The Relationship of Econometrics to Economics and Statistics

SI. Economics

Econometrics is the name for a field of science in which mathematical-economic and mathematical-statistical research are applied in combination. Econometrics, therefore, forms a borderland between two branches of science, with the advantages and disadvantages thereof; advantages, because new combinations are introduced which often open up new perspectives; disadvantages, because the work in this field requires skill in two domains, which either takes up too much time or leads to insufficient training of its students in one of the two respects. As a boundary science, econometrics is younger than the adjacent regions, which fact likewise has advantages and disadvantages. As a disadvantage, the lack of an established doctrine, and also the lack of established textbooks, can be felt; as an advantage, is the fresh enthusiasm, with which its students work. The purpose of this book is to provide an orientation. For this purpose, the most important results of econometric research will be discussed. If one reviews these results, which for the greater part have come into being during the last two decades, a considerable vitality becomes evident.

To understand the position of econometrics, it is necessary to pay some attention to its older neighbors, economics and statistics.

Economics, the science of the satisfaction of human wants, is itself not yet very old, dating from the end of the eighteenth century. It has taught us to distinguish the various functions which can be exercised in the satisfaction of wants, such as that of the entrepreneur, the workman, the landowner, and the moneylender. It has taught us to distinguish different sorts of

goods and services, such as consumption goods, production goods, labor, capital services, and so on. It deals with the production process, and exchange and distribution; with prices of goods and services and income formation; with forms of wealth and money; and with international relations in all these fields. It has set up a number of laws in a very general form, which —under certain circumstances—govern the satisfaction of wants, such as the laws of price formation, and it has been able to explain a number of very important facts and tendencies. Economic thinking in business and government circles has developed strongly during the past decades, and it has benefited the technique of economic policy in many respects, despite many failures.

The insight which economics has brought, however, has been mainly qualitative. Even with simple quantitative problems, it has to indicate several possibilities without being able to say which of these possibilities will be realized. For instance, the answer to the question, whether a lowering of railroad rates will bring about an increase or a decrease of the proceeds, cannot be given. It depends, of course, on the elasticity of demand for railroad transportation. If the elasticity is greater than unity, the proceeds are increased by a lowering of rates; if it is smaller than unity, the proceeds will diminish. The elasticity, however, is not known.

With problems containing a greater number of causal links, as do most problems which affect the economy as a whole, this difficulty is even greater. If one combines the various effects which a given change in phenomenon A has on phenomenon B—i.e., the effects along various paths—one has to know the relative importance of these effects. To this end, measuring is indispensable.

Our inability to reach definite answers using qualitative methods only, led to attempts to find such answers on the basis of very general principles, for instance, of the principle that a free society would always lead to the most desirable situation. This method, however, soon degenerated into a dogmatic and sterile conflict of one slogan against another. The state of affairs in

economics was comparable to that of the natural sciences in the middle ages; texts of old writers were sworn by and no new investigations were made. Even in 1926, a well-known author referred to various concepts in economics as "empty boxes," without definite content.

These objections applied in nearly the same degree to mathematical economics, because the latter was also confined to very general and abstract formulations, especially of a statistical character. When, after 1900, the problem of the explanation of and the influences working on economic fluctuations came more and more to the fore, it became clear that statics could not render sufficient help. Again, what could be said about the deviations existing between statics and reality was not concrete enough.

So the pressure for concrete formulations and for measurement grew increasingly. Various schools of thought in economic science had already realized this and had begun the collection and adaptation of factual data; insofar as measurement was concerned, increasing use was made of the services of statistics.

§ 2. Statistics,

Statistics has made available very comprehensive collections of concrete data. It has determined the relations between the magnitudes in economic life; for instance, the relative importance of the various branches of industry, the incomes of various population groups, the national income of countries, together with an enormous quantity of detailed data. Statistics has likewise brought quantitative knowledge concerning the development of production, prices, and incomes, and concerning the undulating motions of divergent sorts, which are shown by these phenomena. It has also been able to register the development of the phenomena after certain decisions of economic policy have been made; for instance, whether, in certain cases, after the levying of an import duty, trade increased or decreased, and how much.

However, statistics remained relatively superficial, even when refined computing procedures were employed. It could ascer-

tain that the development of a certain type of production moved around a "trend"—i.e., a line indicating the general tendency—which rises in geometrical progression. But an explanation could not be given. It could also determine that the undulating movements in economic life show certain regularities which can be depicted by the so-called "Harvard-barometer." But it could not explain why the line of the stock market leads, compared to that of the commodity markets, and the latter compared to that of the money market, and why these three lines go up and down approximately together. Neither was it clear whether this barometer had some deeper significance or whether it indicated a more or less accidental or self-evident coincidence. Nor could it be stated that the changes which occurred after the levying of an import duty, were actually the consequence of that levying.

So statistics undoubtedly made matters more concrete; but rather the problem than the solution. When the economist tried to reach the solution by reasoning—which, in principle, was the only way—he needed various concepts, like supply and demand curves, which the statistician could not procure for him in a statistically measured form. These could not immediately be derived from superficial observation of the facts: a profounder type of analysis was necessary.

In fact, that profounder type of analysis has gradually come. In certain very simple cases—to be judged by the economist—it is possible to derive a supply or demand curve from the facts. A few theories of the business cycle could be rejected, even on the basis of relatively simple statistical observations; for instance, the more primitive overproduction theories. According to these theories, the fall in prices in the depression is a consequence of a rise in production, and the rise in prices in a boom period is a consequence of increasing scarcity of goods. Such a theory would require an opposite course of prices and quantities sold. Economic observation, however, shows that prices and quantities sold increase and decrease simultaneously. Equally, the theory that during the boom period the production of production goods increases at the cost of that of con-

sumption goods, can, if confronted with the statistical data, be shown to be purely fanciful.

With the help of certain statistical inquiries, which provide cross-sections of economic life, the structure and the functioning of the latter can be approximated; for instance, by means of household budget statistics or cost curves. A further extension of the more profound type of analysis, however, was urgently needed; viz., the statistical measurement of the concepts of theoretical economics, especially of demand and supply curves. In particular, not only the measurement of the size and the course of certain phenomena was important, but also the connection between phenomena causally related to each other.

The technique of this measurement was developed by mathematical statistics as early as the nineteenth century, and was for the time being applied mainly to problems of the natural sciences, especially biology. This measurement technique was the so-called "correlation analysis" and "curve-fitting." In the case of those sciences in which one can conduct experiments, one can see to it that only those two phenomena whose interrelationship is under research are varied while the others remain constant.

In economics, experiment is seldom possible. Nature experiments with the economy by the alternation of day and night, winter and summer, and bad and good harvest years. Further, the authorities of a number of countries sometimes experiment in the field of business-cycle control. But the majority of the relations which exist between economic phenomena cannot be discovered through an experiment. This means, that in reality, not only phenomena A and B, the correlation between which we try to determine, change, but simultaneously other phenomena, say C and D, change as well. The alterations in A which appear now, are not only a consequence of those in B, but also of those in C and D. The economist, however, wishes to know how B influences A, all other phenomena remaining equal ("ceteris paribus"). If the statistician wants to be useful to economics, he must be able to eliminate the influence of C

and D, or he must confine himself to the relatively rare cases in which the influence of these factors is slight.

Statistics has taught us-often with the economist's help-to eliminate these disturbances in an increasing number of cases. Instances thereof will further be discussed in Chapter II. The most refined method is that of the so-called "multiple correlation analysis," which makes it possible, in certain cases, to determine not only B's influence on A, but also that of the other factors, C and D, on A. In this way, an instrument is provided which fits exactly into the economist's concepts, since these concepts, likewise, always deal with functions of several variables. The typical example is the demand curve, which, under the influence of other phenomena than the price-income, for instance—shows a "shift." It can be said that once the formal analogy between the "regression equation" (see § 21) in multiple correlation analysis and the shifting demand curves of theoretical economics is realized, the gap between economic theory and statistical analysis has been bridged. Part of the next chapter will deal further with these concepts.

Mathematical statistics, however, has still another task. Statistical observations often contain errors. And relations in economics are, in fact, more intricate than even the economist generally assumes in order to keep his reasoning within bounds. For both these reasons there are deviations and errors in the figures and these lead to errors in the results. How great is their influence? What, in other words, is the accuracy of the results? What is the margin of error? Mathematical statistics can inform us of this in many cases. Its task for the future lies in this direction.

§ 3. Econometrics

As we have seen, there is a need for concrete formulations and measurement in economics and for more intensive statistical research; for a mutual influence, therefore, of these two branches of science on each other. Econometrics tries to realize this. If a person wants to coöperate with another he has to be willing to meet the other halfway. This should be done in eco-

nomics by formulating its theories so as to permit measurement, and in statistics by developing a desire to measure relevant things. We have already mentioned the example of the demand curve. The economist should not, for instance, maintain the point of view that, except for income, the prices of all goods influence the demand for butter, because this makes it impossible for the statistician to measure. He must make a choice and say that as a first approximation, the price of butter and that of margarine will determine the demand for butter. The statistician, on the other hand, should not content himself by measuring the quantity of butter consumed each year and the prices of butter and of margarine separately, but he should try to find the relation between these magnitudes and to answer the question, for instance, how much the demand for butter will decline if the butter price rises by 1 per cent and the margarine price by 3 per cent.

Of course, econometrics had its precursors even before it was christened. Econometricians like to think of Cournot the same way as economists think of Adam Smith, whereas the great modern precursor or, rather, pioneer, has been Moore. In 1931, the realization of the necessity of econometric work had become so vivid that the "Econometric Society" was founded. This international association includes practically all workers in this field and counts its members in all civilized countries.* Its periodical, *Econometrica*, disseminates the results of econometric research work and at the same time forms a tie between the members in expounding their scientific ideas. Articles on econometric work, however, can be found nowadays in nearly every scientific periodical on economics or statistics, while in some countries, special periodicals exist dedicated to econometric or similar researches.

It is difficult to draw sharp boundaries between econometrics

^{*} According to the latest statistics (*Econometrica*, 17:292, 1949), the number of members is 866; 477 of whom are in the United States, 56 in France, 43 in England, 35 in the Netherlands, 28 in Norway, 17 in Italy and in Canada, 16 in Sweden and Argentina, 12 in Spain and in Brazil, 11 in India, Czechoslovakia, Switzerland, Denmark and Japan, 10 in Germany, and so on.

and statistical analysis or between econometrics and mathematical economics. Econometrics could be defined as "statistical observation of theoretically founded concepts," or, alternatively, "mathematical economics working with measured data."

It should not be inferred from the preceding that econometric research is only concerned with the use of correlation calculations. Any other method which promises results can be made use of as well.

It is hoped that by a closer coöperation between theory and observation we shall be able to reap the profits of the mutual impregnation of these two parts. The natural sciences have shown an exceptionally rapid progress of scientific research as a consequence of this. Examples of the stimulating influence exerted by statistical research on economic theory will be dealt with in the next chapter.