

Toward a Theory of Price Adjustment

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THE ROLE OF PRICE ADJUSTMENT EQUATIONS IN ECONOMIC THEORY

In this essay, it is argued that there exists a logical gap in the usual formulations of the theory of the perfectly competitive economy, namely, that there is no place for a rational decision with respect to prices as there is with respect to quantities. A suggestion is made for filling this gap. The proposal implies that perfect competition can really prevail only at equilibrium. It is hoped that the line of development proposed will lead to a better understanding of the behavior of the economy in disequilibrium conditions.

In the traditional development of economic theory, the usual starting point is the construction for each individual (firm or household) of a pattern of reactions to events outside it (examples of elements of a reaction pattern: supply and demand curves, propensity to consume, liquidity preference, interindustrial movements of capital and labor in response to differential profit and wage rates). This point of view is explicit in the neo-classicists (Cournot, Jevons, Menger, and successors) and strongly implicit in the classicists (from Smith through Cairnes) in their discussion of the motivations of capitalists, workers, and landlords which lead to establishment of the equilibrium price levels for commodities, labor, and the use of land. The basic logic of Marx's system brings it, I believe, into the same category, although some writers have referred to his theories as being "class" economics rather than "individual" economics.¹ Although the dialectical discussion of value in the opening sections of Volume I of *Capital*² lend some credence to this view, it is already clear in Marx's discussion of relative surplus value (Volume I, Part IV) that the introduc-

¹ See, e.g., Klein [(1) page 118]: "Instead of studying the behavior of individuals, Marx studied the behavior of classes directly."

² K. Marx (2): Chap. I, and especially the discussion of surplus value in Chaps. VI, VII, VIII, and IX.

tion of new production processes is based on the profit-maximizing behavior of the individual entrepreneur;³ and the role of the individual behavior reaction is basic in Marx's discussion of the equalization of profit rates in different industries in Volume III (especially Chapter X). In the opinion of most contemporary Marxist economists, such as Dobb (3) and Sweezy (4) and of sympathetic critics such as Lange (5),⁴ the value theory of Volume I is to be regarded only as a first approximation to that of Volume III, so that the latter must be regarded as the basic part of Marx's price theory.⁵

There remains one school which might be interpreted as objecting to the development of economics from the viewpoint of individual reaction patterns. These are the institutionalists, such as Veblen (8), who attacked the behavior patterns hypothesized by contemporary economists for stressing the passive reacting character of individual behavior; but this argument seems partly a terminological question and partly an attack on the limited, excessively hedonistic expositions of the marginal utility theory current about 1900. Elsewhere both Veblen (9) and Mitchell (10) have emphasized the importance for the course of economic activity of the behavior of individuals, especially profit-making by firms.

In this individualistic framework, every relevant variable, except those classified as exogenous for the whole economic system, is the result of a decision on the part of some one individual unit of the economy. This paper considers the theoretical analysis of the decisions as to prices.

The standard development of the theory of behavior under competitive conditions has made both sides of any market take prices as given by some outside agency. Thus, for a single market,

$$D = f(p), S = g(p) \quad (1)$$

where D is the demand for the commodity, S its supply, and p its price. The functions $f(p)$ and $g(p)$ represent the behavior of consumers and producers, respectively. But relation 1 constitutes only two equations in the three unknowns D , S , and p .

The theoretical structure is usually completed by adding the condition of equality of supply and demand,

$$S = D. \quad (2)$$

³ See especially Vol. I, pp. 347-53.

⁴ The same view has been expressed by at least one Soviet textbook, Lapidus and Ostrovityanov, *Outlines of Political Economy*, referred to by H. Smith in "Marx and the Trade Cycle" (6).

⁵ An alternative interpretation sometimes adopted is that there is a basic contradiction between the two price theories. This position has been adopted by numerous critics of Marxism, following E. Böhm von Bawerk, *Karl Marx and the Close of His System* (7). The same view has been taken by the ultra-Marxist, Daniel de Leon, who rejected Volume III as Engels' misinterpretation.

What is the rationale of relation 2? In the usual treatise on economics, a great deal of attention is paid to the derivation of the functions entering into relation 1, but equation 2 is usually taken pretty much for granted. If we look further into the reasoning given by such writers as do not regard equation 2 as completely self-evident, it is clear that it is regarded as the limit of a trial-and-error process describable by an equation of the general type

$$dp/dt = h(S-D) \quad (3)$$

where

$$h' < 0, h(0) = 0. \quad (4)$$

(Here and below, primes denote differentiation, so that h' is the rate of change of the function h with respect to an increase in the excess supply.)

Relation 3 is, of course, the well-known "Law of Supply and Demand." It asserts that price rises when demand exceeds supply and falls in the contrary case. Equations 1 and 3 together define a dynamic process in which supply, demand, and price vary in a prescribed way over time. If the process is stable, these three magnitudes approach limits. At the limiting values, there can be no pressure for any of the variables to change. In view of equations 3 and 4, price will remain stationary if and only if equation 2 holds; but if price remains stationary, demand and supply will do so also, by relation 1. [See Samuelson (11) and Arrow and Hurwicz (12).]

The Law of Supply and Demand may be a useful basis for interpreting some empirical phenomena, particularly the course of prices in markets subject to rapid changes in supply or demand conditions, although in fact few such applications have been made; however, the Law is not on the same logical level as the hypotheses underlying equation 1. It is not explained whose decision it is to change prices in accordance with equation 3. Each individual participant in the economy is supposed to take prices as given and determine his choices as to purchases and sales accordingly; there is no one left over whose job it is to make a decision on price.⁶

PRICE ADJUSTMENT UNDER MONOPOLY

Before discussing the mechanics of price adjustment under competitive conditions, we may consider the determination of price under monopoly. Here, there is no question of the locus of price decisions. In the standard theory (essentially unchanged from Cournot's original presentation), the monopolist fixes his price and output to maximize $R(x) - C(x)$, where x is output, $R(x)$ the total revenue curve, and $C(x)$ the total cost

⁶ This problem has not gone unnoticed in the literature; thus T. Scitovsky observes, "The difficulty lies in visualizing a price that everybody on both sides of the market regards as given and that is determined by the 'impersonal forces of the market'" (13).

curve. Price and output are related by the demand curve, and the firm's output will, therefore, always equal demand. This theory clearly presupposes that the monopolist knows the true demand curve confronting him.

Lange (14) has sought to develop a theory of price adjustment for monopolies analogous to the Law of Supply and Demand under competition. Let $U(p)$ be the profit of the entrepreneur if he sets price p , assuming that the output has been fixed in accordance with the demand curve. Then Lange suggests

$$dp/dt = F(U') \quad (5)$$

where

$$F' > 0, F(0) = 0. \quad (6)$$

Rules 5 and 6 amount to saying that the entrepreneur varies his price in that direction which leads to an increased profit. The rules are of the type referred to in mathematics as gradient methods of maximization.

These rules have concealed in them implicit assumptions about the monopolist's knowledge of the demand curve facing him (I assume he has complete knowledge of his cost curve). Since Lange assumes that output equals sales, the monopolist must know the demand at the price chosen, and, to make equation 5 operationally meaningful, he must know the elasticity of demand at that price. On the other hand, the monopolist presumably does not know the entire demand curve, for otherwise he would jump immediately to the optimal position. Further, his knowledge must be changing over time. To see this, let p_0 be the price set at some time t_0 and p_1 the price at some later time t_1 . Since the monopolist is increasing his profit by his successive trial prices, the profit $U(p_1)$ at time t_1 must be greater than $U(p_0)$, the profit at time t_0 . If, at time t_0 , the monopolist had known the demand at price p_1 , he would have known that p_0 was not the point of maximum profit and would have chosen p_1 or, possibly, some price which yielded a still higher profit. Thus the value of demand at p_1 is knowledge which is available to the monopolist at time t_1 but not at time t_0 .

Uncertainty, then, is a crucial consideration in the theory of monopolistic price adjustment. We cannot completely follow Lange in assuming that the monopolist never wets his toes in the cold waters of uncertainty as to the demand curve. It may be that, without knowing the exact value of demand at p_1 , the monopolist knows that even under the worst possible conditions the profit will be greater than at p_0 , where the demand is known. Indeed, it suffices that the expected profit corresponding to p_1 be sufficiently greater than the known profit at p_0 to overcome the entrepreneur's distaste for the greater uncertainty. Hence we must admit the possibility of a discrepancy between output and demand for a monopolist. The discrepancy once observed has a twofold significance for price adjustment.

On the one hand, it informs the monopolist of the extent to which he is in error and yields knowledge to estimate better his demand curve; on the other hand, the discrepancy alters his stock of inventories, which may in turn affect his cost situation in the next period.⁷ The latter effect would, of course, not apply to cases where either no inventories can be accumulated, as with services, or where the carrying costs (including storage, depreciation, and foregone liquidity) are very high. It seems reasonable to conclude that price adjustment will be slower in the last-mentioned case than where inventories can be accumulated or decumulated more readily.

Thus, if demand is higher than anticipated, the monopolist will, in general, raise his price because both his marginal cost and anticipated marginal revenue curves have shifted upwards, and conversely for demands lower than anticipated. If the true demand and cost curves remain unchanged in the process, the monopolist will gradually converge towards his optimal price-quantity position. If, however, the demand and cost curves are shifting over time in response to influences exogenous to the market under consideration, the monopolist's price adjustment relations become part of a general dynamic system which is not necessarily stable. I will not elaborate here a more complete model, which can become very complicated.⁸

COMPETITIVE PRICE ADJUSTMENT

The above sketch of monopolistic price adjustment theory has been introduced here not only for its own sake, but for the purpose of laying the foundations for a theory of price adjustment under competitive circumstances. As has been understood since the days of Cournot and emphasized in more recent times by Chamberlain and Joan Robinson, the competitive firm is a monopolist with a special environment.

Ordinarily, the firm acting under competitive conditions is pictured as a monopolist confronted with a perfectly elastic demand curve. More explicitly, it is assumed that there exists a price, which we may refer to as the market price, such that the firm can sell any output it desires at a price not exceeding the market price, but can sell nothing at a higher price.

Triffin (16) has criticized this criterion of perfect elasticity of demand as a definition of pure competition, arguing that such a demand situation is itself a consequence of the fundamental technological and test factors

⁷ If the total cost of producing x units is $C(x)$, the carrying cost is c per unit, and the amount carried forward is x_0 , the cost associated with delivering x units in the next period is $C(x - x_0) + c x_0$. For low values of c , this cost will be less than $C(x)$, so that the cost curve for the next period has shifted downward.

⁸ Such models are closely related to those which have been developed in inventory theory over the last twelve years. See, for example, Arrow, Karlin, and Scarf (15).

involved. He defines perfect competition instead in terms of certain cross-elasticities of supply and demand as between different firms.

Indeed, suppose we have a situation which conforms in all the aspects of homogeneity of output and multiplicity of firms to the usual concept of perfect competition, but in which the aggregate supply forthcoming at the "market" price exceeds the demand at that price. Then the individual firm cannot sell all it wishes to at the market price; i.e., when supply and demand do not balance, even in an objectively competitive market, the individual firms are in the position of monopolists as far as the imperfect elasticity of demand for their products is concerned.

What is the meaning of market price in such a situation? We are always told by the textbooks that there is one price in a competitive market at a given time. But what determines this one price? The answer has been given clearly by Reder. Under conditions of disequilibrium, there is no reason that there should be a single market price, and we may very well expect that each firm will charge a different price (17). The law that there is only one price on a competitive market (Jevons' Law of Indifference) is derived on the basis of profit- or utility-maximizing behavior on the part of both sides of the market; but there is no reason for such behavior to lead to unique price except in equilibrium, or possibly under conditions of perfect knowledge.

Let us consider in somewhat more detail the case in which demand exceeds supply. Assume that no firm can increase supply in a very short period. Then any individual entrepreneur knows that he can raise the price, even if his competitors do not raise theirs, because they cannot satisfy any more of the demand than they do already. The entrepreneur is faced with a sloping demand curve and raises his price in accordance with the profit-maximizing tactics of a monopolist, as sketched in the previous section. If none of the other sellers do in fact raise their prices, the entrepreneur will gradually approach his point of maximum profit, where the market will be cleared. But, under the conditions specified, it is equally to the profit of all other entrepreneurs to raise their prices also, although, if not subject to the same cost conditions, not necessarily by the same amount. The demand curve for the particular entrepreneur under consideration is thus shifting upward at the same time that he is exploring it. Thus supply will still not be in balance with demand, and the process continues.

It must also be stressed that the amount of uncertainty during this process is apt to be very considerable. Any estimate of the demand curve to a single entrepreneur involves a guess as to both the supply conditions and the prices of other sellers, as well as some idea of the demand curve to the industry as a whole. Under competitive conditions none of these is likely to be known very well. Thus the whole adjustment process is apt to be very irregular. Although the broad tendency will be for prices to rise when demand exceed supply, there can easily be a considerable dis-

persion of prices among different sellers of the same commodity, as well as considerable variability over time in the rate of change of prices.

The uncertainty, in turn, puts a premium on information. Traditional economic theory stresses the sufficiency of the price system as a source of information for guiding economic behavior, and this is correct enough at equilibrium. But the monopolist in general has stricter informational requirements than the competitor, since he needs to know his whole demand curve, not merely a single price. In conditions of disequilibrium, the demand curve is shifting as a result of forces outside the private market of the monopolist, and a premium is placed on the acquisition of information from sources other than the prices and quantities of the firm's own sales.

So far, our detailed analysis has covered the case of a firm acting as a monopolist because demand exceeds supply for the industry of which the firm is a part. We have already seen that, on a market where supply exceeds demand, each firm can also be regarded as a monopolist, though for different reasons. By a parallel argument each buyer on a market with an inequality between supply and demand can be regarded as a monopsonist. The behavior of each firm as a buyer can be described in the same manner as that of the seller, and we forebear from detailed repetition.

However, this further remark requires some revision of our previous picture of the market. In disequilibrium, the market consists of a number of monopolists facing a number of monopsonists. The most general picture is that of a shifting set of bilateral monopolies. The range of indeterminacy in each bargaining situation is limited but not completely eliminated by the possibilities of other bargains. In general, though, it is reasonable to suppose that if the selling side of the market is much more concentrated than the buying side, the main force in changing prices will be the monopolistic behavior of the sellers. The buyers would find little possibility of exerting their individual monopsonistic powers because there are so many of them for each seller. Similarly, if the buying side of the market is the more concentrated, as in nonunionized labor markets, the dynamics will come from that side. It is perhaps for reasons such as these that the immediate location of price decisions is usually vested in the more concentrated side of the market, in sellers in the case of most commodities, in buyers in the case of unorganized labor. (In organized labor markets, bilateral monopoly prevails.) Thus the dynamics of prices may be affected by the structure of the market even in cases where there are sufficient numbers in the market to insure reasonably competitive behavior at equilibrium.

IMPLICATIONS FOR THE SPEED OF ADJUSTMENT

The preceding shows, of course, that the difference between supply and demand is a major factor in explaining the movement of prices, so that the Law of Supply and Demand, as expressed in equations 3 and 4, can be

thought of as a useful approximation. However, the "price" whose movements are explained by the Law must be thought of as the average price. The model presented in this paper has some implications for the speed of adjustment in different markets, as represented by the function h .

Consider, as before, the case where demand exceeds supply and sellers are led to behave as monopolists. The existence of this excess both for the particular seller under consideration and for his competitors enters into the determination of the seller's anticipated demand curve. Given this, he sets his price so as to equate anticipated marginal revenue (possibly discounted in some form for uncertainty) to marginal cost. The price increase will thus depend on the shape of the marginal cost curve. It will be greater if the marginal cost is rising sharply than if it is flat. In particular, then, the speed of adjustment will be greater during a period of full utilization of capacity than in a situation of excess capacity.

A second consideration affecting the speed of adjustment, already remarked in passing, is the possibility of accumulating and decumulating inventories. An accumulation of inventories is both a signal to revise downward the anticipated demand curve and a cause of a downward shift in the marginal cost curve in the next period. A decumulation of inventories has the opposite effects. Hence, price adjustment will be more rapid in industries where inventories play a significant role.

A third factor suggested by the preceding analysis is the degree of information available to the individual entrepreneur. Relative absence of information about the behavior of others in the market increases the degree of uncertainty. Even in the absence of an aversion to risk-bearing, the chances that the entrepreneur will misread the signals are greater than if more information were available; we would therefore expect on the average that the responsiveness of prices to supply-demand differences would be less in the absence of information. An aversion to risk-bearing would increase the entrepreneur's unwillingness to venture on price changes in the absence of information. We would expect, therefore, that well-organized exchanges would display the greatest degree of price flexibility.

One special case in which information would be expected to be relatively scarce is that where the products are poorly standardized. Then knowledge of prices and availabilities of supply for other firms will not have a clear meaning for a particular firm, since its product may not be a perfect substitute, and therefore an excess of demand over supply elsewhere in the market may not be due to an upward shift in demand for all products on the market but to a shift away from its product to that of its competitors.

THE COMPETITIVENESS OF THE ECONOMY

In any state of disequilibrium, i.e., any situation in which supply does not equal demand, it follows from the above model that the economy will show evidences of monopoly and monopsony. These evidences will be the

more intense, the greater the disequilibrium. We can understand from this point of view the feeling of the businessman that, contrary to economic theory, sales are by no means unlimited at the current market price. The demand for advertising and other forms of nonprice competition thus makes more sense than under the model of perfect competition at all times.

The model casts some light on the much-discussed problem of administered prices.⁹ It was brought out by Gardiner Means and others in the 1930's that the quoted prices of some commodities produced by industries in which there was a high degree of concentration tended to be rigid, that is, insensitive to inequalities of demand and supply. Against this point of view it has been objected that the prices at which transactions actually take place differ from the quoted prices and are, for example, lower in conditions of excess capacity. Thus, the actual prices would be more nearly consistent with those of the competitive model. But it remains to be explained why the sellers resort to a fictitious price and secret undercutting instead of openly reducing prices. Explanations, such as Bailey's (18), which run in terms of informal social pressures within the industry, do not seem very satisfactory and, in any case, merely push the problem back one step.

If, however, it is accepted that an inequality of supply and demand leads to a condition of partial monopoly, then the most likely explanation for a divergence between quoted and actual prices is that it is a cloak for price discrimination. Not all buyers receive equal discounts, because they are not informed as to the prices actually paid. Such discrimination, if it can be shown to exist, would, of course, be incompatible with a purely competitive model.

The present model also suggests that the measurement of competitiveness by the concentration ratio has to be interpreted carefully. A degree of concentration which would be perfectly compatible with a reasonable degree of competition if the market were in equilibrium might easily fail to be so compatible in the event of serious inequality between supply and demand. There has been a position strongly held in recent years that the American economy is basically competitive, in that neither firms nor labor unions have, in fact, much control over prices, despite superficial appearances.¹⁰ The present model suggests that the evidence, to the extent that it is valid, relates only to equilibrium and, therefore, to long-run situations. Such long-run competitiveness is not incompatible, on the present view, with considerable short-run monopoly powers in transitory situations.

The incomplete competitiveness of the economy under disequilibrium conditions implies a departure from the maximum of possible efficiency in the use of resources. To be sure, it does not necessarily follow that

⁹ See M. J. Bailey, "Administered Prices in the American Economy," pp. 89-106, and earlier references cited there (18).

¹⁰ For firms, this view has been held by Stigler (19), Nutter (20), and Harberger (21). For trade unions, see Friedman (22).

greater efficiency is necessarily achievable under feasible alternative rules. Any method of resource allocation requires a process for equating supply and demand (or some equivalent), and such a process may be in itself costly, though such costs are not considered in the usual formal analysis of welfare economics. Thus, a completely centralized system will incur high computational and informational costs. The monopolistic and monopsonistic misallocations implied by the model of the present paper may be thought of as costs alternative to those associated with centralization.

In particular, one would expect considerable departures from maximum efficiency in conditions of severe disequilibrium, such as inflations and depressions, despite Keynes's well-known remark to the contrary.¹¹ Under conditions of unemployment, the mobility of resources in response to price differences is seriously impaired. Thus, in a depression workers will not move from the farm to the city, despite considerable wage differences, because they are aware of the difficulty of getting a job; the individual worker faces a falling demand curve.

A REMARK ON INFLATION

The above model casts some light on the concept of cost inflation. Such a doctrine requires that there be important elements of unregulated monopoly in the economy. There is at least some doubt that such elements are significant in the long run. However, the model of this paper suggests that in a certain sense all inflationary processes are cost inflations in that it is the monopoly power resulting from excess demand which is their proximate cause. This may explain why acute observers differ so sharply in their evaluation of the same phenomenon. Those who see cost inflation may be looking at an immediate causal factor, while those who speak of demand inflation have their eye on a more ultimate stimulus.

In view of this, this paper would suggest caution in treating cost inflations by direct regulation.¹² They may be transitory phenomena which are necessary to achieve equilibrium, in which case regulation may simply lead to the replacement of overt by suppressed inflation.

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¹¹ "I see no reason to suppose that the existing system seriously misemploys the factors of production which are in use. . . . When 9,000,000 men are employed out of 10,000,000 willing and able to work, there is no evidence that the labor of the 9,000,000 men is misdirected" (23).

¹² See the proposals of Lerner (24).

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