CHAPTER FOURTEEN

CYCLICAL MOVEMENTS IN INDIVIDUAL MARKETS

INTRODUCTION

WE HAVE indicated in chapter viii that prices and quantities in a number of individual markets show cyclical fluctuations which have periods different from those of the general business cycle. Sometimes these fluctuations are clear only for either prices or quantities. We shall now turn to an explanation of these special cycles. They are not of great importance for the explanation of the general business cycle; it will appear, however, that they have great scientific significance. Because they occur in a more limited field, they can be studied more accurately and the relationship of the various variables is simpler. Study of these cycles will reveal certain basic types of movements that show certain dynamic characteristics in their simplest form. Such a study is therefore of great importance for a good understanding of economic dynamics, quite apart from the relative weight of the commodities involved in the economy. This study will also permit a greater attention for details than is usually possible in studies of general cyclical problems.

THE HOG MARKET

As a first approximation the explanation of the individual cycles in the hog market may be presented as follows. If for one reason or another there is an unusually large supply of hogs, the price will be unusually low; otherwise consumers will not be prepared to consume a larger than normal quantity of pork. This low price will have an unfavorable effect on supplies; but this influence will not be felt immediately; the "production" of

pigs requires a certain period. The natural process, consisting of a gestation period of four months and, in most countries, a fattening period of a year would in itself lead to a lag of sixteen months; to this should be added a period of a "psychic lag" on the part of the farmer who requires a certain time to appreciate a certain market situation. Various authors, therefore, assume a total lag of a year and six months to a year and nine months. Hence a year and a half, or somewhat more, after a low level of prices there will be a relatively low supply of hogs. This will lead to a high level of prices almost without a lag. This high level of prices will, again in a year and a half or somewhat later, lead to a high supply of hogs. Hence there is a tendency to a lasting cycle. Characteristic of this mechanism is that prices and quantities show opposite movements, with low prices corresponding to a typical situation of "overproduction." The model of the hog market is the simplest model of alternating over- and underproduction of commodities of which the volume of production can be controlled. A necessary condition for the occurrence of overproduction, that is to say, a larger production than the suppliers would themselves be prepared to offer in the long run, is a lag between price and the corresponding supply. If there were no lag, suppliers would always be able to regulate supply in accordance with the price. This necessary lag is the only dynamic characteristic of our model.

It will be noted that we deal here again with a very simple case of endogenous fluctuations but of a type different from that given in Example III. This model is still much simpler and is particularly suitable as a methodical starting point for the study of endogenous fluctuations. It has the advantage that the effect of the different data on the character of the movement can easily be seen. Thus it is clear that the period will be double the lag between a change in prices and a change in the quantity supplied. To illustrate a number of other characteristics of the model, we use a graphical representation which is closely related to the demand and supply curves (Fig. 50). The line AB is the ordinary demand curve for pork. The line CD may be compared with the supply curve; but it should be understood in this sense that it indicates for every price p, the quantity x which will be

supplied after a year and a half, that is to say, after the assumed lag. It is assumed that the quantity supplied does not depend on the current price. There will probably always be some effect of the current price, but in the particular case of the hog market this effect appears to be extremely weak and may be disregarded. Hence the instantaneous supply curve would be a vertical, or nearly vertical, line. Since the quantity supplied depends on the price a year and a half earlier, this line would, however, be subject to constant shifts. It is therefore simpler in this case to work with a supply curve as indicated by the line CD. There

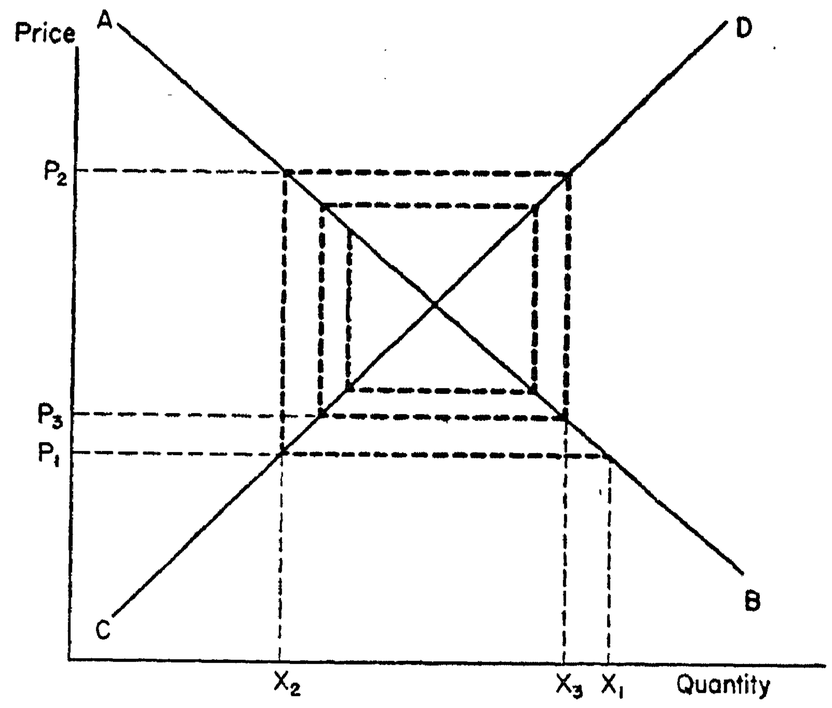

FIG. 50.—The cobweb theorem: diagram to determine the movement of prices and quantities if supply reacts to price with a certain lag.

would seem to be no objection to calling CD a supply curve even though this means some expansion of the concept of a supply curve. We might also call it a quasi-supply curve.

If we measure time in units equal to the lag, the quantity supplied at time 1 will be equal to x_1 (as shown in the diagram) which, on the basis of the demand curve, will lead to price p_1 at the same time. This price p_1 will after one lag period lead to a quantity supplied x_2, which can be found by using the line CD. The quantity x_2 will lead to a price p_2, etc. The entire further development of x and p can be read from the diagram, and it will readily be seen that a fluctuating movement will occur. Strictly speaking, our considerations apply only to individual

periods of time which are not connected and are at distances of approximately a year and a half. However, if one knows all these points, the intermediate positions may be "filled out" in a similar way, so as to give a picture of the full development.

This development over time has been called the "cobweb theorem" because of the shape of Figure 50. The same diagram will also assist us in understanding the character of the movement on the basis of the slopes of the lines *AB* and *CD*. (1) If both lines have the same absolute slope with a contrary sign, there will be a purely periodic movement. (2) If the slope of the quasi-supply curve is greater than that of the demand curve, that is to say, if supply is less elastic than demand, there will be a damped periodic movement. (3) If the slope of the quasi-supply curve is less than that of the demand curve, there will be an antidamped movement. In the first and third cases, the equilibrium position in which the price and the quantity are determined by the co-ordinates of the point of intersection will not be attained.

This fact is also of principal significance since it indicates that any qualitative reasoning which tends to prove an approximation to an equilibrium position can have only very limited validity. It should further be clear that the movement is set off only if and when a certain disturbance from equilibrium occurs. If initially there had been a position in accord with the point of intersection of the demand and supply curves, no movement would have occurred. The larger the initial disturbance, the greater the amplitude of the movement.

When the slope of the quasi-supply curve is less than that of the demand curve, the amplitude of the resulting antidamped movement cannot, of course, increase without limit, as would result from an automatic application of the cobweb diagram. At a certain point the limit of the area is reached in which the approximations used, for instance, the straight-line demand and supply curve, remain valid. Beyond that point, the theorem should not be applied without the necessary adjustments.

As we have indicated, the preceding model reflects only the essence of the mechanism determining the prices and quantities in the hog market. A number of other factors which we have neg-

lected so far are of a certain importance in a second approximation.

On the demand side we have neglected the influence of changes in incomes and prices of competing commodities. Among the latter, beef is the most important. Demand may therefore increase not only by a decline in the price of pork but also by an increase in income or by an increase in the price of beef. These influences are on the whole less pronounced than those of the pork price, since the latter shows wider fluctuations. But during the depression from 1929 to 1932, the effect on pork consumption of falling income was also of considerable importance. A country with large pork exports may also be affected by measures of commercial policy abroad. Both causes did in fact in a number of countries break the regularity of the hog cycle in the depression.[1]

On the supply side, there is also an influence of the cost of production, in particular of the price of corn. Corn prices, however, fluctuate much less than hog prices and are therefore of secondary significance.

A more fundamental point is whether the plans of farmers are not determined by the expected future price rather than by the current price. In principle this should be so. But the question is how these price expectations are determined. It would be wrong to assume that the cobweb theorem necessarily implies that the expected price is equal to the current price. The theorem is compatible with much more general hypotheses. If one were to assume, for instance, that the expected price would be halfway between the current price and the equilibrium price, the same theorem would apply. This in itself, however, would double the degree of damping. And one would have to assume a slope of the quasi-supply curve twice as steep with respect to the price axis to arrive at a movement of prices and quantities equal to that found earlier.

A number of other complications, to which reference has been

1. The opinion of Joseph Schumpeter (*Business Cycles* [New York and London, 1939], II, 430) that the entire hog cycle may be attributed to fluctuations in income is in any case incorrect for Europe, since incomes there do not fluctuate with a three-and-one-half-year period.

made in recent English and German publications, should be mentioned. In England, hogs are fattened during a shorter period, from four to eight months. This should reduce the lag by eight to four months. Yet the English cycle is not shorter than that in other countries where hogs are fattened for a longer period. An explanation of this phenomenon may perhaps be found in the influence of the international competition which determines in part the hog-price level in England.

The supply of hogs may also in part be determined by prices ruling much longer ago, since it depends also on the number of sows available, and this number is in part determined by a much earlier price situation; a sow normally produces five or six litters of pigs. The consequences of this fact have not yet been fully studied. Data necessary for such a study have only quite recently been collected in a regular fashion. But recently the hog market has been subject to many regulations which have affected the pattern of the movements.[2]

A more accurate study of the details of the hog cycle can also be made if a distinction is made between two phases of the production cycle which are often exercised in different farms: the production of pigs—for which there is a separate market—and the subsequent fattening. It would lead us too far to go into these details of the analysis. In this connection we refer to the literature.

THE COFFEE MARKET

After our exposition concerning the hog market, we can be brief in an explanation of the fluctuations in prices and quantities in the coffee market. On the whole, they show the same characteristics. Here, too, the fluctuation of prices is opposite to that of quantities (after elimination of the trend movement from the latter). Here, too, one may state that the demand side responds with a very small lag while there is a considerable lag in the adaptation of supply.

It takes seven years before a coffee tree yields coffee beans. If, therefore, the price situation is favorable and leads to increased

2. Wagemann has pointed out (*Narrenspiegel der Statistik* [Hamburg, 1942], p. 266) that the supply of hogs in Germany continued to fluctuate even after prices had been fixed. An analysis of this phenomenon has not yet been made.

plantings, it will be at least seven years before increased production comes to the market; usually it will take somewhat longer because a certain time elapses before the initiative to additional planting is taken. One may expect, therefore, fluctuations with a period of approximately double this period, and they do in fact occur. These fluctuations will be particularly strong as a high price level may perpetuate itself for seven years before any reaction appears in the market. During those seven years quite considerable plantings will be made.

As in the hog market, disturbances occur, among which differences in yield of the coffee trees should be mentioned especially. When there is an abundant yield, there will be a tendency toward a lower price that may interrupt the normal course of the cycle.

Since 1907, moreover, the coffee market has not been one of free competition. The government of Brazil, a country whose fate depends heavily on coffee, has oftentimes intervened in the market, taking considerable stocks out of the market and actually destroying them in order to influence prices. As a result, the tendencies mentioned have been much less clearly visible in recent decades. The coffee market is nevertheless of historic and theoretical interest; the long period of the production process is also a factor of significance in the regulation of the market which cannot be disregarded with impunity.

THE TWO-YEAR CYCLE OF AGRICULTURAL PRODUCTS

The explanation of a tendency toward a two-year cycle in prices and production of agricultural products would also be found in the length of the production process, together with the fact that production here is not continuous but discontinuous. Let us assume, for instance, that, by a random cause such as extremely favorable weather, the crop of sugar beets should be very large. As soon as the crop figures are known, this will lead to a relatively low price. This price will last for the major part of the crop year, until the new crop comes in prospect. The low price will still prevail at the time when the new sowings are made. At this low price the production of beets may be relative-

ly unprofitable; hence the area sowed with sugar beets will be relatively low and hence, normally, the succeeding crop will also be low. As a consequence of this the price in the next year will tend to be high. In the succeeding year this high price will lead to a larger area sowed and so generally to a larger crop. This will lead to a tendency to a zigzag movement which has often been observed.

This movement, however, can be disturbed to a very considerable extent by many factors. The most important disturbing factor is the fluctuation in crop yields. In the second year, as we have seen, the area sowed will be low. If, however, in this year the yield per acre is unusually large, it may be that the crop as a whole will not be small but average. This would interrupt the normal zigzag movement. Similarly, a large area sowed may be accompanied by a very low yield.

Other disturbing factors are the prices of products the farmer may grow instead of beets. Changes in these prices will affect the decision as to the area to be sowed with beets. The same applies to changes in the cost of production.

There may also be factors operating on the demand side, which would produce deviations from the mechanism indicated above. A strong cyclical recovery will push sugar prices up even when the crops are particularly abundant. This influence will be least pronounced in the case of agricultural products that satisfy very pressing needs, such as wheat and potatoes, but it is quite clearly observable in the case of sugar beets and cotton.

Furthermore, if one considers the market in individual countries, disturbances may originate in the crop movements in other countries, and they are not always parallel. There is, finally, a small systematic deviation from the simple pattern sketched above, on account of the fact that farmers are guided not only by the price at the moment of sowing but also, though in a much weaker degree, by the price of the preceding year. From investigations made by Donner it would further appear that farmers have a tendency to offset a change in the area sowed during one year by a change in the opposite direction during the next year. This fact in itself, without any other considerations, would be enough to explain a zigzag movement; but

this would then not be a movement that could be explained on the basis of economic considerations.

THE AMERICAN MARKET OF RESIDENTIAL CONSTRUCTION

As in the other cases, the actual pattern in the residential market in the United States is the result of causes that constitute the nucleus of the mechanism and of other factors which may more or less accurately be described as disturbances. For a good understanding, therefore, we first treat this nucleus, purposely abstracting from a number of factors to be discussed later.

Here, too, the time period of production has a role of importance. The building of a house will usually take one-half year to a year. Hence, a favorable situation for building houses will not immediately lead to a corresponding supply of dwellings. Two further complications should be added. In the first place, a house is a durable commodity. The total supply of dwellings or of "dwelling services" is therefore a result not only of the building process in the period immediately preceding but also of building activity in all preceding periods. As an approximation, one may say that all dwellings constructed earlier contribute to the supply of dwelling space; the number of houses of earlier centuries that have been demolished is in most cases quite small in comparison to the supply of houses that are still useful. For some cities with particular characteristics this may not be quite true; a somewhat more complicated relation will have to be devised for them.

A further special characteristic of the housing market is the inertia of price, that is, of rents. As a result, partially of long contracts concluded when houses are rented, partially also of the compartmentalization and the imperfection of the housing market, there is a great lag between the movements in the demand and supply factors and the corresponding movements of rents.

The essence of the model which may explain fluctuations in American residential construction is the following. The level of rents is determined mainly by the number of houses available

a number of years before. This number develops at such unequal rates that in comparison to the relatively smooth increase of the population there is sometimes a deficiency, sometimes an excess, of considerable magnitude. We shall explain this fluctuating growth in a moment. As a result of it, rents also fluctuate strongly. The level of rents and the positive or negative excess of dwellings will determine the volume of building activity. The additions to the stock of houses are a reflection, therefore, of the deficiency, but with a considerable lag: in addition to the lag of reaction in rents, there is the further lag between rents and the decisions to build, to which, finally, the period of construction of the house should be added. This may add up to a total lag of nearly four years. The additions to the stock of houses have a tendency to decrease the deficiency to the extent that they are in excess of the number of families who desire a dwelling. We have here the mathematically interesting figure that the decrease of a certain series (namely, the deficiency) is proportional to the value of the same series four years earlier. The consequence of this relation may be illustrated most conveniently by a numerical example; it should be borne in mind again that such an example does not constitute a proof.

Assume that the shortage in the first four years of a given period increases from 0 at the beginning of the first year to 4 at the beginning of the fourth year. Assume that the different reactions are such that the reduction in this deficiency (as a consequence of building activity) is equal to 0.4 times the shortage four years earlier. In order to compute further the changes in the deficiency, we have to compute its decrease in year 5. This will be 0.4 times the deficiency during year 1, which was 0.5. The reduction in year 5 is then $0.4 \times 0.5 = 0.2$. Similarly in years 6, 7, and 8, respectively, $0.4 \times 1.5 = 0.6$; $0.4 \times 2.5 = 1.0$; and $0.4 \times 3.5 = 1.4$. Continuing this simple scheme, we easily find the accompanying figures.

It will be seen that a complete cycle is run in a period of approximately sixteen years. The example has been chosen in such a way that it reflects the situation in the American market for residential construction. The difference in principle from the special cycles discussed earlier is that here the period of the

cycle equals four times the lag (of four years) which is the dynamic characteristic in this example which determines the wave movement. It may be shown mathematically that the ratio of period to lag will not always be 4; when the waves are undamped, however, it will be exactly 4. If the number 0.4 indicating the amount of reduction of the shortage in response to the shortage existing four years earlier (more concretely, the intensity by which the building industry responds to a shortage, whether through rents or not) should be replaced by another number, one could obtain damped or antidamped cyclical movements. The reader may easily experiment with various numbers.

EXAMPLE V

Year	1	2	3	4	5	6	7	8	9
Deficiency at beginning	0	1	2	3	4	3.8	3.2	2.2	0.8
Average deficiency	0.5	1.5	2.5	3.5	3.9	3.5	2.7	1.5	0
Reduction					0.2	0.6	1.0	1.4	1.6

Year	10	11	12	13	14	15	16	17	18
Deficiency at beginning	−0.8	−2.2	−3.3	−3.9	−3.9	−3.3	−2.2	−0.8	0.8
Average deficiency	−1.5	−2.8	−3.6	−3.9	−3.6	−2.8	−1.5	0	
Reduction	1.4	1.1	0.6	0	−0.6	−1.1	−1.4	−1.6	−1.4

The essential difference from the case of the hog market—the simplest case of an alternation of overproduction and underproduction—lies in the long lifetime of houses, as a consequence of which production cannot be identified with total supply. In the case of the housing market, production is equal to the increase in supply over the preceding year.

A number of disturbing factors have so far been disregarded. Some of them are actually dominating in the market of residential construction in countries such as the Netherlands. The prominent role played by the shortage or excess of dwellings in the United States in the dynamics of the market of residential construction should be attributed to the large size these shortages can assume and to the sharp responses of rents and resi-

dential construction to these shortages. In part, these strong reactions were determined by the almost complete absence of government intervention in residential construction (at least until 1933). Thus, in 1918 residential construction stopped almost completely. In our terminology we might say that the war acted as a strong exogenous disturbance which gave a new impetus to the mechanism of fluctuations.

We may now devote some attention to the factors so far left out of consideration. The demand for dwellings depends, apart from rents, also on the level of income and the number of families. In general, the latter series will show a regular and almost monotonic movement which will not give rise to any unexpected changes in demand. Incomes will fluctuate with the business cycle, and it might therefore be expected that rents would move accordingly. As we noted, however, a very considerable lag should be taken into consideration in this connection.

On the supply side, that is to say, the supply of newly built houses, there is the influence of building costs in addition to that of the level of rents. High building costs will depress the level of building. This factor would therefore exercise an influence in the direction of a movement counter to that of the general cycle, also with a certain lag. Furthermore, the incentive to build depends not only on the profits that can be made on rental construction; a large part of construction is for owner use. Therefore, a certain effect is felt of the amount of savings available and also perhaps of unexpected increases in income. On both types of building there is, further, an important influence of the regular availability of credit. In times of uncertainty residential construction is often greatly hampered. We do not refer in this connection to the normal effect of the rate of interest which may be considered as part of construction costs; we refer rather to an influence which shows a pattern clearly different from that of fluctuations in the rate of interest. Thus, for instance, residential construction in the Netherlands in 1907, 1932, and 1935 was suddenly very low. In the United States, residential construction was low in years when a large number of mortgages were foreclosed. In the United States, however, the credit position was closely related to the state of the housing

market, a high foreclosure rate coinciding with a large excess of dwellings. But this does not apply as a general rule in all countries.

Owing to these special factors, the actual pattern of the market of residential construction is obviously different from the simple model we have traced; many irregularities will be found to exist. It would appear, further, that the undisturbed movement in this case is damped but has been kept going by new disturbances. There is, in any case, a tendency toward a systematic movement which should be understood in the way indicated.

CYCLES IN THE IMPORT OF RAW MATERIALS

At the end of chapter viii we have drawn attention to cycles in the volume of imports of raw materials. It would appear that they should be considered as a consequence of the acceleration principle in inventories. This principle, as we have seen,[3] is due to the tendency to keep stocks proportionate with sales. Here, too, a certain lag will occur. On the basis of a number of statistical data, it would appear that the stock at the end of the year would be proportional to, or at least correlated with, the turnover during the year. For convenience we may assume that stocks are equal to one-fourth of the yearly turnover. Let us assume now a chain of succeeding enterprises, for instance, import, wholesale, production. The volume of factory sales is indicated by series *A* in Example VI below. Let there be one ini-

EXAMPLE VI

Year	1	2	3	4	5	6	7	8	9
A. Factory sales...	64	64	64	64	128	128	128	128	128
B. Factory stocks..	16	16	16	16	32	32	32	32	
C. Increase in *B*...	0	0	0	0	+16	0	0	0	0
D. Wholesale sales =*A*+*C*.....	64	64	64	64	144	128	128	128	128
E. Wholesale stocks	16	16	16	16	36	32	32	32	
F. Increase in *E*...	0	0	0	0	+20	−4	0	0	0
G. Importers' sales =*D*+*F*.....	64	64	64	64	164	124	128	128	128
H. Importers' stocks.....	16	16	16	16	41	31	32	32	
I. Increase in *H*...	0	0	0	0	+25	−10	+1	0	0
J. Import=*G*+*I*..	64	64	64	64	189	114	129	128	128
K. Excess imports= *J*−*A*.....	0	0	0	0	+61	−14	+1	0	0

3. Cf. p. 165, *supra*.

tial change between years 4 and 5. Then factory stocks would be as shown by series *B*. Since they refer to the end of the year, they have been entered between the other figures. Series *C*, indicating the increase in stocks, follows from the preceding series. The sum of *A* and *C* would give the purchases by producers or the sale of the trader (*D*). Continuing the computation in a similar way, we finally arrive at the imports, as in line *J*. It will be noticed that this line, in comparison to line *A*, shows a tendency to a zigzag movement with a period of two years. This is shown by line K representing excess imports, or *J*–*A*. If sales indicated in line *A* were to change not once but repeatedly, the difference indicated by K would show each time a tendency toward a zigzag movement very much in accordance with the observations shown in Figure 39.