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AN EXPERIMENTAL IMPERFECT MARKET

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IT IS a commonplace that, in its choice of method, economics is limited by the fact that resort cannot be had to the laboratory techniques of the natural sciences. On the one hand, the data of real life are necessarily the product of many influences other than those which it is desired to isolate—a difficulty which the most refined statistical methods can overcome only in small part. On the other hand, the unwanted variables cannot be held constant or eliminated in an economic "laboratory" because the real world of human beings, firms, markets, and governments cannot be reproduced artificially and controlled. The social scientist who would like to study in isolation and under known conditions the effects of particular forces is, for the most part, obliged to conduct his "experiment" by the application of general reasoning to *abstract* "models." He cannot observe the actual operation of a *real* model under controlled conditions.

The purpose of this article is to make a very tiny breach in this position: to describe an actual experiment with a "market" under laboratory conditions and to set forth some of the conclusions indicated by it. The experiment has been carried out in a number of classes in economic theory, with the students offering themselves up as the guinea pigs. It was actually designed to illuminate a particular problem which I had analyzed earlier in abstract terms,[1] viz., that of the effect of deviations from a perfectly and purely competitive equilibrium under conditions (as in real life) in which the actual prices involving such deviations are not subject to "recontract" (thus perfecting the market), but remain final. It was designed also as a pedagogical experiment; and in my own experience has been found stimulating and instructive to students both (*a*) for their actual participation as buyers and sellers in a market mechanism and (*b*) for the many comparisons afforded, both of similarity and of contrast, between the laboratory market and its diverse counterparts in the real economic world. Pedagogy to one side, however, it has in its present form, yielded at least some "scientific" results. It is evidently capable of substantial variations and might possibly be extended and adapted to other problems.

[1] "Note on Deviations from Equilibrium," *The Theory of Monopolistic Competition* (5th ed.; Harvard University Press, 1946), p. 25.

DESCRIPTION OF THE EXPERIMENT

The participants are informed that they are to take part in a "market," approximately half being buyers, the other half sellers. Under the simplest conditions, usually followed, each person deals in only one unit of the commodity. Cards are passed out on which are written either "B" or "S," for "buyer" or "seller," and a figure defined as the Marshallian demand price or supply price as the case may be. Thus a person receiving a card marked "B-36" would be willing to pay as high as 36 but no higher in purchasing his unit; "S-20" would be willing to sell his unit for as low as 20 but no lower. Each participant will naturally not reveal the figure on his card but will bargain, seeking to obtain as great an advantage as possible. An interval is allowed within which the participants move about seeking to conclude bargains with each other, and a warning is given before the market ends, so that those who have been holding out for a better deal may come to an agreement, if possible. As rapidly as contracts are concluded, they are reported at the desk, tickets are surrendered, and the bargains are recorded in sequence. A convenient way to record them is in three columns headed "B," "S," and "P," giving for each bargain the buyer's limit, seller's limit, and price. The last item of price has usually, but not always, been written on the blackboard as reported, so that this information (analogous to the ticker tape for the stock market) might have its influence on subsequent bargaining. When the market is declared ended, all tickets are turned in for those unable to conclude a bargain, since these are obviously necessary to complete the demand and supply schedules. The data may then be read back to the class with instructions to discover what the price and sales volume would have been, had the market been perfect, and to compare them with the average of actual prices and with the actual sales volume.

With few exceptions, the problem has been presented in terms of straight-line demand and supply curves of the same slope but opposite sign. In the example here given, tickets for both buyers and sellers ranged from 18 to 104, taking even numbers only. Since there were more tickets than there were participants, the B and S cards were shuffled separately, and the requisite number of each was dealt off the top. This procedure leaves irregular random gaps without altering the essential symmetry of the schedules and enables the instructor to say truthfully that he does not himself know in advance what the equilibrium price is.

ANALYSIS OF RESULTS

Let us now follow through an example. The figures are given in Table 1. Actual sales were 19 units, and the average of actual prices was 52.63. The perfectly competitive figures are obtained by arranging buyers' tickets in descending, and sellers' in ascending, order and placing the two columns in juxtaposition, as at the right of Table 1. The schedules are shown graphically in Figure 1. Perfectly competitive sales are found to be 15, substantially less than the actual figure; and the equilibrium price is found to be indeterminate between 56 and 58 or, to take a single figure, 57, which is substantially more than the average of actual prices.

These divergences are clearly without significance when only a single example is considered, since they might easily have resulted from mere chance. Let us therefore look at the summarized results of the forty-six times the experiment has been carried out. In these forty-six ex-

periments the actual volume of sales was higher than the equilibrium amount forty-two times and the same four times. It was never lower. The average price

TABLE 1

Transactions			Market Schedules	
B	S	P	B	S
56	18	55	104	18
54	26	40	102	20
72	30	50	94	26
84	34	45	90	28
44	44	44	86	30
102	42	42	84	32
80	20	40	82	34
60	28	55	80	36
48	40	45	76	40
76	36	45	74	42
94	52	55	72	44
68	58	62	68	46
66	46	55	66	50
82	32	58	60	52
90	72	72	58	54
104	54	54		
52	50	50	56	58
86	64	64	54	62
74	62	69	52	64
			50	66
Left Over			48	68
			44	70
38	68		38	72
50	66		34	74
28	82		32	78
32	88		30	80
18	90		28	82
26	84		26	84
22	104		24	88
24	78		22	90
30	80		20	98
20	98		18	104
34	74			
58	70			

Equilibrium sales..... 15
Actual sales..... 19

Equilibrium price..... 57 (56–58)
Average of actual prices... 52.63

was higher than the equilibrium price seven times and lower thirty-nine times. The schedules used—hence the equilibrium values—were different in each example, and no statistical computations for the entire sample of forty-six experiments have been made. The simple figures given, however, clearly indicate divergences not to be attributed to chance. They require explanation.

The characteristic excess of actual sales over the equilibrium amount, as indicated by the demand and supply curves, is explained by the fact that imperfections introduce prices above and below the equilibrium figure. At prices above it some "normally" excluded sellers may make bargains; at prices below it

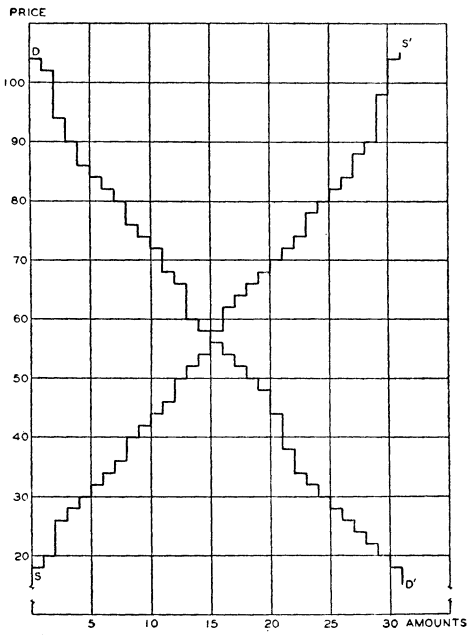

Fig. 1

some "normally" excluded buyers may make bargains. For instance, the seller whose limit is 58—and who would not make a sale if the market were perfect—has a good chance to make a bargain with *any* of the normally included buyers; sellers 62, 64, and 66 with any of the first thirteen buyers; seller 68 with any of the first twelve buyers, and so forth. Sellers 58, 62, 64, and 72 did, in fact, dispose of their units in the example before us. Similarly, buyers 56 and 54, normally excluded, can make a bargain with *any* of the normally included sellers;

buyer 52 with any of the first fourteen sellers; buyer 50 with any of the first thirteen sellers, and so forth. Buyers 56, 54, 52, 48, and 44 did, in fact, make purchases in the example before us. Since every buyer and seller will, by hypothesis, make a bargain within his limit if possible, the volume of sales can never fall below the equilibrium amount;[2] and the bringing-in of normally excluded buyers and sellers almost always carries it above this amount, as in the present example. The conclusion seems unavoidable that "price fluctuations render the volume of sales normally greater than the equilibrium amount which is indicated by the supply and demand curves,"[3] a proposition which must be of substantial importance in applying theory to the real economic world, since all actual markets, whether purely or monopolistically competitive, are more or less imperfect.

Although no *pair* of normally included buyers and sellers can fail (by hypothesis) to make a bargain, individual buyers *or* sellers, normally included, may so fail, as did buyer 58 in the present example. In a perfect market he would have made a purchase; yet, before he actually did so, all those with whom he might have made a contract had committed themselves with others. Such exclusion has happened for a single normally included buyer or seller perhaps ten to twelve times out of the forty-six trials. It might conceivably happen for more than one (always on the same side of the market) —as, for instance, in the present example—if seller 28 had made a bargain with buyer 50 instead of with buyer 60, in which case both buyers 58 and 60 would have been excluded at the end.

This possible exclusion (by imperfections) of normally included buyers or sellers was first revealed by the experiment, which thus served to correct an erroneous statement,[4] carelessly made on the basis of purely abstract analysis, that such could not be the case. This may be meager fruit from our "laboratory" method, but it proved at the time exciting at least to the writer and to one particular group of students.

What now explains the characteristic tendency of prices to be lower than the equilibrium figure, as witnessed by the price average being lower thirty-nine times and higher only seven times out of the forty-six trials? By contrast with the characteristic excess of sales just discussed, there seems to be nothing in the

[2] In perhaps four or five cases out of the forty-six it was discovered—when the unused tickets were turned in at the close of the market—that a single transaction which could have been made had not been made. In other words, the highest remaining buyer's ticket was higher than the lowest remaining seller's ticket. In each of these cases the bargain was ruled as having been made at the midpoint between the two figures. This procedure was justified on the ground that, since there was pressure for time, the buyer and seller would, in fact, have found each other if the market had lasted longer. The reader may judge for himself the legitimacy of this procedure—the results would have been changed only slightly, had it not been resorted to.

[3] Since I reached this conclusion on the basis of abstract argument in 1933 (*op. cit.*, p. 27), I have never seen it challenged, with the single exception of a brief critical comment by R. F. Harrod in the *Economic Journal* (December, 1933, p. 666). Mr. Harrod believes that I have "slipped into error" and that the argument "would be appropriate to a simultaneous manifold of prices, but not to a variation of prices through time."

It will appear from the latter portion of this present article how the argument does apply, at least under certain assumptions, to the variation of prices through time; but this phase of the matter was not made explicit in the earlier brief treatment to which he took exception. I believe that his point is not damaging but shall not attempt to discuss it in detail, since he might not himself make it against the argument as now developed. I might add that the time analysis below is entirely a by-product of the laboratory market.

[4] *Op. cit.* (1st ed.), p. 27: "Since none of the normally included buyers and sellers can by any circumstance be left out. . . ." The statement is corrected in subsequent editions.

problem as defined which would account for it—at least, neither the writer nor any one of hundreds of students who have participated in the experiment has been able to find anything. Several plausible explanations *not* related to the mechanics of the problem have indeed been advanced but, before stating them, it will be instructive to note several ways in which a bias (upward or downward) *might* have been introduced into the conditions of the problem itself, as indicated by the shapes and lengths of the schedules. For this purpose simple diagrams are useful.

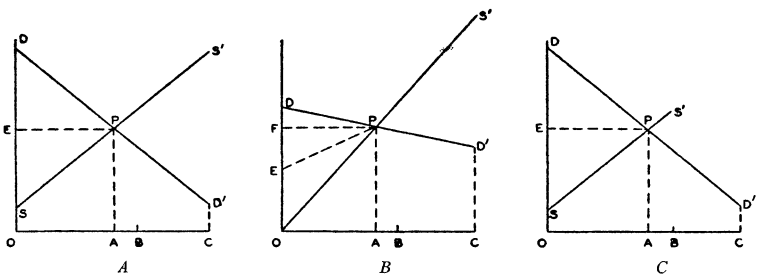

FIG. 2

The demand and supply curves for the problem were always approximately as shown in Figure 2, *A*, where evidently—granted equal bargaining power and skill on both sides—one would expect *average* prices to show no systematic deviation from *AP*.

If the curves had been shaped as in Figure 2, *B*, the demand curve being much flatter than the supply curve, the midpoints between successive normally included buyers' and sellers' limits would lie on *EP*, and their average is evidently $(OE + OF)/2$, or less than *AP*. Taking in normally excluded buyers and sellers represented by *AB* and extending *EP* accordingly would raise this figure; but it would equal *AP* only when *all* excluded buyers and sellers were regarded as influencing the actual prices by their offers and attitudes. It seems clear that those farthest to the right would have, at best, an influence less than those normally included and, therefore, that curves of this shape would give a downward bias to average prices. Similarly, the manner in which a steep demand curve and a flat supply curve would indicate an actual average higher than *AP* is evident.

Again, if either curve had been shorter than the other, bias would have resulted. Thus if, as in Figure 2, *C*, the supply curve were cut short as shown—although there would be no bias if only those buyers and sellers to the left of *B* were considered—the presence of buyers from *B* to *C* would tend to pull prices down. Similarly, if the demand curve were shorter than the supply curve, there would be a tendency for the presence of more suppliers with higher limits to pull prices upward.

To repeat, however, the curves were generally symmetrical, as in Figure 2, *A*. How, then, can the downward bias in the results be accounted for? Three explanations have been given: (1) College students are, on the whole, more used to being on the buyer's side of the market than on the seller's. Those receiving buyer's tickets are therefore likely to feel more natural and to bargain more effectively. A corollary would be that, if the experiment were tried with a group of stockbrokers, who deal constantly on

both sides of the market, the bias would be eliminated. (2) The markets with which students are mostly familiar (even though from the buyer's side) are retail markets, where, as a matter of market technique, there is no bidding on either side but a placing of prices upon goods by sellers. In the experiment the sellers therefore would have a strong tendency to look at what was formally defined as their lower limit, or *supply price*, as really a *price*. If they sold at anything at all above this figure, they would feel that they had done very well indeed and would be unlikely to press for a greater advantage. A corollary to this explanation would be that if the experiment were tried with a group of employers in an unorganized labor market, where prices (wages) are named by the buyers (employers) and accepted or rejected by the sellers (laborers), there would be an upward, rather than a downward, bias.[5] (3) In real life, buyers come into a market with money or general purchasing power which will still serve them in other markets if they fail to make a purchase in this one. Sellers, on the contrary, come into a market with goods for which, in general, they have little or no use themselves and which they are therefore eager to convert into money. Whatever may be the effects of such considerations in various markets in the real economic world, they may have unconsciously affected the participants in the experiment. A corollary would be that, if the problem had been defined somehow in terms of a barter of two commodities instead of in terms of a sale for a money price, there would have been no bias.[6]

It may be added that, in several instances, a first price either above or below the equilibrium was followed by others similarly above or below. Of course, no causal relation is proved by such sequences; but it is at least possible that—since no one knows what the equilibrium price is (incidentally, a very realistic feature of the laboratory market)—the first bargain was interpreted as near the equilibrium figure and hence mistakenly followed as a guide by others. This factor would evidently afford no explanation of bias in a large number of examples, since early prices would in repeated experiments occur both above and below the perfectly competitive figure.

All the sources of possible price "bias" that have just been discussed would be quite without influence if the market had been perfect. This is true of both the shapes and the lengths of schedules (Fig. 2, *B* and *C*) and of "bargaining power," the myriad aspects of which have been only suggested by the three possible explanations of a downward bias in our particular problem. The conclusion must be that important forces present in *actual* (always imperfect) markets may be wiped out by the perfectly competitive assumption—forces which produce not random deviations but systematic and predictable departures from "perfectly competitive" norms. Such forces must be given their due importance in defining the norms toward which prices "tend." They would presumably cause the same or similar deviations from the norms of perfect monopolistic competition as from those of perfect competition in the case at hand.

[5] Strictly speaking, it would be necessary for the market experience of the participants in this case to be dominated by the labor market rather than by other (such as retail) markets, in which they would also take part in real life. A similar reservation should be made under (1), above.

[6] If any reader can offer other (plausible) reasons than these three, I should be interested to hear them.

A "MOVEMENT TOWARD" EQUILIBRIUM?

In Marshall's description of equilibrium in a corn market he says that "unless they [the two sides] are unequally matched—unless, for instance, one side is very simple or unfortunate in failing to gauge the strength of the other side—the price is likely to be never very far from 36*s*. [the equilibrium figure]; and it is nearly sure to be pretty close to 36*s*. at the end of the market."[7] It may be of interest to note that no tendency for

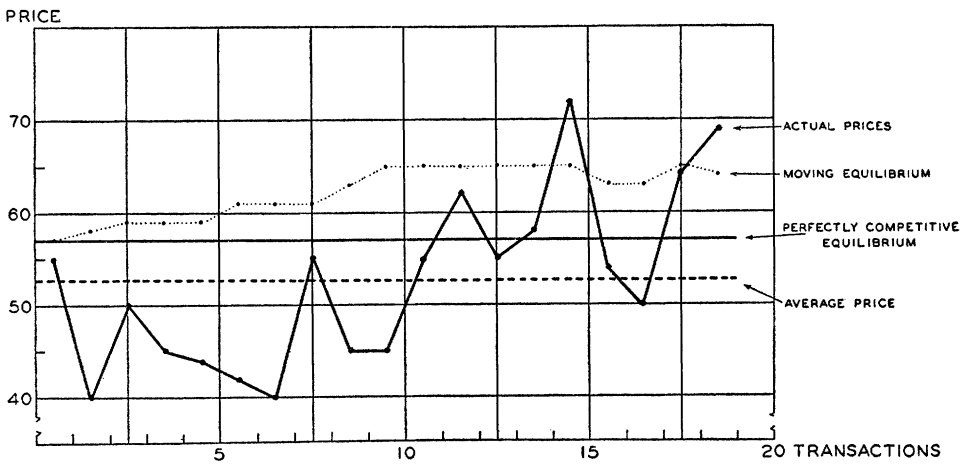

FIG. 3

prices to move toward equilibrium during the course of the market or for the last price to be closer to equilibrium than earlier ones is discernible in the data of our experiment.

In Figure 3 the successive prices are plotted in relation to the equilibrium figure of 57 (also in relation to the average figure of 52.63 and to a "moving equilibrium" to be explained shortly). The trend of prices during the market is evidently upward, thus correcting the earlier bargains at low figures. But, after what might appear to be a "movement toward equilibrium" in the eleventh to fourteenth transactions (prices 55, 62, 55, 58), there are again wide deviations and a final price upon which the market closed, which, if anything, is striking for its divergence from equilibrium. Among the other forty-five examples, the most diverse patterns appear, with no apparently predominant tendencies to be noted.

It may be recalled that prices were sometimes written upon the blackboard as deals were completed and sometimes not; and it might be thought that a tendency toward equilibrium could be expected only when this information (analogous to the stock-market ticker tape) were provided for the remaining buyers and sellers in the market (as it was in the case before us). This view, however, reveals an all-too-common confusion between actual prices and the equilibrium price. All that can *ever* be known—either before, during, or after any *real* market—is the actual prices; for no buyer or seller can know any limits other than his own and data on the mental attitudes of the various buyers and sellers are never available to the economist who would like to construct the

[7] Alfred Marshall, *Principles of Economics* (8th ed.), p. 333.

schedules. Our laboratory market is of particular significance in that the schedules *can* be constructed after the market has ended, although they are, quite realistically, unknown to the participants during its existence. Actual results can therefore be compared with the hypothetical ones. Information during the market as to the *equilibrium* price would help establish a trend in that direction, but information as to *actual* prices may do the opposite, in so far as they are divergent from equilibrium and are falsely interpreted to be near it. (This was possibly the case in the first half of the market before us.)

My own skepticism as to why actual prices should in any literal sense tend toward equilibrium during the course of a market has been increased not so much by the actual data of the experiment before us—which are certainly open to limitations—as by failure, upon reflection stimulated by the problem, to find any reason why it should be so. It would appear that, in asserting such a tendency, economists may have been led unconsciously to share their unique knowledge of the equilibrium point with their theoretical creatures, the buyers and sellers, who, of course, in real life have no knowledge of it whatsoever.

THE SHORT-TIME COMPONENTS OF LONG-TIME MARKETS

Our analysis enables us to compare a "long-time" market with various types of shorter-time ones contained within it. Such comparisons arose out of the experiment and will be introduced here in the order in which they actually evolved from it.

In the first place, it appeared that there might be recomputed after each transaction the new equilibrium price for the market as it then stood. In this way we recognize what is evident upon reflection—that in any market situation the bargain which has just been completed is no longer a part of the market, the situation henceforth being described by the demand-and-supply schedules remaining rather than by the initial ones. If the bargain in question was made between a buyer and a seller both of whom were intra-marginal, they would cancel out, and, in spite of their disappearance from the schedules, the equilibrium price for the remainder would be unaffected. But if either the buyer or the seller was either marginal or extra-marginal, the intersection of the schedules would be affected, and, in general, a new equilibrium would be defined. The procedure for discovering the new equilibrium is as follows: remove from the demand-and-supply schedules—as arranged in Table 1 on the right—the tickets for the first transaction (B-56, S-18), move up the buyers' tickets below 56 and the sellers' above 18 to fill in the gaps, and read off at the margin the new equilibrium figure for the second transaction; then remove the tickets for the second transaction (B-54, S-26) to discover the equilibrium price for the third; and so on. This has been done in Table 2 and is plotted in Figure 3 as the "moving equilibrium."

It now appears that the equilibrium, as defined for a market by the original conditions and ordinarily identified with it throughout its entirety, may be quite out of line with a substantial portion of it. In the present example the equilibrium price of 57, indicated by the curves, holds only for the first transaction. It rises steadily thereafter until, when the market is half over (after the ninth transaction), it stands at 65, eight points above the initial figure, and its final value (for the last transaction) is 64. Its average is 62.32, more than five points

above the conventional conception of equilibrium for the market. It would seem that, whatever the "tendencies" one might expect toward equilibrium, they would be toward this constantly "corrected" moving figure rather than toward the initial one. In this sense its average of 62.32 is much more significant than the "perfectly competitive" 57. On the other hand, the path and average value of the moving equilibrium cannot be discovered from the original conditions alone—it is the product of the actual unfolding of the market.[8]

A second and more important type of "submarket" arose out of an attempt to discover the supply and demand schedules which set the limits for the *individual* transactions, since these are evidently not governed by the limiting prices in the larger market. Thus the limits set by the original schedules (Table 1) are 56–58, and only one of the actual transactions took place within them—the fourteenth, at the price of 58. The type of submarket just obtained—by narrowing down the original market through removing, one by one, the completed transactions—does not advance us in our quest, for here again only one transaction took place within the limits indicated for it by Table 2—the next to the last one at the price of 64 (limits 64–66). Even the very last transaction, in whose market "equilibrium sales" are only *one unit*, took place at a price (69) outside the limits (62–66) set by its own schedules! How can such things happen? Cannot some type of "submarket" be defined which will obey the law of supply and demand within itself?

Let us look for a moment at a real market, such as the stock exchange, where it seems evident that the transactions of a year, regarded as an annual market, may be broken up into months, weeks, and days, and even those of a day into hours and minutes. A market extending for *any* period of time—even ten minutes, as in our classroom problem—is in some sense a summation of markets of still shorter duration. In such a succession of markets, prices change because conditions change. Not only are buyers and sellers constantly dropping out because they have completed contracts, but new buyers and sellers are constantly being added. Also buyers' and sellers' limits are constantly changing as they re-evaluate their willingness to buy or sell in view of changing moods and new information, including the behavior of the market itself. Schedules are constantly shifting, and we now see that

TABLE 2

Transaction No.	Limits of Equilibrium Price	Equilibrium Reduced to Single Figure
1	56–58	57
2	58–58	58
3	58–60	59
4	58–60	59
5	58–60	59
6	60–62	61
7	60–62	61
8	60–62	61
9	62–64	63
10	64–66	65
11	64–66	65
12	64–66	65
13	64–66	65
14	64–66	65
15	64–66	65
16	62–64	63
17	62–64	63
18	64–66	65
19	62–66	64
Average of successive equilibria		62.32

[8] Just as no reasons were found in the "mechanics" of the problem itself for the downward bias in actual prices as compared with "equilibrium," so there appear to be no reasons for systematic bias in the relationship of the moving equilibrium to the initial one: its movement upward and its higher average value in the present example are not to be taken as typical.

what appear to be "imperfections" over any substantial period may alternatively be regarded as a succession of prices under a succession of different demand and supply conditions.

In these respects our classroom example was highly realistic—it was actually composed of a succession of submarkets, in each of which only a fraction of those in the more general market were to be found. Bargaining was going on not only over a period of time but also in

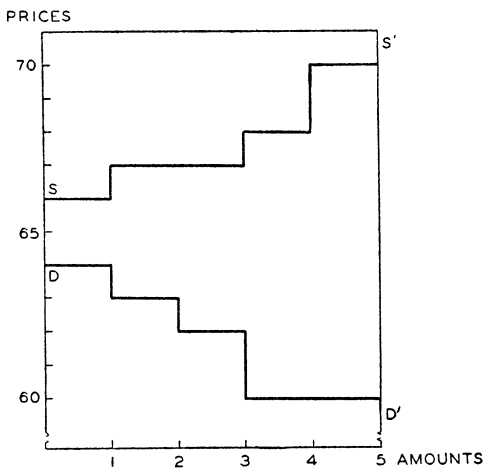

FIG. 4

numerous places at the same time, between groups ranging from two to half a dozen. There was a continual shifting about of individuals, and each momentary grouping constituted a market in a very real sense, with schedules and limits of its own. May it not now be said that each price was necessarily within the limits of these smaller markets, even though outside those defined by the larger ones?

The answer is "No," since (in the absence of recontract) these smaller markets are also imperfect. In the vagaries of bargaining, it is always possible that an actual offer made by someone at a figure outside the limits set by the schedules will be accepted by someone else before it is replaced by a competing offer nearer to or within the limits. For the same reasons as in the larger market, therefore, the actual price or prices in these smaller ones need not lie within the range which, according to their schedules, equates demand and supply.

Let us therefore proceed to a third type of submarket: the still smaller momentary one in which each transaction is made. Before any contract can be closed, *actual* bids and offers must be made. Such bids and offers give us still another set of schedules, whose nature at any moment must be that all bids lie *below* all offers so that the demand and supply curves do not meet and no contract can be made until the curves change. When a bid is raised or an offer lowered to a meeting point so that a contract is closed, this "market" includes momentarily *within the margin* only a single buyer and seller, both of whom then drop out, leaving again a demand curve (bids) lying at all points below the supply curve (offers). Schedules for such a market are illustrated in Figure 4, where the highest bid is 64 and the lowest offer 66.

This "market" of actual bids and offers is in a sense more real than any of the others, since the limiting prices which make up its schedules are the only ones which ever receive objective expression. A familiar example is the schedule of bids and offers in the hands of the specialist in charge of each security on the stock exchange. One is tempted to conclude that only when we have reached this ultimate and irreducible "market" will particular prices conform with certainty to the range within which supply and demand are equated, the range in this case being always reduced to a point;

but, in fact, the conditions are not quite so severe as this.

The conditions necessary in an imperfect market to assure that a particular price lies within the limits where supply and demand are equated are (*a*) that all demand and supply prices within the margin be marginal and (*b*) that they constitute the effective limits to price, the first extra-marginal items lying outside them. The first condition allows for the possibility of what might be called a "multiple margin" with several sales;[9] more usually, however, the equilibrium volume would probably be limited to a single transaction. If this first condition were not met, a contract might be made with an intra-marginal buyer or seller at a price beyond that of the marginal buyer's or seller's limit. If the second condition were not met, a contract might be made with a marginal (or intra-marginal) buyer or seller at a price beyond the limit set by the first extra-marginal seller or buyer.[10] The market of actual bids and offers is a particular instance under these more general conditions, in which the marginal demand price and marginal supply price are equal at the actual price.

The strange case of the last transaction in our original problem is now seen to be explained as an instance of the failure of the second of these conditions. The market for it may be reconstructed from the leftover tickets in Table 1 plus B-74 and S-62, who made the last bargain. With buyers 74 and 58 (plus others lower) and sellers 62, 66, 68, and 70 (plus others higher) the limits were set by the marginal seller (S-62) and the first extra-marginal seller (S-66). Yet the actual bargain, made by S-62 and B-74, was at the price of 69. In the market of actual bids and offers, either S-62's offer of 69 was accepted by B-74 or the other way around; and clearly, *in this market*, the *actual* offers of S-66 and S-68 were either above 69 or lacking altogether, thus giving conformity to our second condition. In the *more general market*, however, S-66, the first extra-marginal seller, defined the upper limit to price; the second condition, therefore, was not met. In terms of this larger market the contract at 69 was made possible only by the inactivity of both S-66 and S-68, who were either trying to make a bargain somewhere else at the time or, if immediately present, were holding off, hoping to do better in a moment. (It must never be forgotten that in the problem, as in real life, both the equilibrium price and the remaining number of possible transactions are quite unknown to the participants.)

The phenomena here described in abstract terms are quite familiar in real life, and examples are not hard to find. Suppose A is willing to pay $50\frac{1}{2}$ for 100 shares of a security, but, the last sale being at 50, he enters a bid at that price,

[9] As an example of a "multiple margin," there might be five buyers with identical limits of $2.00 and five sellers with identical limits of $1.00 and no other buyers or sellers. The market price would then lie between the limits of $1.00 and $2.00. There might be five different contracts at different prices, but none of them could lie outside the limits set by the market.

[10] To illustrate the first possibility, assume buyers 52, 50, and 46 and sellers 46, 48, and 52 (limits 48–50, set by the marginal buyer and marginal seller). Either included seller might contract with B-52 at 51, or either included buyer might contract with S-46 at 47, in either case outside the limits within which supply and demand are equated. To illustrate the second possibility, assume buyers 52 and 48 and sellers 46 and 50 (limits 48–50, set by the first extra-marginal seller and first extra-marginal buyer). Either seller (marginal or first extra-marginal) might contract with B-52 at 51, or either buyer (marginal or first extra-marginal) might contract with S-46 at 47, in either case outside the limits within which supply and demand are equated. The reader may find it helpful to work out these cases for himself in simple graphs.

hoping to save half a point. Suppose, now, that another buyer, B, whose upper limit is $50\frac{1}{4}$, makes the next purchase at $50\frac{1}{8}$ and that all subsequent sales are higher than $50\frac{1}{2}$ indefinitely, thus excluding A. B was clearly the first extramarginal buyer at the time he made his purchase (except, of course, in the market of actual bids and offers), and his upper limit of $50\frac{1}{4}$ was the lower limit to the price. Yet the actual sale took place below this at $50\frac{1}{8}$, and he was the one to make the purchase instead of A. This sort of thing must happen over and over again daily on the great exchanges, and I should hazard the guess that many a reader will recognize himself in the unhappy role of *ex ante* included, but *ex post* excluded, buyer A.

Again, let us suppose that a man is willing to go as high as $25,000 for a house but actually bids only $20,000, expecting to get it for this figure. The owner offers to sell at $22,000, but the prospective buyer still thinks he can get it for $20,000 and decides to hold out for a few days more. Meanwhile, the seller's offer of $22,000 is accepted by someone else.[11]

AN EXPERIMENT WITH SUBMARKETS

Actual data have not been recorded for submarkets of the second and third types discussed above, since such markets have not, in fact, been determined experimentally. Yet it may be instructive to consider how this might have been done—for example, in the case of the second type (consisting of smaller groupings within a given aggregate)—and to carry through an approximation to the experiment. It would have been possible to create the smaller markets, after the tickets for the larger market had been distributed, by designating a series of smaller groups and recording the data for each. The fact that the demand and supply prices of the participants in such markets would not, in general, be the same as for the larger market (although necessarily lying within the latter as limits) could be taken into account by having the participants submit their individual limits for the smaller market (in secret) to a central authority in each case before the bargaining began. An approach to this procedure, which will indicate in a general way what is involved, may be achieved under somewhat more restrictive assumptions by mechanically dealing out the cards after the manner of solitaire and reading off the results.

For this purpose let us assume (*a*) that the limits for the larger market (i.e., the figures on the tickets) are also those of the smaller markets; (*b*) that the smaller markets consist of a succession of subgroupings from the larger one, taking buyers and sellers at random and removing those who make bargains as fast as they are made; and (*c*) that the equilibrium price indicated by the submarket schedules actually obtains in each case. The rules followed might be subject to further variation in detail, but the example given will illustrate the possibilities.

The same schedules were used (right of Table 1), except that they were shortened by cutting off some of the extreme excluded buyers and sellers: buyers at 30 and below and sellers at 80 and above. This leaves twenty-four buyers and twenty-four sellers. Both the B and the S tickets were well shuffled, and three of each were dealt off to compose the first market, as shown in Table 3. Two trans-

[11] In this example, any resemblance between the buyer in question and any of the author's friends is purely coincidental.

actions resulted at a price of 55 (assumed to be midway between the limits of 48 and 62). Tickets for these two transactions were removed, and those for the excluded buyer and seller (B-48 and S-62) were put back into the pack, which was then reshuffled and the process repeated. There were fourteen markets as indicated in the tables and summarized below them. There was an aggregate of 20 sales, which should be compared with a volume of 15 if the same sellers with the same limits had made up a single perfect market, as shown in the schedule at the right of Table 1. The average price was 57.05, which happened in this case to coincide almost exactly with the equilibrium price in the perfect market (taken as midway between the limits).

The same method was tried, taking six buyers and six sellers at a time, with resulting total sales of 19; it was tried again, taking twelve each at a time, with resulting total sales of 17. Again, moving in the opposite direction from the original three each, taking two each at a time was tried, with resulting total sales of 21; and taking one each at a time—a succession of bilateral monopolies—with resulting total sales of 23. It seems evident that, as the number in the submarkets increases from two (the minimum of one buyer and one seller) to forty-eight (twenty-four buyers and twenty-four sellers), where it equals that of the larger market, sales tend to diminish until, when all buyers and sellers are present at once, they equal 15.

A conclusion of some practical import is indicated by this experiment. If, instead of trading continuously in the stock market (for example), buyers and sellers submitted bids and offers hourly to a central authority who would arrange them in schedules and announce the equilibrium price, the volume of sales would be substantially reduced without (it would appear) greatly interfering with

TABLE 3

Market 1		Market 2		Market 3	
B	S	B	S	B	S
94	26	84	20	102	58
82	40	74	34		
		72	64	58	66
48	62			56	68

Market 4		Market 5		Market 6	
B	S	B	S	B	S
60	50	76	62	104	44
		68	66	90	70
52	66				
32	74	66	68	58	72

Market 7		Market 8		Market 9	
B	S	B	S	B	S
56	36	52	42	66	18
54	54			50	28
		50	52		
34	78	48	68	34	68

Market 10		Market 11		Market 12	
B	S	B	S	B	S
86	32	80	46		
				48	52
44	46	44	52	44	68
32	52	34	78	38	74

Market 13		Market 14		Left Over	
B	S	B	S	B	S
44	30	58	52	48	68
				38	72
38	52	48	68	34	74
34	72	34	72	32	78

SUMMARY

Market No.	Sales	Price
1	2	55
2	3	68
3	1	62
4	1	56
5	2	67
6	2	71
7	2	54
8	1	51
9	2	42
10	1	45
11	1	49
12	0	.....
13	1	41
14	1	55
Total	20	.....
Av. price (weighted)	.....	57.05

anyone's legitimate purchases or sales of securities.[12] If such bids and offers were submitted once a day, the volume would be still further reduced.

As an added factor in reducing volume, it appears likely that manipulation would in some measure be interfered with by such a procedure, since the common technique of making prices move by control over a quick succession of momentary submarkets (consistent with much less or no control in the longer-time market) would be impossible. That part of total sales which is manipulative would therefore be reduced. On the other hand, there seems to be no reason why speculation arising out of legitimate differences of opinion as to the relation between present and future values would be interfered with in any degree.

No attempt will be made to give a detailed summary of conclusions, but a final word of caution is necessary. All the above analysis has been carried out in terms of curves of falling demand prices and of rising supply prices, and its conclusions may evidently not be generalized beyond these conditions. The important cases of a fixed (perfectly inelastic) supply, of constant cost, and of decreasing cost have not been touched upon; and, indeed, further considerations (especially in relation to the short versus the long run) would arise in the interpretation of our curve of rising supply prices as a cost curve. Some slight beginnings have been made in looking into these cases, and it is evident that they pose problems of their own. For instance, in the case of a fixed supply, sales *could* not, by hypothesis, be greater than the equilibrium figure (what happens then?); and in the case of constant cost (indeed, in *all* cases of cost) the familiar problem is raised of the nature of the costs appropriate to the short-run (submarket) and long-run (total-market) conditions and of their relations to each other. But consideration of these problems is not included in this paper.

One final comment: an objection may be made to this general line of analysis to the effect that it yields only the expected results of its special conditions—that "no one would ever have thought that if a market were broken up into a series of individual pairs of buyers and sellers, and dealings run in successive contracts through time, there would be any tendency toward the market-clearing price of a perfect market."[13] But is this not precisely what *has* been thought? It cannot be overstressed that all *actual* markets are, *in fact*, a succession of contracts separated in time; and actual markets have been thought by generations of economists to be approximately described by the device of a perfect market, which assumes that they are not separated in time. If it seems that strange results have been here derived by subjecting market schedules to arbitrary manipulations, it is replied that the "manipulations" are intended to be realistic and not arbitrary. Perhaps it is the perfect market which is "strange"; at any rate, the nature of the discrepancies between it and reality deserve study.

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[12] There would be nothing really novel about such a procedure, since it is, in fact, followed each day for the accumulated bids and offers at the ten o'clock opening of the market in New York.

[13] Specific comment made to the writer.