs do not change, a fall in demand would probably result in a fall in output rather than in price. It is only if the supply curve shifts downward due to falling labor costs that any significant price decline can take place. In contrast, those minerals which are found in deposits of widely varying richness will have rising industry supply curves, and a fall in demand will intersect the supply curve at a lower point, thus permit-

[48] *Production, Employment, and Productivity in the Mineral Extractive Industries, 1880-1938*, National Research Project, Works Project Administration, p. 63.

[49] *Employment and Output per Man in the Mineral Extractive Industries*, National Research Project, Works Project Administration, 1940, Report S-2, p. 74.

[50] In some cases the owner of a very valuable natural resource might prefer shutting down operations long before price fell to the point where it equalled direct operating costs. Since minerals are exhaustible resources, mining involves a cost akin to user cost, and if the mine is very rich and the producer has high future expectations this user cost might be great.

ting a price fall as well as a contraction in output. Any downward shift in costs, of course, would increase the price drop and permit a larger output than would otherwise be possible.

MANUFACTURING: MINERAL RAW MATERIALS

THE processing of mineral materials by manufacturing industries can be examined in a manner similar to that used for the processing of agricultural materials. Table 6 presents the relevant data for a

TABLE 6

Percentage Change in Unit Costs and in Output, Various Mineral Processing Industries, 1929-1931

Industry	Labor Cost	Materials Cost	Direct Cost	Value	Output
			(per unit)		
Lime	—18	—17	—18	—20	—22
Clay products	—14	—7	—11	—11	—52
Petroleum refining	—10	—34	—33	—36	—9
Fertilizer	—13	—15	—14	—15	—22
Tin cans	—20	—16	—17	—18	—8
Wire drawn from purchased rods	—4	—29	—24	—24	—49
Nonferrous metal products	—20	—45	—41	—38	—41
Washing machines	—24	—24	—24	—22	—21
Buttons	—14	—18	—16	—17	—12
Pens	—1	—24	—17	—16	—17
Clocks and watches	—4	—5	—5	—3	—26
Manufactured heating and illuminating gas	—12	—12	—12	—1	—8

Source: Cost and value data, *Biennial Census of Manufactures: 1933,* Bureau of the Census, pp. 308, 358, 397, 427, 428, 491, 492, 523, 631, 632; output data, Solomon Fabricant, *The Output of Manufacturing Industries, 1899-1937* (National Bureau of Economic Research, 1940), pp. 497, 517, 531, 522, 552, 553, 556, 559, 578, 593, 596.

number of different industry groups. Like the agricultural processing industries, the mineral processing industries in Table 6 show a correspondence between direct costs and prices, with one significant exception. This exception is manufactured heating and illuminating gas; in this industry direct costs dropped 12 per cent while price dropped only 1 per cent. The reason for this discrepancy is obvious: gas is a public utility and its rates are fixed. It has been included in the selection of industries in Table 6 to show how an inflexibility of prices relative to costs would show up, even in a case where costs were not particularly flexible.

The mineral processing industries are very different from the ag-

ricultural processing industries with respect to the magnitude and consistency of the drop in materials cost. For the agricultural processing industries it was noted that materials costs dropped considerably, and in all cases more than labor cost. In contrast, the materials costs for lime, clay products, fertilizer, tin cans, buttons, clocks and watches, and manufactured gas dropped less than for any agricultural processing industry, and in some of these cases fell less than did labor costs. The industries which exhibit this smaller drop in materials costs are either those which obtain a significant portion of their materials from those extractive industries in which the price drop would be expected to be small, or else those which use more highly fabricated materials, which already have a considerable amount of labor cost in them. Petroleum refining and nonferrous metal products behave differently from the industries just listed, in that their material costs do drop significantly. Again this is what would be expected, because of the nature of the mineral industries supplying them. The remaining industries require further explanation. Wire drawn from purchased rods uses both steel and copper. The drop in materials cost for the wire industry, therefore, should fall somewhere between those of these two raw materials. If the fall in materials cost for tin cans and the fall in price of nonferrous metal products are taken as indicators for steel and copper respectively (since nothing better is available), materials cost in the wire industry does behave as expected. For washing machines, labor cost declines more than it does for any other industry in Table 6, which is hardly to be expected. The explanation here may lie in the lack of validity of a production index which does not take into account a change in the quality of the product. If cheaper washing machines were produced in 1931, the real output would have fallen more than indicated by the production index, and the declines in both labor cost and materials cost would have been smaller than appear here.

The conclusion that is reached from an examination of these mineral processing industries, then, is in accord with that reached for agricultural processing industries. The prices of producers tend to move in accordance with their direct costs, computed as the weighted average of labor and materials costs. In some of the mineral processing industries, a fall in demand does not produce a sharp decline in materials cost; instead the decline in materials cost is about equal to the decline in labor cost so that price, materials cost, and labor cost all move together. In those cases where materials cost does

decline sharply, the reaction will be like that in the agricultural processing industries. The higher the degree of fabrication the more closely the change in the price of the product will approach the change in labor cost, since labor cost is relatively a more important part of the total value of the product.

Again, it should be noted that the use of the change in direct cost as an indicator of marginal cost in this analysis implies all the restrictive assumptions that were discussed above with reference to the agricultural processing industries. It is quite possible that a number of the industries listed in Table 6 did not have constant marginal costs and fixed technical coefficients among their inputs in this period. If the quantitative importance of these deviations was not overly great, however, the changes in direct costs may still reflect the approximate change in marginal costs. In some instances, it may even be true that some of the discrepancies shown in Table 6 would disappear if a better approximation to the change in marginal costs could be obtained. Thus, for instance, if the marginal-cost function in nonferrous metal products actually declined with expanding output, the drop in direct cost shown in Table 6 would overstate the actual drop in marginal cost, so that marginal cost and price might have moved more closely together than did direct cost and price.

MANUFACTURING: SUMMARY

UP TO this point in the analysis, specific industries in manufacturing have been discussed to illustrate particular points, but there has been no discussion of how well manufacturing as a whole fits this pattern. It would not be meaningful to combine all of manufacturing, for reasons which have already been pointed out. The aggregation of agricultural processing industries with mineral processing industries, and materials-producing industries with those making highly fabricated goods, would, because of the relative shifts in the importance of these various groups, obscure the very relationships which were being investigated. Some disaggregation is therefore necessary. To cover all of manufacturing, and yet preserve to some extent the differences among the different major industries, the 16 major industry groups used in the census classification are presented in Table 7. For three of the industry groups, production indexes are not available.

Generally speaking, the correspondence between the drop in direct costs and the drop in prices for the various industries is quite close. In 7 of the 16 industries, the drop in price was within one per-

centage point of the drop in direct cost. In 5 industries prices dropped more than direct costs, and in 4 industries less. The 2 industries in which the discrepancy was greatest were chemicals and rubber; in both of these price would have been expected to fall more than it did. In forest products, iron and steel, and nonferrous metal products, price dropped somewhat more than would have been expected. There does not seem to be any single simple explanation that can account for these divergences.

TABLE 7

Percentage Change in Unit Costs and in Output,
Major Industry Groups, 1929-1931

Industry Group	Labor Cost	Materials Cost (per unit)	Direct Cost	Value	Output
Food and kindred products	—11	—30	—28	—25	—9
Textiles and their products	—18	—32	—28	—28	—13
Forest products	—13	—10	—11	—15	—45
Paper and allied products	—14	—18	—17	—16	—14
Printing, publishing, and allied industries	+1	—10	—6	—6	—16
Chemicals and allied products	—9	—23	—21	—15	—15
Products of petroleum and coal	—4	—27	—25	—25	—17
Rubber products	—22	—37	—33	—21	—31
Leather and its manufactures	—12	—28	—24	—25	—18
Stone, clay, and glass products	—13	—10	—11	—11	—34
Iron and steel and their products	+2	—7	—5	—8	—50
Nonferrous metals and their products	—8	—41	—37	—33	—42
Transportation equipment	+9	+3	+5	+5	—55

INDUSTRIES WITH NO OUTPUT INDEXES

Industry Group	Total Labor Cost	Total Materials Cost	Total Direct Cost	Total Value
Machinery	—48	—44	—46	—48
Railroad repair shops	—68	—54	—62	—58
Miscellaneous	—61	—63	—62	—68

Source: Cost and value data, *Biennial Census of Manufactures: 1933*, Bureau of the Census, pp. 42, 133, 218, 262, 280, 307, 358, 372, 380, 397, 426, 491, 522, 593, 618, 630; output data, Solomon Fabricant, *The Output of Manufacturing Industries, 1899-1937* (National Bureau of Economic Research, 1940), pp. 410, 460, 475, 481, 485, 486, 514, 519, 535, 543, 556, 565, 592.

Aggregation like that of Table 7 has both advantages and disadvantages in drawing conclusions regarding the behavior patterns of individual firms. Since many firms are included in the aggregate,

the effect of normal random variance is reduced, and the average change for the group as a whole takes on more significance. On the other hand, aggregation combines what are essentially unhomogeneous groups. Any single industry includes a variety of products, and some of these products will have wider margins between direct cost and price than others (margin in this sense equals price minus direct cost divided by price). If with a fall in demand the rates of contraction of high-margin and low-margin products are different, the aggregate would show a change in the average margin even if the margin for every individual product remained unchanged. The use of finer industry classifications in Tables 4 and 6 was in part an attempt to avoid some of these aggregation problems. Even with a single homogeneous industry, however, the aggregation problem would not be entirely overcome. Margins in large firms may differ from those in small firms, and the rate of contraction of firms in a depression may be related to size. Or, margins for plants in one part of the country may be different from margins in another part, and the contraction in output may be more severe in one section of the country than in others. For an accurate appraisal of the behavior of the relation between direct costs and prices, it would in fact be necessary to make the analysis product by product and plant by plant throughout the country. Examination of a few representative individual plants, furthermore, would not be sufficient; every plant has special conditions, and there is ample evidence that the change in margins from year to year is highly variable in individual cases. What would be required would be distribution curves of margins for all the plants and products in a given industry. Preliminary investigation along these lines has indicated that, although there is wide dispersion in the behavior of individual plants, there is a central tendency, and this central tendency normally is around the point of zero change in margins (i.e. the gap between price and direct cost is a constant percentage of price).

This discussion is not intended to imply that all the discrepancies between the changes in direct costs and the changes in price which appear in Table 7 can in fact be explained by problems of aggregation. On the contrary, some of the actual correspondence between direct cost and price change may well be the result of the fact that a number of essentially dissimilar groups have been combined, and in doing so their differences have been averaged out.

There are a number of other considerations, besides that of aggregation, which should be taken into account in appraising these

484

statistics. First, the records upon which the statistics are based are accounting records, and for small firms especially records of labor cost and materials cost are not kept uniformly and consistently from year to year or from firm to firm; similarly, the valuation of inventories on different bases will obviously lead to difficulties in interpretation. Secondly, price would be expected to move with marginal cost only when there have been no technological changes, no significant institutional changes, and no secular growth or decline. Over a two-year period some such changes are bound to occur, and to the extent that they do margins could be expected to shift. Finally, it has been assumed that marginal cost corresponds to direct cost, with direct cost computed as average labor and materials cost per unit of output (i.e. that all production functions are linear). In actual fact, the productivity of labor in many industries is affected by the scale of output,[51] and in such cases the change in direct cost may not be a good indicator of the change in marginal cost and so should not necessarily agree with the change in price. Any adequate analysis of the discrepancies between the change in direct costs and the change in prices in manufacturing industries must take all of these factors into account.

DISTRIBUTIVE TRADES

THE products processed by the manufacturer, and some of the products coming direct from the farmer, must pass through the channels of distribution. Direct costs in the distributive trades are primarily the goods purchased for resale to other distributors or to consumers. The labor costs and other materials costs and the rent can generally be considered fixed over rather wide ranges of output, so that the purchase price of goods for resale (including transportation) is fairly closely identified with the industry's marginal cost. Here again, the analysis is hampered by the fact that very little information is available, but something can be done with the concept of gross margins. In the distributive trades the difference between the prices paid by the distributors for goods and the prices received by them for the same goods is normally expressed as a percentage of final price and is termed gross margin. This concept differs from markup in that it is calculated on the basis of actual receipts (including discounts, sales, etc.) rather than on the basis of quoted prices. Table 8 gives

[51] In this connection see the studies of the *Production, Employment, and Productivity in 59 Manufacturing Industries,* National Research Project, Works Progress Administration, 1939.

the percentage gross margins for a variety of different distributors. For almost all groups there is no significant change in gross mar-

TABLE 8

Percentage Gross Margins in the Distributive Trades, 1929-1932

Type of Establishment	Number of Stores	Percentage Gross Margin			
		1929	1930	1931	1932
Wholesale grocers, Ohio	17	12	11	11	10
Wholesale machinery supply	35-44	24	24	24	25
Meat markets, Chicago	34-50	22	25	28	29
Food chains	17,754-33,147	20	n.a.	22	22
Clothing stores, sales, to $100,000	n.a.	35	36	34	33
Specialty stores	70-85	34	34	33	32
Chain shoestores	661-1,361	34	n.a.	n.a.	33
Variety chains	1,579-2,188	33	n.a.	32	31
Department stores, sales, to $10 million	21-30	34	34	34	34
Department stores, sales, $4-$10 million	44-54	34	34	33	33
Department stores, sales, $1-$4 million	110-142	32	32	32	32
Department stores, sales, $500,000-$1,000,000	57-95	31	31	31	31
Department stores, sales, $250,000-$500,000	115-167	29	30	29	29

n.a. (not available).

Source: M. P. McNair, S. F. Teele, and F. G. Mulhearn, *Distribution Costs* (Harvard University Press, 1941), pp. 419, 583, 431, 387, 246, 222, 285, 288, 112, 113, 108, 109, 106, 107, 105.

gins in the period 1929-1932. The one major exception is Chicago meat markets; gross margins here rose from 22 per cent in 1929 to 29 per cent in 1932. Whether or not meat markets are a significant exception cannot really be determined on evidence at present available, but by and large it does not appear that the gross margins in the distributive trades change violently with a contraction in demand and costs. In other words, prices charged by the distributive trades tend to follow closely the prices they have to pay for the goods they sell.

SUMMARY

THIS examination of the different industrial sectors of the economy during the period 1929-1932 indicates that their actual behavior was consistent with the explanations which would be offered by a student taking his first course in value theory. At no stage in the discussion has it been necessary to consider the effect of industrial concentra-

tion to explain the relation between the fall in direct costs and the fall in price. The major determinants of price changes, according to both the theory and the empirical findings, should be (1) the relative importance of agriculture in the economy, and the extent to which demand for agricultural goods falls; (2) the nature of mineral resources and the importance of labor cost in mining, coupled with the extent to which demand for mineral goods falls; (3) the fall in the wage rate and its effect on labor cost;[52] and (4) the shape of production functions.

Generally speaking, economists are accustomed to taking as given the technological and institutional elements of the economic system. The relative magnitude of agriculture in the economy, the distribution of mineral resources, and the shape of production functions are all of this nature. The change in demand and the change in the wage rate and its relation to labor cost, however, are more properly economic problems. Income analysis in its more recent forms attempts to predict the changes in the patterns of consumption and investment in the economy; if this attempt becomes successful it should be possible by studying behavior patterns to predict changes in demand for various kinds of final goods and trace these back to the derived demands for agricultural and mineral goods.

An adequate theory of the wage rate is, however, still lacking. This lack is much more serious than might at first appear. Throughout the analysis up to this point, it has been implicitly assumed that when changes in direct costs agreed with changes in prices, it was not because the direct costs themselves were determined by prices. Should the causality run in the opposite direction, i.e. should direct costs be determined by prices instead of by other forces, the question of what determines prices would still remain open. It is probable that the price of a producer's final product does not affect the cost of his materials except through its effect on his demand for the materials, but this is not necessarily true of labor cost. If the wage rate in a plant is sensitive to the price of the final good which the plant produces rather than to the profit or loss of the plant or to the change in output, it may well be that costs will cease to

[52] To the extent that differences in the behavior of the wage rate might be explained by differences in industrial concentration, however, it is still possible that industrial concentration would in fact affect prices. For an analysis of monopoly as a possible determinant of interindustry wage structure, see Joseph W. Garbarino, "A Theory of Interindustry Wage Structure Variation," *Quarterly Journal of Economics*, May 1950, pp. 282-305.

be an explanation of prices, and that instead it will be possible to predict wage changes by changes in prices. This matter would bear further looking into, and until some adequate explanation of what wage rates do depend on can be given, the theory itself is incomplete.

As a final qualification of the empirical findings, it should be noted that the relationships observed for the period 1929-1932 may no longer be relevant.[53] If, for example, there is considerable public pressure to limit the profits of producers, it would be quite possible that producers would not operate so as to maximize profits in the short run. Furthermore, it may no longer be true that the price of agricultural materials will rise and fall more than labor cost. Industry-wide bargaining and the sensitivity of labor to changes in the cost-of-living index may render wages more highly variable, at least in the upward direction,[54] and in the downward direction agricultural price supports may prevent the normal fall in agricultural prices. Finally, governmental action in imposing rationing and price control might have a strong effect on price-cost relationships. For all these reasons today's pattern may be quite different from the pattern of twenty years ago.

The relevance of the findings in Part 3 for the topic of price flexibility as it was conceived by Means and those who came after him needs no particular elaboration. The major patterns of price behavior in the economy can be adequately explained in terms of factors other than industrial concentration. This is not to say that in some instances the consideration of the industrial organization of an industry might not be necessary, nor that in explaining wage-price relationships monopoly and monopolistic relationships need

[53] The empirical evidence for the period 1929-1932 does not throw any light on what would happen with rising income and demand. Periods of upswing are more difficult to analyze because the movement tends to be slower and because technology is more apt to change. An examination of the relatively rapid upswing of 1921-1923 has been made, however, and it appears that price behavior in this upswing was in general accord with what would be expected.

[54] In this connection the significance of guaranteed annual wages is interesting. Insofar as guaranteed annual wages remove some of the cost-of-production workers from marginal cost and make their wages a fixed cost which must be paid regardless of the level of operation, the importance of labor in marginal cost would be reduced over certain ranges of output. At points of production above the level consonant with the guaranteed wage, however, the normal relation of price to direct labor and materials cost would continue. If materials costs in the industry in question are variable, prices with guaranteed annual wages would tend to be more variable at points under "normal" output, but not different at points above "normal" output.

not be explored. What can be said, rather, is that *even if monopoly did not exist* a price system very similar to the existing one would emerge as long as wages were less flexible than agricultural prices and some mineral prices.

4. *The Theory of Price Behavior and Aggregative Price Indexes*

IN THE preceding section, the theory of price behavior has been analyzed in terms of a disaggregation of the economy. There still remains, however, the question whether this theory of price behavior is compatible with the aggregative price indexes covering the economy as a whole. For an explanation of price behavior to be completely satisfactory, it is necessary to show that it can in fact explain both micro- and macroeconomic behavior. This final section, therefore, will consider whether or not the theory of price behavior outlined in the preceding section provides a valid explanation of (1) the behavior of component prices in consumer-price indexes, (2) the behavior of the wholesale-price index, and (3) the relative movements of real and money wage rates.

THE CONSUMER-PRICE INDEX

THE major components of the consumer-price index which are available for the United States are food, apparel, rent, gas and electricity, other fuels, ice, house furnishings, and miscellaneous. The price indexes for these components are shown in Table 9 for the period 1929-1951, along with the cumulative decline from 1929 to various stages of the depression and the cumulative rise from 1933 to various stages of recovery. The price indexes for food show the greatest cumulative movement in each stage. This is of course what would be expected, since foods are agricultural products that reach the consumer without any very great degree of processing by labor. The indexes for apparel move somewhat less than those for food; again this would be expected since, although most of the materials involved come from agriculture, the goods go through more processing by labor before they reach the consumer. House furnishings are somewhat similar to apparel, but contain more non-textile components. In the first two years of the decline house furnishings did drop more than apparel, but by 1932 and 1933 the drop in apparel was very much greater. Rent presents a special problem. In the earlier stages of the depression the rent index did not drop as much as food, apparel, or house furnishings, but by 1933 it had dropped considerably more than house furnishings and

TABLE 9

Consumers-Price Index by Commodity Groups, 1929-1951, and Cumulative Percentage Changes, 1929-1941

Year	Total	Food	Apparel	Rent	Gas and Electricity	Other Fuels	Ice	House Fur- nishings	Miscel- laneous
				INDEXES	(1935-1939 = 100)				
1929	123	133	115	141		113		112	105
1930	119	126	113	138		111		109	105
1931	109	104	103	130		109		98	104
1932	98	87	91	116		103		85	102
1933	92	84	88	100		100		84	98
1934	96	93	96	94		102		93	98
1935	98	100	97	94	103	99	n.a.	95	98
1936	99	101	98	96	191	199	n.a.	96	98
1937	103	105	103	101	99	191	n.a.	104	101
1938	101	98	102	104	99	101	n.a.	103	102
1939	99	95	101	104	99	99	100	101	101
1940	100	97	102	105	98	102	100	101	101
1941	105	106	106	106	97	108	104	107	104
1942	117	124	124	109	97	115	110	122	111
1943	124	138	130	108	96	121	114	136	116
1944	126	136	139	108	96	126	116	136	121
1945	128	139	146	108	95	128	116	146	124
1946	139	159	160	109	92	137	116	159	129
1947	159	193	186	111	92	156	126	184	140
1948	171	210	186	117	94	183	135	195	150
1949	169	202	190	121	97	188	140	189	155
1950	172	205	188	131				190	157
1951	186	228	205	136				211	165
				CUMULATIVE PERCENTAGE CHANGES					
1929-1930		—5	—2	—2		—2		—3	0
1929-1931		—22	—10	—8		—4		—12	—1
1929-1932		—35	—31	—18		—9		—24	—3
1929-1933		—37	—34	—31 } —44		—13		—25	—7
1933-1934		+11	+9	—6 }		+2		+11	0
1933-1935		+19	+10	—6		.		+13	0
1933-1936		+20	+11	—4				+14	0
1933-1937		+25	+17	+1				+24	+3
1937-1938		—7	—1	+3				—1	+1
1933-1939		+13	+14	+4				+20	+3
1933-1940		+15	+16	+5				+20	+3
1933-1941		+26	+20	+6				+27	+6

n.a. (not available).

Sources: *Statistical Abstract of the United States, 1950*, Dept. of Commerce, p. 285; *Federal Reserve Bulletin*, May 1952, p. 548.

it continued to drop in 1934, reaching a level 44 per cent below 1929—a greater drop than that shown by any other component. Rents could be expected to be somewhat sticky in their response to a decline in economic activity, because they are contracted for on a longer-term basis than most consumer prices. However, it would appear that the relatively fixed stock of housing makes rent very sensitive to demand if the period of adjustment is long enough. For gas and electricity, fuel, and ice, only a combined index is available for the period 1929-1933. It is evident from inspection of the component indexes for later years, however, that this index combines a number of different types of price behavior. Gas and electricity show very little variability, as would be expected in view of public-utility price-setting procedures. Ice uses as materials primarily electricity and water—both utilities—and these combined with some labor would determine its price behavior. As would be expected the price of ice is, next to gas and electricity, the least variable of the consumer-price components. The fuel index is based largely upon price changes in coal and fuel oil. The price of coal would be expected to be considerably less variable than that of fuel oil, since it has a much larger labor component; thus the fuel index combines a fairly invariant price index with a more variable one to yield an index of about the same variability as those of apparel and house furnishings. The index for miscellaneous items, finally, is composed of such prices as street-car and bus fares, upkeep of automobiles, medical care, newspapers, radios, motion pictures, other recreation, barber and beauty-shop services, and toilet articles. These prices tend to be relatively less variable because of such factors as rate regulation and customary prices, as well as the importance of labor services and the high degree of fabrication.

The behavior of the different components of the index followed somewhat the same pattern after 1939 as before, except that the effects of price control are quite evident. Food prices did not rise as much as would have been expected in terms of the rise in apparel and house furnishings. From 1941 to 1945, in fact, the prices of both apparel and house furnishings rose by 37 per cent, whereas food rose by only 31 per cent. This is probably due to the greater ease of controlling food prices—the lower-priced lines in apparel and house furnishings tended to disappear from the market. With the end of the war and the removal of price control, the prewar relationship among the components in the consumer-price index was restored.

491

It is thus apparent that the relative movements of the various components of the consumer-price index do behave approximately as would be expected on the basis of the preceding analysis of the determinants of relative prices. Any detailed analysis of the exact year-to-year movements would of course have to take into account such factors as the relative sizes of the agricultural harvests, the extent of government and foreign demand for agricultural products, the various rounds of wage increases, and the secular changes in productivity in different parts of the economy. Each of these elements has a role in determining relative price movements. But the basic structure of consumers' prices and the major changes that can be expected in this structure during periods of economic fluctuation do emerge quite clearly from this relatively simple analysis.

THE WHOLESALE-PRICE INDEX

THE BLS wholesale-price index is based on some 900 price series and 1,700 price quotations.[55] Prices for the same commodity at several different stages of production are often included. For example, cotton appears in the index as raw cotton, cotton yarn, cotton gray goods, cotton piece goods, and cotton clothing. For each of these stages a representative commodity sample has been selected and priced at the primary market level of distribution. In the remaining space of this paper it would not be feasible to go through each of these series in the manner that was done for the cost-of-living index. Instead, it will be useful to give some brief attention to the general aggregative nature of the series. The wider variability of the wholesale-price index over the cost-of-living index is well known. In terms of the theory of price behavior suggested by this paper, this greater variability would be expected. As was pointed out in Part 3 above, the prices of agricultural raw materials and semifinished goods would be expected to exhibit greater variability than the prices of finished goods. This expectation is based on the observation that (1) the labor-cost element tends to be less variable than the prices of agricultural raw materials; and (2) the higher the degree of fabrication, the more important labor costs become relative to the cost of the original agricultural raw materials in the total direct cost. Since price tends to move with direct cost, the larger the influence of labor costs in direct cost, the more the variability of final output prices will tend to decline to that of labor costs. Many

[55] *Handbook of Labor Statistics, 1950*, Dept. of Labor, 1951, p. 117.

agricultural raw materials and semifinished products are included in the wholesale-price index, whereas these same items are excluded from the consumers-price index, since only fully processed goods reach the consumer. Since the theory of price behavior outlined in Part 2 would thus produce a greater variability for the wholesale-price index, and since this greater variability is in fact found, there is no evidence from this test that there is any basic contradiction between the general nature of the wholesale-price index and the theory of price behavior.

The wholesale-price concept originated in the period when economic theory was concerned with the relation between the "price level" and the quantity of money. Economic statisticians regarded the wholesale-price index as a sampling of prices in the system, and thus in some sense a measure of the level around which prices tended to cluster. Economists tried to differentiate between situations in which relative prices in the price structure changed and those in which the general level of price itself changed. Changes in the price level were considered to involve only random changes in the price structure. But such a dichotomy is possible only if changes in the level are not systematically related to changes in the structure. According to the foregoing analysis of the determinants of price change, any price movement in the system necessarily involves relative price changes; a change in level without a change in structure is impossible. With a change in income the primary response will be in the prices of agricultural goods, and the repercussions will diminish as the goods become more and more highly fabricated. The "price level" of agricultural materials and some mineral materials is thus always in flux, being affected by such things as the level of income, foreign demand, and weather conditions. But the "price level" of highly processed goods may hardly vary at all.

As an indicator of the "level" of prices, therefore, the wholesale-price index is not a meaningful economic construct; rather it is merely a conglomeration of those price quotations which are easiest to get. Vertically unintegrated industries will provide a much greater number of price quotations, and even if these more numerous prices are weighted by value added at each stage the result will not be the same as that which would be obtained using the final-goods price of an integrated industry. Whenever a product contains materials of agricultural origin or of mineral origin with variable prices, the price variation will be dampened as the degree of fabrication increases, approaching the variation of labor cost. The variability at-

493

tributed to an industry's prices in the wholesale-price index, there-fore, will depend upon the particular stages in the fabrication process for which price quotations are included. It is probably no exaggeration to say that the wholesale-price index is no better as an indicator of inflation and deflation than freight-car loadings are of the deflated gross national product—if as good.

RELATIVE MOVEMENT OF REAL AND MONEY WAGE RATES

STATISTICAL information on the movement of an index of the real wage rate has appeared in the economic literature from time to time, but the conclusions to be drawn from this data were never very clear.[56] The analysis of the determinants of relative price changes presented in the body of this paper is related to this discussion and can throw some light on what should be expected in terms of the relation between the consumer-price index and the money wage rate.

With a fall in the money wage rate and a contraction in income, the components of the consumer-price index can be divided into groups of commodity and service prices which will (1) fall faster than the wage rate, (2) fall with the wage rate, and (3) fall less than the wage rate. Goods whose value contains an appreciable propor-tion of agricultural or variable-priced mineral materials will vary more than the money wage rate. Goods which are highly fabricated or whose value is mostly labor services will vary directly with the money wage rate. Finally, goods whose prices are administratively fixed, i.e. utilities, will change less than the money wage rate. Rent

[56] See for example John T. Dunlop, "The Movement of Real and Money Wages," *Economic Journal*, September 1938; J. M. Keynes, "Relative Movements of Real Wages and Output," *Economic Journal*, March 1939, pp. 34-51; L. Tarshis, "Changes in Real and Money Wages," *Economic Journal*, 1939, pp. 150-154; J. Henry Richardson, "Real Wage Movements," *Economic Journal*, September 1939; Richard Ruggles, "The Relative Movements of Real and Money Wage Rates," *Quarterly Journal of Economics*, November 1940, pp. 130-149. In his original article, Keynes stated that prices would rise faster than money wages in recovery because in perfect competition a producer would be faced with a rising marginal-cost function, and prices of output would therefore have to rise faster than the wage rate as output expanded. In attempting to generalize the problem for an economy as a whole, Dunlop used the cost-of-living index as a measure of price change, but these are in fact not the prices which are ger-mane to the theoretical discussion. Prices in this context should have been re-stricted to the selling prices of the producers who actually paid the wage rates. The cost-of-living index is a conglomeration of prices which are paid by con-sumers. It includes agricultural prices, import prices, rent, and prices of con-sumer services. However, although the cost-of-living and money-wage-rate con-troversy was not meaningful in terms of its original problem, it is still interesting to ask how real wage rates behave at different phases of economic fluctuations.

is the one element in consumers' expenditures which cannot be classified in this manner. As noted above, in the short run rent may be fairly inflexible because of contractual obligations, but in the longer run it becomes extremely flexible. The question whether a decrease in the money wage rate will cause an increase or a decrease in the real wage rate will thus depend on the importance in terms of weights and degree of variability of the prices which are more variable than the money wage rate compared with the prices which are less variable than the money wage rate. The relative variability of the different prices will depend on the magnitude of the total income decline which accompanies the decline in the money wage rate. For an exact prediction in any particular instance, it would be necessary to know how much investment, government expenditures, and the propensities of various groups to consume change, as well as changes in foreign demand for agricultural goods and the influence of changes in weather conditions. But some general conclusions can be drawn. In a mild recession or in the early phases of a major depression it would be quite possible for the real wage rate to decline, largely because of the lag in the response of rent to changes in income. In a deeper, more prolonged depression, however, it seems likely that the real wage rate would rise. Rent becomes more variable than money wage rates in the longer run, so that the only components of expenditures whose prices remain less flexible than money wage rates are a few public utilities.

An adequate empirical investigation of this problem would be particularly hard because of the difficulty of obtaining a measure of the money wage rate for an economy as a whole. In addition, retail-price quotations always involve the problem of the failure to take adequate account of the change in the quality of goods. For these reasons, the problem of the movement of real and money wage rates will probably remain in the sphere of pure theory for some time.

C O M M E N T

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THE positive content of Ruggles' paper is essentially the development of a few simple hypotheses to account for the broad patterns of price behavior in the United States in the period 1929-1931. These hypotheses may be summarized as follows:

1. The collapse in the prices of agricultural goods was attributable to the stability of agricultural output in the face of a drop in demand, which stability was in turn attributable to the shape of marginal cost curves in agriculture.

2. The prices of some minerals fell by about the same percentage as unit direct costs, while the prices of others fell more sharply than unit direct costs. By and large, price behavior of the former type occurred in minerals industries in which supply curves tended toward the horizontal, while that of the latter type characterized industries with rising supply curves.

3. The prices of manufactured goods tended to decline in the same proportion as unit direct costs; the decline in unit direct costs in turn tended to be large if agricultural raw materials or some minerals bulked large in direct costs, and to be small to the extent that labor, some minerals, and labor-intensive manufactured goods bulked large in direct costs.

4. The prices of goods sold in the distributive trades tended also to decline in the same proportion as the decline in unit direct costs.

Two significant inferences may be drawn from Ruggles' findings, one of which is implicit in the structure of his argument, while the other is explicitly set forth. First, if we assume the validity of a series of quite daring assumptions, Ruggles' findings may be interpreted as indicating that firms by and large tended to equate marginal cost and marginal revenue in approved textbook fashion. It must be emphasized, however, that the empirical validation of this proposition involves so many bold assumptions, both of a theoretical and a statistical character, that it can hardly be regarded as more than a plausible conjecture.

In the context of the present volume, the second conclusion is the more relevant—i.e. that "the major patterns of price behavior in the economy can be adequately explained in terms of factors other than industrial concentration." While Ruggles does not entirely rule out the possibility that differences in concentration ratios (or in some other index of market organization) may have some effect on differences in cyclical price behavior, he does feel, at least for the period he has studied, that the influence of these factors is at best peripheral, and that the forces emphasized in his own analysis are overwhelmingly more important. In manufacturing and distribution, Ruggles appears to feel that the correspondence between changes in unit direct costs and changes in price is so close that little remains to be explained. Thus Ruggles appears to go even

farther than Neal,[1] with whose principal conclusions he is in substantial agreement, for Neal went on to study the relation between concentration ratios and the sensitivity of price to changes in unit direct costs, finding that concentration "does affect the flexibility of price relative to direct cost," but "only to a minor extent."[2]

In one respect at least, Ruggles' claim is certainly too broad. He concludes his discussion of agricultural price behavior with this statement: "Agriculture, then, because of the nature of its marginal costs, would be expected to maintain its output in the face of a fall in demand. . . . The whole impact of a contraction in demand falls on price; price will decline until the full quantity produced can be absorbed by the economy."

If this statement were so, Ruggles would have succeeded in accounting for the broad movements of agricultural prices without introducing considerations of market organization. But the shape of the farmer's marginal cost curve does not in itself explain the fact that he will maintain output in the face of a fall in demand; a monopolistic firm might have a marginal cost curve for all the world like a wheat farmer's, but its response to a decline in demand might be quite different. Ruggles' conclusion follows only if it is also specified that the firm in agriculture is operating in a steeply rising range of its marginal cost curve, but this is so only because an unregulated agriculture, in its major branches, is purely competitive. Hence it appears to be logically necessary to invoke considerations of market organization to explain the behavior of agricultural prices.

A similar point relates to Ruggles' treatment of price behavior in the minerals industries. Here he finds a more complex pattern of price movements than in the other major sectors of the economy, but his explanation of price behavior in this area is somewhat obscure and is marred by the implicit assumption of the prevalence of pure competition—an assumption not valid in many branches of minerals production.

Some comments may be made, also, regarding Ruggles' explanation of the behavior of the prices of manufactured goods. His findings, taken together with those of Neal, establish quite conclusively that the predominant influence governing price behavior in the period studied was the behavior of unit direct costs. The link be-

[1] Alfred C. Neal, *Industrial Concentration and Price Flexibility* (American Council on Public Affairs, 1942).
[2] *Ibid.*, p. 140.

tween prices and direct costs is so strong that it must certainly be the starting point in any future analysis of cyclical price flexibility of manufactured goods.

However, the following qualifications and amplifications suggest themselves:

1. Additional calculations indicate that if Ruggles had used a broader sample for his comparisons of percentage changes in unit direct cost and unit value in various agricultural and minerals processing industries, the correspondence between the two might have been somewhat less striking. (See his Tables 4 and 6.) Industries are easy to find in which the divergence between percentage decline in unit direct cost and percentage decline in value per unit was significantly greater than in most of the industries represented in these tables. Indeed, there are some cases in which unit direct cost fell so much more sharply than unit value that the unit over-head-plus-profit margin increased.[3]

2. In industries in which unit direct cost in 1929 stood in a very high ratio to unit value, it would seem a priori unlikely that the percentage decline in these two variables could diverge widely. At one extreme, unit value is not free, except in very unusual circumstances, to fall below unit direct cost; at the other extreme, given the condition of markets in depression, few industries will be in a position to raise the unit overhead-plus-profit margin (i.e. the difference between unit direct cost and unit value) above the pre-depression level. If these two points are taken as establishing the limits of the extent to which the degrees of decline may diverge, and if the ratio of unit direct cost to unit value in a particular industry in 1929 was, say 90 per cent, then a decline in unit direct cost of, say 30 per cent is consistent with a price decline of not less than 27 per cent and not more than 37 per cent. By contrast, if an industry in 1929 had a low ratio of unit direct cost to unit value—say 50 per cent—then a 30 per cent decline in unit direct cost would be compatible on these assumptions with a decline in unit value of as much as 65 per cent and as little as 15 per cent. Hence the higher the ratio of unit direct cost to unit value, the narrower are the limits within which percentage declines in these variables are free to diverge.

An examination of the 1929 census data for the manufacturing

[3] This category would include such industries as ice cream, malt, linoleum, soap, rubber tires and tubes, asbestos products, and wall board and plaster

industries studied by Ruggles (Tables 4 and 6) indicates that these industries tended to have higher ratios of direct costs to value of products than did the broader industry groups into which they fell. Of twenty-two manufacturing industries listed in Tables 4 and 6,[4] sixteen had ratios of direct costs to value of products that were higher than the ratios for their census industry groups. An extreme case is the food and kindred products industry group. For the group as a whole, the ratio of direct costs to value of products was 79 per cent, but for the four industries in Table 4 that fell into this group, the ratios ranged from 85 to 91 per cent.

Hence there is some reason to believe that a different sample of industries, in which the ratios of direct cost to value of product were more representative of the respective industry groups, might have displayed a less perfect relationship between percentage price decline and percentage direct cost decline than did the industries studied by Ruggles.

3. Although the unit overhead-plus-profit margin is simply the difference between unit direct cost and unit value, one may not properly infer from the fact of an approximately equal percentage decline in direct cost and unit value that the unit overhead-plus-profit margin fell by about the same percentage. This seeming paradox arises because a high ratio of unit direct cost to unit value implies a low ratio of unit overhead-plus-profit to unit value; hence a relatively slight divergence in the degree of decline of unit direct cost and unit value may make possible a large divergence between these two percentages and the percentage decline in the unit overhead-plus-profit margin.

For example, Ruggles' Table 4 shows, for cane sugar refining, a decline in unit direct cost of 11 per cent as compared with a decline in unit value of 10 per cent. However, since the 1929 ratio of direct cost to value of products in this industry was 90 per cent, the narrow margin by which the decline in unit cost exceeded the decline in unit value resulted in a decline in the unit overhead-plus-profit margin of only 2 per cent.

Hence it it not permissible, from a knowledge of percentage change in unit direct cost and unit value alone, to draw any conclusion concerning the behavior of the unit overhead-plus-profit margin. This observation amplifies rather than qualifies Ruggles'

[4] Including all but manufactured heating and illuminating gas, which Ruggles treats as an atypical case.

499

analysis, but it is a point that deserves emphasis because much of the past interest in the question of cyclical price flexibility has been closely associated with an interest in the cyclical behavior of margins.

4. If one concludes that Ruggles' essay suggests a somewhat greater sensitivity of the prices of manufactured goods to direct cost changes than probably prevailed in 1929-1931, one is then led to ask whether market organization factors may have played some part in accounting for differences in degrees of sensitivity. This question was studied in a particular framework by Neal,[5] who used the well-known census concentration ratios in conjunction with an analysis of price—direct-cost behavior. Neal found, as previously noted, that concentration does affect the sensitivity of price to direct cost changes, but the relationship appears to be quite weak. Neal's evidence fully supports his conclusion.

This might well be the end of the matter, if there were not abundant reason to be dissatisfied with the census concentration data as a measure of market characteristics that may be associated with differences in the sensitivity of price to cyclical direct cost changes. The shortcomings of the census concentration ratios as measures of market power are numerous and well known. Hence it must still be considered an open question as to whether a more reliable index of degree of market power, if it were possible to devise one, might show a closer relationship between extent of market power and sensitivity of price to direct cost changes.

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RUGGLES has set four principal tasks for himself in this interesting paper: (1) to summarize the present state of the literature on price flexibility; (2) to develop his own criterion of flexibility; (3) to test price behavior during 1929-1931 in various parts of the economy, using his criterion; and, rather indirectly (4) to evaluate the importance of industrial concentration as a determinant of price flexibility. His central conclusion is a strong one and deserves mention at the outset. It is that the "major patterns of price behavior in the economy can be adequately explained in terms of factors other than industrial concentration." As will become evident subsequently, his explanation squares perfectly with the traditional theory of short-

[5] Neal, *op. cit.*, Chap. VI.

period price formation. Clearly, this finding is somewhat novel for the concentration field, and in any case of high interest.

Perhaps the most important purpose of studies of concentration is to gauge its significance for short- and long-period changes in the structure of relative prices. The question is certainly appropriate. Interest in concentration was originally stimulated by the recognition that in certain industries sellers were few, which suggested the possibility that fewness could lead to unusual power over price. If so, then these prices should show some variance of behavior relative to those formed in markets involving large numbers. On this reasoning, Gardner Means some twenty years ago opened up the issue with his now famous study of the comparative flexibility of industrial and agricultural prices. Means' findings have since been severely criticized on sound technical grounds, but interest in the problems he raised remains very much alive.

Inquiry into the possible impacts of concentration upon changes in price structure takes two main forms. With the publication of Schumpeter's provocative and unorthodox views concerning concentration, large-scale enterprise, and their connection with technological change, the way was opened to investigation of changes in relative prices over very long periods. So far, this problem has received only limited attention, though its importance is recognized. By contrast, much effort has been applied to the short-period, investigation given impetus by price behavior during the great depression. These studies have been concerned with the impacts upon relative prices of marked change in aggregate demand. Ruggles' paper is an important contribution to this literature.

The fact that prices change relatively to one another when effective demand changes is only the beginning of the question. Certainly there is no a priori reason to expect all prices to change proportionally and in the same direction. Thus the inquiry cannot be limited simply to one of measurement. It must be informed by some guiding theoretical conception. In other words, the theorist requires some criterion for the comparison of "expected" with "actual" price changes in particular cases. Only then can he isolate deviant cases. Many criteria have been proposed, some normative, which proclaim how much all prices *ought* to change; others purely hypothetical, which attempt to predict how much prices *would have* changed if certain determinants were effective and others not.

Clearly, if the question of structural flexibility is to be linked to something we may vaguely call monopoly power, then what is

needed is a criterion by which those cases in which that power is effective can be isolated from the universe of prices as a whole. If I interpret him correctly, Ruggles has attacked the question by adoption of the Walrasian model as a reference point (nonnormative) for the formation of relative prices. By use of a criterion derived from this model, he has then attempted to find out whether changes in relative prices during 1929-1931 did or did not conform to the predictions yielded by that model.

Conventional short-period price theory emphasizes two principal determinants, those of demand and of cost. Selling price will shift to a new equilibrium (barring the kinked-oligopoly case) with a shift in either determinant or of both together. However, if with a change of demand or a cost-invoked move along the demand schedule, the *elasticity* of demand is the same at the new point ·of equilibrium as it was at the old, then selling price will change proportionally to and in the same direction as the change in short-period marginal cost. Furthermore, this will be true whether the change in marginal cost involves a *shift in* or a *move along* the cost schedule. Thus it is a change in the elasticity of demand that makes for perverse behavior of the price-cost relationship in a given case. Alternatively, on Ruggles' criterion, prices show perfect flexibility when they move directly and proportionally with short-period marginal cost. Otherwise they are inflexible, excessively flexible, or inversely flexible.

Using this criterion of perfect price flexibility, Ruggles can isolate the effects of changes in demand elasticity without undertaking the impossible task of measuring them. He can limit the statistical problem to measurement of relative changes in prices and costs. If the results fail to conform to the criterion, then he infers that a change in demand elasticity has intervened as an additional determinant.

Changes in elasticity of demand normally can be expected when the seller has a sloped demand curve and his cost schedule shifts, or when his sloped demand curve shifts and he must find a new price-output equilibrium. Such phenomena would occur in cases of monopolistic competition or pure monopoly. Oligopoly is more difficult because competition is "co-respective" and various alternative hypotheses become possible. Still, even here if the behavior of prices under oligopoly were deviant, Ruggles' criterion would reveal it. Assuming that the data are adequate to its use, then, Ruggles can contend that his criterion is a workable method for turning up

important cases of impure markets—"important" in the sense that prices there were found to be rigid, sluggish, or perverse relative to changes in marginal costs.

When it comes to the empirical utility of his approach, Ruggles displays appropriate caution and declares that his findings are "purely illustrative." They are studded with many needed reservations and qualifications. I must admit, however, that at times I found it difficult to follow the exact nature of the statistical operations employed. If I comprehend them correctly, they rest upon these principles: (1) to use average direct cost (suitably weighted for relative amounts of cost pertaining to production labor and to materials) as an approximation of short-period marginal cost; (2) to use average value product as a measure of selling "price" for the composite product; and (3) to use matched census data for the foregoing in each category examined. On this basis, Ruggles tests for flexibility for a group of rather narrowly defined and relatively homogeneous industries, and also for broader and in my opinion less reliable aggregates.

The inevitable statistical frailties and expedient assumptions turned up, and these are candidly noted and evaluated. Moreover, it is a marked advantage to use data that in the main are homogeneous as to reporting source; to use wage costs for production labor rather than that treacherous substitute, average hourly earnings; and to use value product per unit of output as a synthetic price, in place of frequently deceptive quoted prices. Yet, as Ruggles himself observes, the value product technique has its own shortcomings. Given an "industry" in the sense of a statistical box, one will usually find multiple products and multiple markets; and varying markups by product, by firm, and by plant. Value product will serve as a measure of price only when the contents of the statistical box are really homogeneous. Otherwise one will derive an artifact rather than an indicator of actual price change. For this reason more confidence may be placed in Ruggles' findings for the narrower segments of the economy.

The outcome of his inquiry led Ruggles to the conclusions mentioned earlier, that relative prices in 1929-1931 changed in a manner that could be expected from value theory, and that the patterns found could be explained without appeal to industrial concentration as a special factor. In that period, direct costs throughout the system were determined by these influences: (1) the prices of agricultural raw materials, which mainly are "demand-controlled" be-

cause the shape of the cost function leads to continuous production at capacity; (2) the prices of mineral products, which tend to move inversely with output because of varying richness of deposits; (3) the form of the production and marginal cost functions in each industry; and (4) the level of the wage rate. The forces of technological change and of secular growth or decay of industries may be ignored because the period is short.

As Ruggles views the behavior of prices during 1929-1931, deflation lowered agricultural demand, and through this the prices of farm products. This helped depress wage costs. Materials and wage costs together lowered direct costs in varying degrees in the later stages of processing and fabrication, and selling prices generally moved downward in the same proportions. Prices paid by distributive trades thus fell, and even with constant gross margins, their selling prices also dropped.

While I certainly would not dispute Ruggles' account of price formation or of the interrelations among prices in the system, I think his conclusions are likely to be misleading. His statistical inquiry is described as illustrative and necessarily limited. But his conclusions could be used as a generalization when in fact they apply only to a single empirical case, that of 1929-1931. They may also be misleading because they could be interpreted to mean that concentration, taken as a symptom of monopoly power, is of little or no importance for price behavior. Actually, all Ruggles himself suggests is that concentration was of no apparent significance for price behavior as he observed it in one case with what he himself terms a limited investigation. Fuller study might fortify this conclusion, to be sure. Yet there remain many well-known cases of rigidity, sluggishness, and perversity, as well as other exhibits in the museum of economic horrors. Ruggles himself is quite aware of them, but his conclusion might suggest otherwise. In my opinion, it is likely that his statistical scalpel was necessarily too blunt an instrument to lay them bare.

Thus it is the adequacy of the instrument that gives me concern. I have no quarrel whatever with Ruggles' technique for testing the influence of concentration upon price changes in the short-period. Quite the contrary. Further inquiry on these lines is urgently needed, as I shall argue below. Statistical tests of this type are a kind of screen for sifting out industries in need of more intensive study. The difficulty is, however, that the mesh of the screen may be made

so coarse by the available data that it may be incapable of yielding definitive results.

Accordingly, alternative approaches become necessary, and here the old-fashioned technique of case study acquires renewed importance. Inquiry should begin with those prominent cases in which sellers are few, to determine the nature and vigor of competition. Within this context, several tests of competitiveness can be made. Are there technical indivisibilities that make for few producers, or are there other reasons? Is entry possible? If not, why not? Are profits relatively high because of growing demand and rapid innovation, or because of restrictive devices? Is there effective cross-product competition? What kind of price policies have the rivals followed? What has been the behavior of their price-cost relationships by products in periods of rapidly changing demand?

The value of concentration studies of Ruggles' type is great and beyond question. All that I wish to stress is that the problems of competition and monopoly call for other tests and other approaches as well, before definitive conclusions can be drawn.

I also suggest that one case, that of 1929-1931, is not enough in itself. This, of course, Ruggles acknowledges, and he has carried part of his study forward in time in order to broaden its scope. Other suggestions are possible. For instances of deflation, inquiry would be desirable and probably possible for 1920-1922, 1937-1938, and 1948-1949. Cases of inflation also deserve investigation. Certainly 1940-1942 belongs here, and at this time price and wage controls were not effective. The period 1935-1937 might also be classed in this group. More interesting would be the immediate postwar years, say 1946-1948. Wage control was a dead letter after August 1945, and price control became such within a year. It would be of great importance to see what happened to price-cost relationships, starting from the distortions invoked by direct controls and the large backlog of vastly increased cash holdings. No doubt there would be difficulties. Yet here would exist a prime case in which to test the importance of concentration for its effects upon prices in a period of rapid change.

It may well turn out that our economic system has been, and remains, far more competitive according to the standards of traditional wage and price theory than many of us have hitherto suspected. However, before we can adopt this view as a firm conclusion we shall require much more work, using a variety of tools. For this purpose, Ruggles' approach and findings are of high significance.