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ELECTRONIC COMPUTERS AND BUSINESS INDICATORS

I. THE PROBLEM

A principal purpose of studying economic indicators is to determine the stage of the business cycle at which the economy stands. Such knowledge helps in forecasting subsequent cyclical movements and provides a factual basis for taking steps to moderate the amplitude and scope of the business cycle. It is of critical importance around turning points; for example, failure to recognize a downturn may lead to the adoption of policies to curb expansion when a recession is already under way. In using indicators, however, analysts are perennially troubled by the difficulty of separating cyclical from other types of fluctuations, particularly seasonal fluctuations.

This problem can be illustrated by the situation in the summer and fall of 1954, when government officials were trying to determine whether or not this country was coming out of a mild recession. The President had said earlier in the year that he would wait for several months to see whether an upturn in business activity occurred before deciding on further government action to stimulate business. In the meantime debates were taking place in Congress and in the press, with many urging that vigorous contra-cyclical measures be taken before the country once again was engulfed in a disastrous depression.

One of the vexatious problems was to determine whether changes in business activity, from, let us say, September to October, 1954, were larger or smaller than normal seasonal changes. It was easy enough to determine how the volume of business in September and October, 1954, compared with September and October, 1953, but that was not the question. September and October, 1954, were

certainly lower than the corresponding months of 1953, but that was not so important as how they compared with July and August, 1954. In forecasting for the months immediately ahead, it was crucial to know whether the economy during the preceding four or five months had been rising to the levels of October, 1954, or declining to them.

This problem confronts all business concerns with large seasonal fluctuations. Decisions are often necessary on price and inventory policy, commitments to make capital expenditures, and so on. Such decisions must be based upon forecasts of the volume of business in the months ahead, often for the country at large as well as one's own company. Officials of business concerns sometimes cannot tell, on the basis of raw data, whether their own business is in a rising or declining stage, and they are making forecasts of the future without knowing whether their business has been getting better or worse in the immediate past.

Knowledge of the seasonal pattern in the sales of its products (as well as of the materials it purchases) is also important to a company. This information is needed by all companies to determine the level of production that is most efficient, in terms of production costs, on the one hand, and storage facilities, insurance costs, and the risks of forced selling, on the other. Some companies forecast only their annual total sales, and then, on the basis of this single forecast, they plan their production schedules, their inventory and price policies, and establish quotas for their salesmen. For the companies in this group which also experience large seasonal fluctuations, a good first approximation of the monthly pattern of sales can be obtained by prorating

ing the estimated annual total over the months according to the pattern shown by the seasonal factors. The seasonal factors will be of further value in making shorter-term forecasts, that is, forecasts of month-to-month changes. The original estimates based upon the distribution of the annual forecast can be revised each month by applying the normal seasonal change to the most recent month's experience. Measures of the average magnitude of the irregular fluctuations and the pattern of their variations would provide valuable supplementary information. Knowledge of the average month-to-month movements of both the seasonal and the irregular factors can be used to reduce overordering, overproduction, and overstocking.

II. TYPES OF ECONOMIC FLUCTUATIONS

For many years economists and statisticians have found it useful to consider each economic time series as a composite of cyclical, trend, seasonal, and irregular factors. The cycle consists of short-run cumulative and reversible movements characterized by alternating periods of expansion and contraction and lasting three to four years, on the average, from trough to trough, though the range may extend from two to ten years. The trend makes up the still longer-run movements of the series and ordinarily has little effect upon month-to-month movements of economic series; for convenience in short-term forecasting it is often combined with the cyclical factor.¹ The seasonal factor consists of intra-year movements and follows a more or less regular pattern. For example, each year farm income rises steadily from early spring to fall and then drops sharply again to early spring. Most economic series contain significant seasonal fluctuations, but some contain virtually none (stock prices, for

example). The irregular fluctuations are those that remain after the other types are accounted for. They are occasioned by a wide variety of factors: exceptional events, such as unusual weather, strikes, unexpected political developments, or the failure of a large business concern, and statistical errors, such as sampling errors, response errors, and errors caused by defective seasonal adjustments.

Irregular, seasonal, and cyclical movements all vary a great deal in magnitude from one series to another. The irregular are very large, for example, in the liabilities of business failures but are very small in grocery sales. Similarly, the seasonal factor is quite large in the construction and retail industries but small in many lines of manufacturing. The cyclical amplitude is considerably larger in new-orders series than it is in employment series. The relations among these types of fluctuations for different eco-

¹ This practice is usually followed in this paper. The reader should try to bear this in mind, because sometimes the trend is important, even over short periods—for example, in series showing airline traffic since 1947. The curves used to delineate the cyclical component also show shorter movements that are not generally recognized as cyclical—for example, the rise from July to October, 1932, and the decline from the spring to the fall of 1951. Furthermore, the term "cyclical" is used in other sciences, and especially in mathematics, to mean something different—a curve with a recurrent cycle that has a symmetrical pattern, a standard amplitude, and a fixed period. For these reasons, the use of the word "cyclical" to identify our curves leaves something to be desired; another word, possibly "systematic" or "oscillatory," might be preferable if we were starting afresh. But the use of the term "cyclical" to describe alternating periods of business expansion and contraction, with uneven patterns, varying amplitudes, and irregular durations, is so widespread among economists that it would probably be impossible to substitute another term now.

The method of time-series decomposition described here follows the general plan formulated by earlier analysts of economic time series, particularly Warren M. Persons (see his articles, "Indices of Business Conditions" and "An Index of General Business Conditions," *Review of Economics and Statistics*, January and April, 1919).