CHAPTER SIX

RANDOM MOVEMENTS

IN CHAPTER I we mentioned two types of random movements, those which are distributed normally and those which are not. Both have in common an absence of system in the succession of values of the variable in question. This may be further explained as follows. From all the values wich a certain variable x assumes, we take all instances in which x has one particular value, for example, 2. We then take all values which follow immediately upon this value 2. These may be very different; in general, they will represent all values which the series x can assume. We now make a frequency distribution of all these "immediately succeeding" values: so many times 0, so many times 1, so many times 2, etc. We may make a similar frequency distribution for all values following immediately upon another value, for example, 1. If we have a sufficient number of observations, we should, with any desired degree of approximation, find the same frequency distribution. This is the essential character of a random movement. This property of a random movement may also be expressed by stating that its successive values are independent. Given a certain first value of any two values of the series, one cannot determine the second one. The frequency distribution to which we referred is the frequency distribution of the series.

A random variable may be normally distributed, in which case its frequency will, for a long succession of values, approximate a normal or Gaussian distribution. If a random variable may be considered to be the sum of a large number (in principle, an infinite number) of components, each small and independent of the others, it will tend to be distributed normally.

In economic analysis one usually deals with normally dis-

tributed random variables, since the number of forces which affects one economic variable is usually very large.

Whether any particular economic variable should be considered as random will depend on the nature of the analysis. Two examples will make this clear.

a) First, successive values may or may not be independent, according to the period of observation. Thus, a series may be random in its annual figures but not in its monthly figures. The monthly figures may show a certain inertia: they may change only little from one month to the next. In such a series a high value for one month is likely to be followed by a high value for the next month, and a low value is likely to be followed by another low value. Yet the sum of twelve monthly figures, represented by an annual figure, may very well satisfy the criterion of independence. Thus it depends on the period used whether a series should be considered as a random variable or not.

Many series of prices and production of agricultural products provide good examples of this. During one crop year with a large crop, prices will be low in every month. There may still be some variation at the beginning of the crop year, when the size of the crop is not yet exactly known; similarly, the prices at the end of the crop year will be affected by expectations concerning the new crop. But generally prices will tend to be low. Prices in successive months are not independent of one another. On the other hand, average prices for successive crop years will be practically independent of each other. Here, the year is the natural unit of time. Successive annual figures may be considered as independent and therefore as random.

b) Second, the random character of a component depends on how far our analysis is pushed. Assume that the movement of a certain economic variable may be considered as consisting of the sum of a number of elementary movements, each of which is due to the influence of one particular other variable. Usually, a few of these elementary movements will be very important; their amplitude will be great, whereas the amplitude of any one of the other elementary movements will be relatively small. Normally, the important components will be due to factors that are known: they are most readily observed or are due to factors

that are easily identified or at least they will be made the subject of the most intensive research. There will therefore be a tendency to consider these most important components as the systematic components and to consider the sum of all other influences as the random component.

This random component will then combine the minor influences of all other factors. In view of the complicated nature of the economy, the number of these other factors is usually very large, and their influences may be considered as approximately independent of one another; they often represent factors originating in very different parts of the economy. The distribution of the random component may therefore be approximately normal. The arbitrary nature of the distinction between systematic and random components is clear, as the border line between important and unimportant factors may be drawn differently and a different random component found accordingly. To some extent this may depend on the state of economic science. Only known influences will be called systematic; as the influence of more factors becomes understood, there will be a tendency to shift the border line, although it need not always coincide with the demarcation line between known and unknown influences.

Although an economic variable may have a random distribution through time, this does not mean that one may not choose to explain it further. The values which such a variable assumes through time may be explained as the result of values assumed by other random variables through time. Thus, an economically systematic explanation has been given for a mathematically random variable. The size of the crop, for instance, will normally be considered as systematic in the economic sense, although it is a random variable in the mathematical sense of the word.

Among the most important concrete examples of random fluctuations in the economy are the economic series related to agriculture. Crop yields per acre fluctuate from year to year, and these series show a random pattern. The explanation of this pattern does not fall within the scope of economics; it belongs to biology. It has been found that many factors affect

yield, but a few among them are most important, such as the amount of sunshine in a certain critical period, the amount of rain in another critical period, etc. Since both the amount of sunshine and the amount of rain (their explanation lies in the field of meteorology) depend on a very large number of factors, the random character of yield fluctuations is attributable to this large number of factors.

The random character of crop yields does not imply that certain related series, such as the total crop or the price of agricultural products, are also random. These latter series depend on systematic factors as well. The total crop represents the product of the yield per acre and the number of acres under cultivation. This latter series is affected to some extent by prices and in this way indirectly by the yields of previous years. Often, however, this influence is relatively unimportant in comparison with the fluctuations of yields. Even if we abstract from this and consider the entire crop as a random variable, it would still not be permissible to consider prices as entirely due to chance. In the simplest case the price is determined by the total supply available during a certain crop year. This supply is equal to the sum of the current crop and the carry-over from previous years. The larger the crop was in the preceding year, the larger the carry-over will be. Thus the price in any one year will reflect not only the current but also the past crop; since last year's crop also affected last year's price, the prices in the two successive years will not be independent of each other. Hence, the price cannot be considered to be entirely a random variable.

Other examples of random movements in the economic sense are provided by certain series that are in many respects analogous to those of agriculture, such as the catch of fish. Fluctuations in catch are also in part due to fluctuations in temperature. Here again the unit of time necessary to obtain a random pattern of the series is one year.

Most other examples of random fluctuations are relatively of less importance; usually the appropriate time unit is less than a year. Short random fluctuations occur in almost all economic series. They are very pronounced in series that refer to a small num-

ber of subjects, such as the series of capital issues. Economically speaking, the month in which a certain issue is floated is largely a matter of chance. One issue of a large corporation that happens to take place in a particular month will make the figures of capital issues for that month accidentally high. In the trade figures of relatively smaller countries, the random entry of one large ship in a particular month (rather than in the preceding or the following month) may also play some role. Another example of a somewhat different character is given by the international movements of short-term capital. They may show large random fluctuations in disturbed periods. A certain rumor, a measure of economic policy that happens to be announced in a particular month, may produce sharp movements that should be considered as random compared with the general cyclical pattern.