Survey of Economic Forecasting Techniques: A Survey Article

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BY CHARLES F. ROOS

ECONOMIC OR BUSINESS forecasting has long engaged the attention of both professionals and amateurs. Almost every decision made in business or government necessarily rests upon some kind of forecast of economic conditions. In short, forecasting, implied or stated, is unavoidable. "We live in the present and cannot avoid the future; the decisions we make today will affect tomorrow. Indeed, many of them must look toward a longer-range future. Such decisions, whether made against the background of articulated forecasts or out of a subconscious but often quite strong feeling about the climate of life to be expected, imply projection in the sense of some view of the future. The choice is not between making and not making an extrapolation into the future; it is between making the projection in overt and sometimes quantitative terms, and proceeding by feel and by faith. Even inaction implies some picture of the future."[1]

Successful forecasting reduces the area of avoidable risk. How business needs and uses forecasts has been summarized very well about as follows:[2]

Successful budgeting of expenses, costs, and profits depends on good forecasting of sales income.

Good forecasting can help stabilize production and employment over the years by ironing out variations caused by seasonal fluctuations of sales.

Satisfactory control of inventories of all kinds—raw materials, component parts, semi-finished materials, work in progress, and finished goods—is dependent on satisfactory forecasts of future sales, of raw materials and parts requirements, of raw material and parts prices.

Successful planning of long-term investment programs of new mills and other facilities and of corresponding new capital requirements depends on reasonably accurate long-term forecasting of sales.

The successful use of standard cost systems for cost and expense control and

[1] Simon Kuznets, "Concepts and Assumptions in Long-Term Projections of National Product," *Long Range Economic Projection, Studies in Income and Wealth*, Vol. 16, National Bureau of Economic Research, New York, 1954, p. 36. See also Walter E. Hoadley, Jr., "The Importance and Problems of Business Forecasting," Chapter I, *Determining the Business Outlook*, New York, 1954; and C. F. Roos, *Charting the Course of Your Business*, New York, 1948, pp. 75–77.

[2] Frank D. Newbury, *Business Forecasting*, New York, 1952, pp. 4–5. See also Wilson Wright, *Forecasting for Profit*, New York, 1947, pp. 1–8; and *Business and Economic Forecasting*, Report of the Committee on Economic Policy, Chamber of Commerce of the United States, 1954, pp. 1–2.

for satisfactory pricing of products depends on good long-term forecasting of sales and production volume.

Government decisions with respect to taxes, revenues, appropriations, money and credit supply, foreign trade and balances, employment, capital facilities—flood control, harbors and navigation, roads, streets, water supply, sewage systems, schools, hospitals, and jails—, general services, and economic controls, rest upon actual or implied forecasts of economic conditions.[3]

Today, economic or business projections must be and are being made in many places by many people. Econometricians ought to be interested if for no other reason than to determine whether the techniques can be improved.

The author has already considered in detail the forecasting methods known as: (1) factor listing, (2) the equalizing of areas below and above trend, (3) ratio of total production to consumers' goods prouction, (4) the Dow Theory, and (5) the Bradford Smith Index.[4] These techniques will, therefore, not be discussed here. Also, ground covered in the excellent articles by V. Lewis Bassie and Eric Shankleman will not be retraced except insofar as seems necessary to point up disagreement or to fill in essential background.[5]

For purposes of the present paper forecasting techniques are classified as follows:

(1) *Naive.* These are unsophisticated, scientifically uninstructed projections. They include coin-tossing and other random methods, guesses, straight line or mathematical trend projections, autocorrelations, and harmonic analysis.

(2) *Leading Indexes.* These are indexes or time series which usually (or always) change before a change in the index or aggregate to be forecast. For example, shipments of goods precede earnings; and industrial contract awards always precede industrial construction.

(3) *Comparative Pressures.* These methods usually involve ratios or differences. For example, the ratio of inventory to sales, production to capacity, new orders to production, or shipments to new orders. They may involve the difference between demand and supply.

(4) *Opinion Polls.* These are the weighted or unweighted averages of naive forecasts, or of forecasts made by people who have information and techniques of forecasting not available to the poll taker.

(5) *Econometric.* "Econometric" is a word coined to mean the union of economic theory and mathematics, statistics, and accounting. Econometric methods

[3] Alvin H. Hansen, *Fiscal Policy and Business Cycles*, New York, 1941; R. A. Musgrave, "The Fiscal Outlook," *Journal of Business*, Jan., 1954, pp. 4–16; George W. Mitchell, "Forecasting State and Local Expenditures," *ibid*, pp. 17–21; Arthur Smithies, "Long-Run Projections and Government Revenue and Expenditure Policies," *Long-Range Economic Projection*, National Bureau of Economic Research, New York, 1954; and *Income, Employment and Public Policy*, New York, 1948, especially the essays by David M. Wright, Richard A. Musgrave, Walter F. Stettner, and E. Cary Brown.

[4] Roos, *Charting the Course of Your Business*, New York, 1948, pp. 64–71.

[5] V. Lewis Bassie, "Recent Developments in Short-Term Forecasting" in *Short-Term Economic Forecasting*, National Bureau of Economic Research, 1955. Eric Shankleman, "Economic Forecasting in Great Britain," *Applied Statistics*, Vol. II, June, 1953, pp. 86–100.

of forecasting, to be successful, must be concerned with truly dynamic theories of economics, not the static theories of Walras, Pareto, and Marshall or the quasi-dynamic theories of Keynes. Consequently, we shall not be seriously concerned here with the Keynesian models that failed so utterly to indicate the post-war economic conditions.

1. NAIVE METHODS OF FORECASTING

There are literally hundreds of thousands of persons engaged in economic forecasting of one kind or another. If all of them simply guessed, hundreds would be correct in their forecasts time and time again. The record itself does not separate the careful, sophisticated forecaster who has used a scientific system from the guesser and charlatan.

If 1,000 forecasters should merely toss a coin to determine whether production would rise or fall, about 500 would be right at the first turn. These would be "successful" and would, let us say, get a second turn. About 250 would be right also on the second turn. If we should continue this process, we could expect about 15 to be right on each of the first six forecasts, and one on each of the first nine forecasts. This lucky coin tosser would then have the amazing record of having called nine turns correctly. A robot could have been as successful! The same results are obtained (but for different players) whether the series being forecast is random or possesses structure.

On the other hand, suppose that someone noticed a kind of structure—several changes in the same direction before a reversal—in the history of the series he was forecasting. He might follow this pattern where it was definite in his forecasts and resort to coin tossing at the points of expected uncertainty. If the historical structure persisted during the forecast period he would achieve a good record.

"We find, in all the series representing our industrial life, a curiously insistent and characteristic rate of growth. There seems to be no measure of the intensity of the fluctuations in business save in terms of variations from the line of characteristic growth. And from this method of measuring the deviations from the 'normal' or customary it becomes clear that alternating waves of prosperity and depression have proceeded with a certain irregular but notable rhythm for at least the past eighty years, waxing and waning most notably in the period for which the evidence is most trustworthy and most extended."[6]

This observation and the work upon which it was based led to two important techniques of business forecasting: (1) the fitting and extrapolation of straight line or mathematical trends and (2) cyclical or harmonic analysis of the residuals from trend.[7]

[6] Carl Snyder, *Business Cycles and Business Measurement*, New York, 1927, p. 20; and Warren M. Persons, *Forecasting Business Cycles*, New York, 1931.

[7] For technical considerations of means of obtaining the best "predictor" see Norbert Wiener, *The Extrapolation, Interpolation and Smoothing of Time Series*, Cambridge, 1942, pp. 92–100. See also M. G. Kendall, *The Theory of Advanced Statistics*, Vol. II, London, 1948, and H. T. Davis, *The Analysis of Economic Time Series*, Bloomington, 1941.

Despite disastrously poor results in 1929, 1933, and 1937, the method of trend projection still engages the attention of forecasters. The reason is simple. So long as there is economic momentum or persistence in a given direction for more than a forecast period, a trend projector will be right more often than he will be wrong. In fact, he will be correct in *every forecast except* those at the *turning points*. For example, if a series advances for thirty successive months, wavers or steadies for two months, and then turns down for twenty months, the forecaster using trend projections to forecast the next month will be correct in direction at least 49 out of 52 times. If he tosses a coin during the two months of uncertain trend, he may by chance get additional correct forecasts and score 50 to possibly even 52 correct calls out of 52— a truly remarkable record by a naive method! Yet, counting the percentage of correct forecasts seems to be the standard way of evaluating a forecaster's performance.[8]

From the businessman's point of view it is the correct forecast of the turn rather than the projection of trend that is important; for the average business itself has a momentum that carries along in the direction of the general trend and a forecast of continuance implies no change in policy. In contrast, as the turn is approached, a change in policy is clearly indicated with respect to inventories of raw and finished materials, hiring and training of personnel, loans and other financial matters, and sales effort. With this situation in mind, the author has concentrated his research on the detection of turning points and has generally been content to project the trend until a turning point could be detected.[9]

When the trend has been removed from an economic time series, there will often be a cyclical, or quasi-cyclical, structure in the resulting residuals. These harmonic characteristics of time series are the features which have generally been described as business cycles.

Most residual time series can be represented reasonably well by the sum of a small number of harmonics. For example, a combination of three harmonics can be made to pass through ten points chosen almost at random. If additional points are near these ten (due to serial correlation), the curve will pass reasonably close to them. But this does not prove a law of oscillation nor does it indicate that the cycles will continue in the future with the same amplitudes, periods, and phase relationships.

The search for periodicity in a wide variety of time series has nonetheless gone on with considerable vigor and outstanding success insofar as historical representation is concerned.[10] World War II, however, produced important repercussions

[8] Heinz E. Luedicke, *The Effectiveness of Opinion Surveys*, National Association of Purchasing Agents, New York, 1954, p. 9; Stahrl Edmunds, "Economic Forecasting and the Role of the Economist," paper presented at the joint meeting of the American Statistical Association and the American Economic Association, December 1952; and Walter E. Hoadley, Jr., *op. cit.*, p. 23.

[9] C. F. Roos, "Some Problems of Business Forecasting," *Proceedings of the National Academy of Sciences*, March, 1929. See also, *Economic Measures, Base Book*, 1938–1954; *Charting the Course of Your Business*, New York, 1948, pp. 63–94; and "Economic Forecasting," *The Controller*, Oct., 1954, pp. 456–458.

[10] H. T. Davis, *The Analysis of Economic Time Series*, Bloomington, 1941; E. R. Dewey

throughout the economy and generally changed the phase relationships of such time series as may have had prewar oscillatory characteristics. For example, prior to the war, textile production per capita had oscillated in 22 to 26 month cycles with such regularity that odd-numbered years were high and even-numbered years low. Then, because of war demands, 1942 could not be a low year, and after the war even-numbered years were high and odd-numbered years low. While the Korean War did not modify this new phase oscillation, it did change the amplitude of textile fluctuation. Even the extended steel strike of 1942 changed the "oscillatory" character of production of both consumers' durable goods and capital goods.[11] And, as a result, the cycle projectors generally have been unsuccessful since World War II.

This lack of success has led at least one economic analyst to declare that the cycle method of forecasting "is quickly becoming an intellectual curiosity of the post-war period."[12] This criticism seems too harsh. In the case of textiles cited above there is evidence to indicate that the 22–26 month cycle is associated with inventory building and depletion. Indeed, one can generalize to say that cycles, where they have been observed, have usually been associated with inventory change, if one means consumers' inventories in the case of consumers' durable goods and housing and capacity in the case of investment goods. But it should be clearly understood that replacement cycles damp themselves out unless new energy is introduced to keep the cycles going.

A very general dynamic theory of competition which involved profit outlook or expectation and dynamic equations of demand was presented in 1927 by the author.[13] For the important special case for which the dynamic law of demand depends linearly upon price, the rate of change of price, and some external variable such as disposable income, the price which maximizes profit over a period of time is composed of an oscillatory term, the movements of which are modified by the integral of the function defining the external influences.[14] This function, to use the language of physics, acts as an impressed force upon the system. As such, it can change profoundly the character of the oscillations.

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and E. F. Dakin, *Cycles, The Science of Prediction*, New York, 1947; *Cycles*, published monthly by the Foundation for Cycle Research, New York, and especially the October, 1954 issue; Clarence D. Long, Jr., *Building Cycles and the Theory of Investment*, New York, 1940; and Roy Wenzlick, *Real Estate Analyst*, 1934–1954.

[11] C. F. Roos, *Economic Measures*, March 27, 1952 and July 17, 1952. A complete set of *Economic Measures*, 1938–1954, is on file at the offices of H. C. Wainwright and Company, Boston, Massachusetts and is available for inspection. The Econometric Institute has three additional sets which can be examined by research workers. The University of Oslo has a copy of the basic charts published in 1938.

[12] V. Lewis Bassie, "Recent Developments in Short-Term Forecasting," *Short-Term Economic Forecasting*, National Bureau of Economic Research, 1955. Also severely critical is M. G. Kendall, "The Analysis of Economic Time Series, Part I, Prices," *Journal of the Royal Statistical Society*, Vol. CXVI, 1953, pp. 11–34.

[13] C. F. Roos, "Dynamic Economics," *Proceedings of the National Academy of Sciences*, Vol. 13, 1927, p. 147. See also, Roos, "Generalized La Grange Problems in the Calculus of Variations," *Transactions of the American Mathematical Society*, Vol. 30, 1927, pp. 368–369.

[14] H. T. Davis, *Theory of Econometrics*, Bloomington, 1941, p. 359.

Dynamical theories of demand and supply, to be realistic, must necessarily introduce as a primary variable some measure of general business activity—disposable income, supernumerary income, gross national product, corporate profits, etc. This is true whether the theory is formulated in terms of the extremal properties of the profit integral or sum (expectations) as above or whether it arises from special considerations as in the case of automobiles.[15] This measure of general business activity then assumes the role of an impressed force in the dynamic system.

If this external economic force is constant, price will be periodic. Moreover, if this external variable is an impulsive force, that is to say, very great for a brief period of time, the oscillation again *becomes* periodic with the same period. If the impulse is so great that the elastic limits are exceeded, then the period lengthens.

Therefore, if the energy which supplies the economic system with its movement is derived from a series of erratic shocks not too violent in magnitude, one should expect to find cycles in economic time series.[16]

Consequently, it seems that if one accepts either (1) a theory of expectation or (2) profit maximization as basic to a dynamic system, he must be on the lookout for cyclical or near cyclical phenomena, the periods of which can be drastically changed by erratic shocks associated with random events, such as wars, changes in monetary policy, droughts, large business failures, new inventions, government deficits, etc.

Related to both the methods of trend projection and harmonic analysis is the method of autocorrelation or the projection of a series by means of a correlation of the series with itself at different points of time. The autocorrelation function is defined as

$$r(t) = \frac{1}{2}\int_{-a}^{a} x(s)\, x(s+t)ds$$

and the Schuster periodogram of harmonic analysis is given by the square root of the cosine transform of the autocorrelation function.[17] Methods are also known for obtaining "optimum" prediction by the autocorrelation technique.[18]

The methods of trend projection, cycle analysis, or autocorrelation, or any other mathematical processing of a time series whose structure conceals tender balances, nuances, and interrelationships of a fluid, dynamic life which is not understood, necessarily lead to naive forecasts. Mathematical processing or analysis can never substitute for sophistication. And until one understands the

[15] C. F. Roos and Victor S. Von Szeliski, *Dynamics of Automobile Demand*, 1939, published by the General Motors Corporation.

[16] Ragnar Frisch, "Propagation Problems and Impulse Problems in Dynamic Economics," *Essays in Honor of Gustav Cassel*, London, 1933, pp. 171–205; and Harold T. Davis, *The Theory of Econometrics*, Bloomington, 1941, p. 395.

[17] H. T. Davis, *The Theory of Linear Operators*, Bloomington, 1936, pp. 262–270.

[18] Norbert Wiener, *The Extrapolation, Interpolation and Smoothing of Stationary Time Series*, Cambridge, 1942, pp. 101–105. See also A. Kolmogoroff, "Interpolation und Extrapolation von stationaren zu falligen Folgen," *Bulletin Academy of Sciences*, U.S.S.R., Ser. Math. 5, 1941; and M. G. Kendall, *The Theory of Advanced Statistics*, Vol. II, London, 1948.

forces that built a particular structure in an economic time series and how these forces are currently changing, he cannot forecast with confidence even though by chance he scores a preponderance of successes.

2. LEADING INDEX METHODS OF FORECASTING

Business forecasters have long sought for an index or indexes which would change consistently before some other index which they wished to forecast. Andrew Carnegie counted the smokestacks belching smoke to tell which way business was going. The Harvard Business School in the 1920's constructed several series which were supposed to indicate what was ahead in business and finance. The author in 1938 examined 248 monthly indexes to determine which, if any, had lead characteristics.[19] Geoffrey H. Moore and associates in 1950 examined 801 monthly and quarterly time series or indexes for the United States to determine which were consistently early and which late in a business cycle.[20] Moore found that the following eight publicly available series had lead characteristics: (1) residential building contracts, (2) commercial and industrial building contracts, (3) new orders for durable goods, (4) prices of industrial common stocks, (5) wholesale prices of basic commodities, (6) average work week in manufacturing, (7) number of new incorporations, and (8) business failures, liabilities, industrial and commercial.

Many students had previously observed relationships between fluctuations in construction and in general business activity and pointed out that construction leads.[21] This is not surprising because contracts necessarily precede the procurement of materials—steel, lumber, brick, stone, cement, electrical equipment and wiring, plumbing equipment and pipe, and various finishing materials. All these have to be manufactured (generally to order) after the building contract has been let. Moreover, the payrolls and other income arising from this production, as well as the actual construction itself, lead to demand for all types of goods and services. Thus, if construction is a significant part of *cyclical* production,[22] or business activity, contract awards should have leading characteristics.

[19] Series found to have consistent lead characteristics were charted in *Economic Measures*, Oct., 1938. They still had the same lead characteristics in 1954.

[20] Geoffrey H. Moore, *Statistical Indicators of Cyclical Periods and Recessions*, New York, 1950, National Bureau of Economic Research, Occasional Papers 31, 1950; and Moore, "Analyzing Business Cycles," *The American Statistician*, April-May, 1954, pp. 13–19. See also Wesley C. Mitchell and Arthur F. Burns, "Statistical Indicators of Cyclical Revivals," Bulletin 69, National Bureau of Economic Research, May, 1938.

[21] J. R. Riggleman, "Building Cycles in the United States, 1875–1932," *Journal of the American Statistical Association*, Vol. XXVIII, 1933, pp. 174–183; C. F. Roos, *Dynamic Economics*, Bloomington, 1934, p. 69; H. W. Robinson, *The Economics of Building*, London, 1939; Clarence D. Long, Jr., *Building Cycles and the Theory of Investment*, Princeton, 1940; Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, New York, 1946; and Norman J. Silberling, *The Dynamics of Business*, New York, 1943.

[22] Several attempts have been made to divide national output into economic classes which might show different cyclical behavior and timing. Simon Kuznets, *Commodity Flow and Capital Formation*, New York, 1938, showed the value in 1926 prices of production for the period 1869–1936 for the commodity groups: consumers' perishable goods, consumers'

The production of cyclical goods for the period 1935–1939 comprised about 35 per cent of total production; and the production of construction materials, about one-fifth of this total.[23] This would not be a large enough share of the total to give construction contracts *per se* a lead over total business. Residential building is, however, subject to many of the same economic and sociological factors as consumers' durable goods; commercial construction and large parts of municipal construction are related to residential building; and machinery and equipment are installed after industrial construction has been completed. Consequently, construction contracts serve as a "proxy" variable[24] for other important cyclical groups.

Not only residential building contracts, but also commercial and industrial construction contracts, lead other business indexes primarily because they are "proxy" variables for other more direct measures.

New orders for durable goods frequently precede production—as in the case of machinery and equipment. In other instances, and particularly in the consumers' durable goods field, manufacturers attempt to regulate their inventory by gearing their production to incoming new orders and backlogs. Consequently, one would expect new orders for durable goods generally to precede such other general indexes as production, employment, payrolls, personal and national income, and gross national product.

Comprehensive weekly and monthly new order indexes for (a) consumers' non-durable goods, (b) consumers' durable goods, (c) capital goods, (d) durable goods, and (e) all goods for the period 1919–1938 were first published in 1938. These monthly indexes were constructed from original data supplied by over 1000 companies which reported orders for specific types of goods, not undefined and non-homogeneous composites. In some instances, "proxy" series were used, e.g., food containers in the place of manufactured food, fractional horse–power motors for some consumers' durable goods, and certain key automotive parts for the entire automobile industry. The samples were raised to industry levels by means of the value–added data of the Census of Manufactures, and the indexes were seasonally corrected.[25]

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semi-durable goods, consumers' durable goods, construction materials, capital goods and materials and supplies; Roos, *Economic Measures, Basic Charts*, Oct., 1938, published theoretical demand and new order indexes for consumers' non-durable goods, consumers' durable goods, and capital goods, consistent with the Kuznets data; Roos, *Economic Measures, Basic Charts*, July, 1946, published a reclassification for the period 1923–1946 of the industries comprising the Federal Reserve Board's industrial production index into the Kuznets groups. A chart showing the results of the 1946 study is reproduced on pages 24 and 25 of Roos, *Charting the Course of Your Business*, New York, 1948. See also, W. H. Shaw, *Value of Commodity Output Since 1869*, National Bureau of Economic Research, 1947.

[23] Roos, *Economic Measures, Basic Charts*, July, 1946, Econometric Institute, Inc., New York.

[24] Roos, *Dynamic Economics*, 1934, p. 26, defined *new* automobile registrations as a "proxy" variable for automotive purchasing power which was not then available.

[25] Roos, *Economic Measures, Basic Charts*, Oct., 1938. Most of these new order indexes and comparable demand indexes had been worked out by early 1937 and were used to predict the 1937–1938 recession.

Several of the basic series have been published elsewhere. See, for example, Roos, "Dyna-

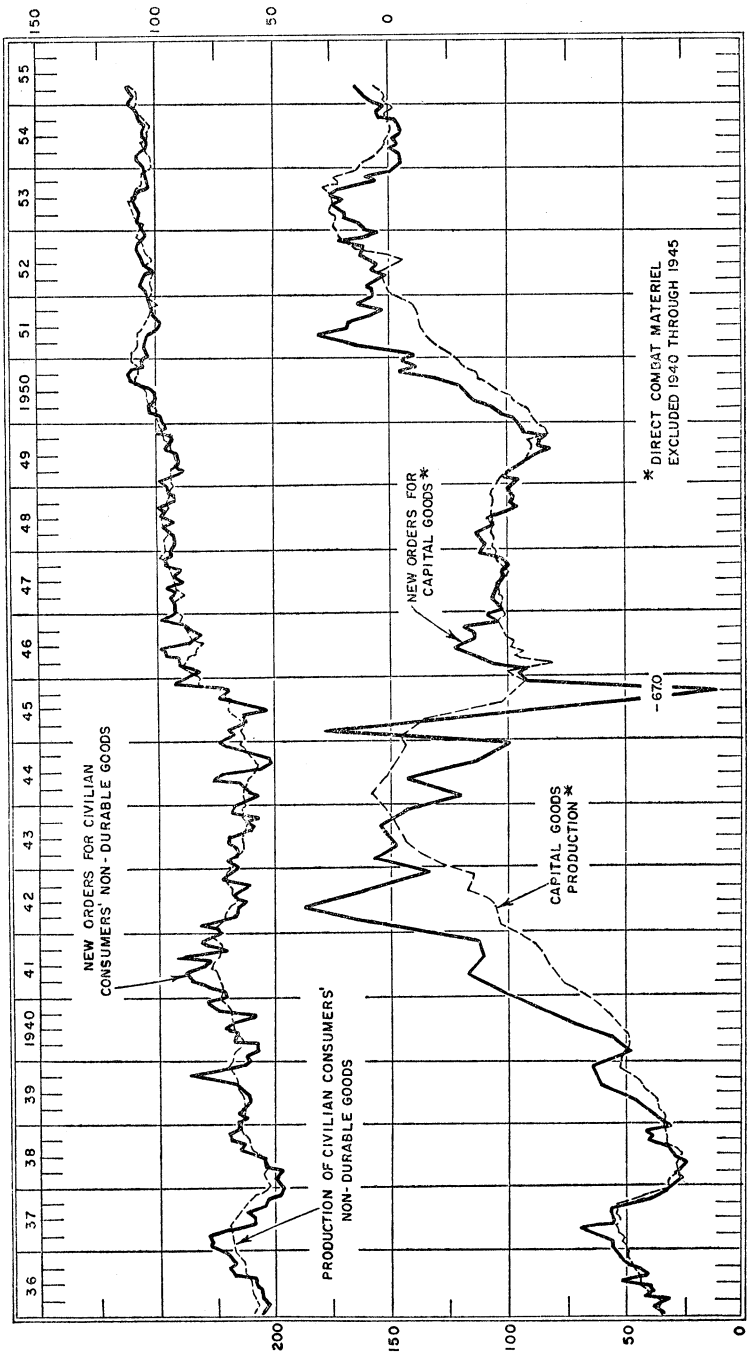

FIGURE 1.—New Orders Received by Manufacturers and Production

Changes in new orders for both non-durable consumers' goods and capital goods are fundamental for indicating both the top and bottom of an economic cycle as may be determined from Figure 1 which shows these new orders for the 1936–1940 period.[26] While capital goods new orders are early at the tops of the cycles, they may lag several months at the bottom because new equipment is not then needed. On the other hand, new orders for non-durable consumers' goods are always early at the bottom and may be either early or late at the top. Even at the top, however, ample warning is usually given because non-durable consumers' goods new orders normally run in excess of consumption for several months before turning downward.

The index of new orders for heavy producers' or capital goods has always had an abnormal rise at the end of a prosperity phase, and has turned down precipitously ahead of important declines in production and even stock prices. Abnormal demand for capital goods develops in various segments of industry when production is about 10–15 per cent under productive capacity. Such mad scrambles for additional plant and equipment (1922, 1923, 1929, late 1936 and early 1937) usually mark the speculative inventory-building and over-expansion phase of the business cycle in which the recovery move generally culminates. After this speculation has been going on for some time and consumers' goods orders begin to drop, more or less serious depression then follows.

It has long been known that stock prices are early in the business cycle. For years businessmen have watched the stock market for confirmation of their hopes and fears regarding the outlook, and consumers have had more or less purchasing power as the market went up or down.[27]

Stock prices, of course, precede such lagging business indexes as production, electric power consumption, railroad carloadings, retail sales, national income, or gross national product.

"But unless it can be proved that stock prices turn up or down before any other business index, it cannot be maintained that the stock market foresees the future of business with the help of nothing but its own supernatural intuitions; while if something else can be found that moves as soon as stocks, or even sooner, then this soothsayer will stand convicted of quackery and the trick of its prophesies will be seen to be simple enough for anyone to use. This last is in fact the case; there does exist a business series, to be described below, that moves as soon as or

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mics of Commodity Prices," *Studies in Mathematical Economics and Econometrics*, Chicago, 1942; and Roos and Von Szeliski, "The Demand for Durable Goods," *Econometrica*, April, 1943.

The United States Department of Commerce, the National Industrial Conference Board, and McGraw-Hill subsequently constructed one or more new order indexes.

[26] Comparable new order series for the period 1919–1939 have been presented on pages 21 and 22 of C. F. Roos, *Investment Management in an Unstable Economy*, New York, 1940. See also, *Economic Measures*, October 1938.

[27] J. M. Keynes, *The General Theory of Employment*, 1934, pp. 314–324, emphasized the importance of changes in stock prices on (1) new investment, and (2) the propensity to consume. For earlier consideration of these points see C. F. Roos, *Stabilization of Employment*, Bloomington, 1933, pp. 227–239.

even sooner than, stocks, and one which any novice can follow if he can only get access to it. Hence, we must conclude that the speculative fraternity as a class has no greater ability to foresee business conditions than have well-informed traders as individuals.

"The business series referred to above, which moves even sooner than stocks, and which displays even longer forecasting power, is called 'Orders Received' or 'Bookings.' It leads all other series in the business cycle. Why should it not? Orders must be booked by the salesmen before goods can be made in the factories, or receivables financed by the banks. Naturally, orders move first, business volumes next, and interest rates last. Stock prices only do their best to keep up with orders."[28]

During the past 45 years there have, however, been several important changes in stock prices that are not directly traceable to changes in new orders. For example, in April and May of 1940 new orders were rising but stock market prices plunged down in response to panic selling by Europeans and Americans coincident with the march of the German armies into the lowlands. And stock prices continued to move downward in 1941 and part of 1942 despite a sharp rise in new orders. During this period, European liquidation of American stocks and fear of burdensome war-time taxes and price controls determined the market trend. In contrast, through 1945 and the first half of 1946 stock prices rose despite a declining trend in combined new orders. In this latter period the dominant market forces were the repeal of the excess profits tax, low interest rates, and the sharp rise in retail trade.

Another important timing factor for stock prices is the *rate of change* of bank deposits which may be called the money gradient. This gradient is a measure of the expansive or contractive forces originating in the banking system. It is not claimed that businessmen run their businesses by an index of the rate of change of total deposits; rather each businessman is guided by changes in his own bank deposit position, tending to expand production and inventories when it is improving and to contract them when it is getting worse. The general course of the money gradient is useful in confirming and reinforcing the interpretation of general trends and levels of current earnings, "particularly at times when the trend in orders is otherwise in doubt."[29]

[28] John Burr Williams, *The Theory of Investment Value*, Cambridge, 1939, p. 7. Nothing in the paper by M. G. Kendall, "The Analysis of Economic Time Series—Part I, Prices," *Journal Royal Statistical Society*, Vol. CXVI, 1953, pp. 11–34, contradicts this conclusion. See particularly the comment by Bartlett on Kendall's paper, p. 30.

[29] Roos, *Investment Management in an Unstable Economy*, 1940, p. 20. The explanation of stock prices given here is in marked contrast to that given by J. M. Keynes, *General Theory of Employment, Interest and Money*, New York, 1936, pp. 149–158. Keynes likens stock market valuation to a "game of Snap, of Old Maid, of Musical Chairs—a pastime in which he is victor who says *Snap* neither too soon nor too late, who passes the Old Maid to his neighbor before the game is over, who secures a chair for himself when the music stops." pp. 155–156. Curiously enough, in two books on forecasting just published by The National Bureau of Economic Research there is only a one-sentence reference to monetary factors, and that by a critic, Morris Copeland. See also Copeland, "Current Problems in Measuring Money-

A great many stockholders, possibly a majority, know very little about monetary changes, new orders, current earnings, or other forces that ought to affect common stock prices. Why then is the pattern of stock prices not random? Suppose that there are 1,000 equal traders in a particular stock and that 900 merely toss coins to determine whether they buy or sell. Suppose that the other 100 are informed as to conditions and act in accordance with this information. Then if conditions are improving, there will be about 550 buyers and 450 sellers and share prices will improve. Contrariwise, if conditions are deteriorating, there will be about 550 sellers and 450 buyers and the trend of prices will be downwards. In short, the informed few generally determine market trends, because the average expectation of the guessers is zero.

Consequently, stock prices may well have predictive value for business over the short term; but one must make certain that there is no undercurrent of mass bias in the opposite direction as during the German invasion of the lowlands in 1940. This last is not easy unless one is sure of the business trend; and, in that case, he does not need the stock market as a predictor.

Prices of basic commodities have predictive value or lead characteristics in much the same way as stock prices. Manufacturers generally buy raw materials as they receive new orders. Consequently, new orders is a good measure of the industrial demand for raw materials; and supply usually changes slowly, particularly at the tops and bottoms.

Since the rate of change of bank deposits or money gradient is a measure of the likely change in new orders and of the ability of manufacturers to hold inventory, to a first approximation, Price = (New Orders)$^{\alpha_1}$ $\times$ (Money gradient)$^{\alpha_2}$ $\times$ (Inventories)$^{\beta}$ $\times$ (constant), where α_1 and α_2 are elasticities of demand and β, an elasticity of supply.[30] A functional of past prices and a slight time trend were included in 1942 in an improved formula and coefficients determined to obtain a "calculated" price. The calculated series had "a persistent lead of about two months over the actual price series. Hence, it is a genuine forecasting series, at least until it becomes too widely used."[31] This warning may as well not have been issued in 1942, for 12 years later the "calculated" series had the same two months lead over actual prices. Figure 2 is a continuation of the series published in 1942 with a four year overlap.

The length of the average work week in manufacturing is also related to new orders at a previous time. Manufacturers usually handle a small unexpected

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flows," *American Statistical Association Journal*, June 1954, p. 363; and "Feasibility of a Standard Comprehensive System of Social Accounts," Income Conference, National Bureau of Economics, October, 1954. Reference should also be made to Wilson Wright, *op. cit.*, pp. 49–57.

[30] Roos, "Dynamics of Commodity Prices," *Studies in Mathematical Economics and Econometrics*, Chicago, 1942, pp. 268–292. The formula of the present paper reduces to that given on p. 274. See also C. F. Roos and Harrison Cole, *Common Sense of Commodity Prices*, Pamphlet of Econometric Institute, 1943.

[31] The "calculated" price and the actual price appear weekly in *Economic Measures*, Econometric Institute, New York. The quotation is from page 276 of "Dynamics of Commodity Prices," *loc. cit.*

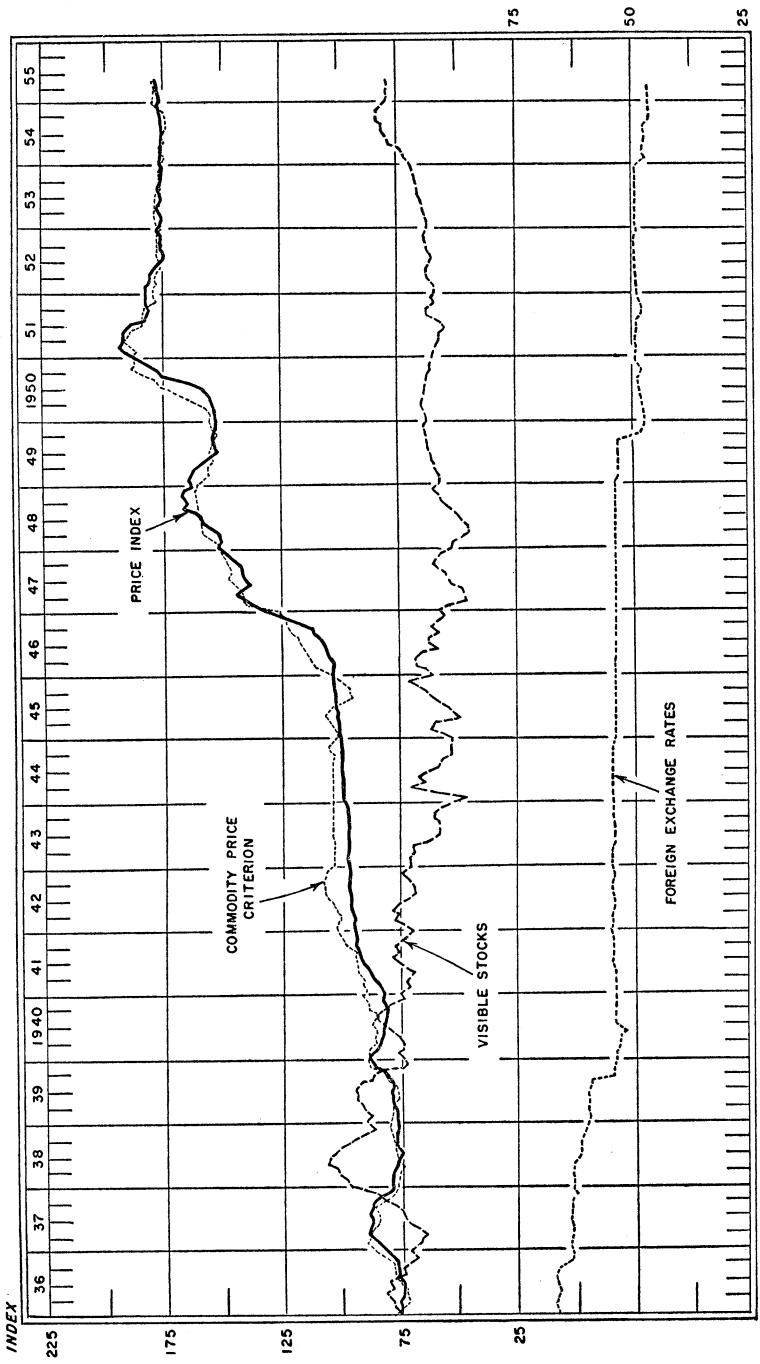

FIGURE 2.—Industrial Commodity Prices—Actual and Calculated

increase in new orders by increasing the length of the work week even at the expense of premium overtime; for a small amount of premium time is always cheaper than hiring and training new workers. Similarly, manufacturers prefer to reduce the hours a little on a decline in orders rather than risk losing trained workers through layoffs. Consequently, one would expect the length of the work week to lead business indexes such as employment, railroad carloadings, electric power consumption, and other typically late indexes. But all the information contained in the change in hours is available in the earlier series, new orders, provided only that new orders have been less than capacity.

The number of new incorporations is necessarily related to the ease with which new orders can be obtained at profitable prices. Near the top of the cycle, competition increases as a result of rapidly expanding capacity, a shortening of delivery time, and the consequent reduction in new orders for consumers' goods. Entrepreneurs recognize this situation and delay incorporations to "get a better look." At the bottom, the supply of raw materials at distress prices dries up, wages firm, and new orders stabilize for a few weeks and then turn up. These are the signals that entrepreneurs want to see before going ahead with their plans for new incorporations. And business failures, industrial and commercial, lead in the business cycle for the same reasons.[32]

The fact that new capital issues lead many other business series has long been known. There is an economic mechanism which normally operates shortly before the cyclical upturn of each business cycle to increase the flow of new money into corporate enterprise, and the same mechanism regularly operates shortly before the cyclical downturn of each business cycle to decrease the flow of new money into corporate enterprise. A comparison of the volume of new security issues with payrolls producing durable goods is of special importance because the great variations "in industrial production are associated with changes in the production of durable goods."[33]

Most publicly available business indexes show only slight differences in phase relationships and in many instances the differences are by no means consistent. As presented, they are at best useful only for the confirmation of a trend forecast by other means and as raw material for building indexes that do have forecasting value either for the short or long term. For example, a money gradient defined as the ratio of demand deposits this month to a weighted average of demand deposits for the past twelve months has for years given warnings of likely changes in production and prices six months to a year later.[34] The index shown in Figure 3 measures the net additions to (or subtractions from) purchasing power arising from changes in bank deposits. If bank deposits decrease this month, the pur-

[32] Dun and Bradstreet, New York, publish both new incorporations and business failures.

[33] Leonard P. Ayres, *Turning Points in Business Cycles*, New York, 1939, p. 85.

[34] This is line (15) of *Economic Measures*, 1938. The same series appears on Chart II, p. 273 of Roos, "Dynamics of Commodity Prices," *op. cit.* for the period 1919–1939. Wilson Wright, *Forecasting for Profit*, New York, 1947, pp. 53–54, has made effective use of the equation of exchange $MV = PT$ as a forecasting tool. PT is taken as national income.

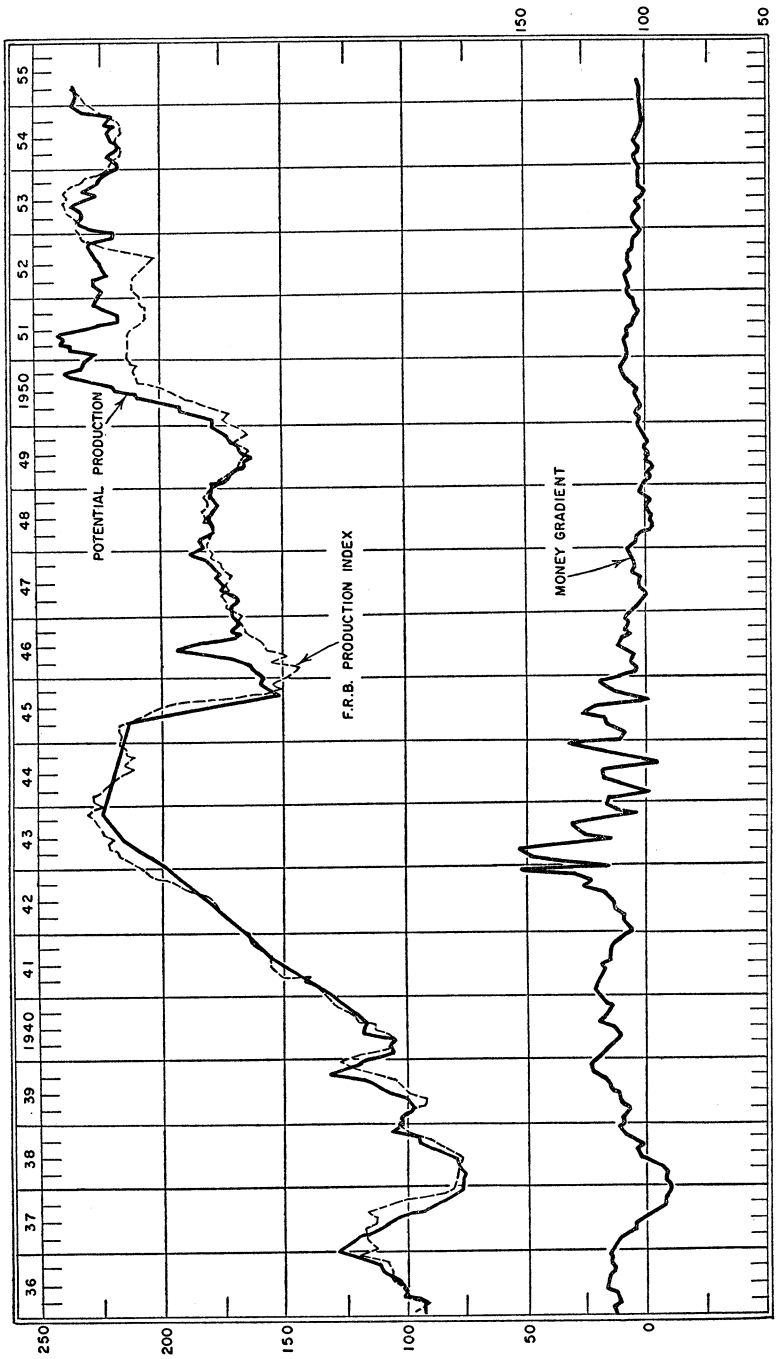

FIGURE 3.—Relation of New Orders and Monetary Change to Production

TABLE I

BUSINESS SPENDING

(1926 = 100)*

	January	February	March	April	May	June	July	August	September	October	November	December	Annual Average
1919	75	72	69	76	80	87	90	93	91	94	97	93	85
1920	95	88	91	88	85	85	83	85	88	84	85	84	87
1921	78	71	69	68	71	72	70	72	72	76	77	74	73
1922	73	75	79	78	82	82	82	82	83	87	80	81	80
1923	84	87	86	86	79	84	81	78	77	81	83	84	83
1924	82	82	85	85	83	84	86	89	90	91	91	93	87
1925	96	96	95	93	96	98	101	97	98	101	101	99	98
1926	102	100	101	100	99	98	100	100	99	99	97	103	100
1927	104	105	108	106	105	107	106	113	115	113	118	111	109
1928	119	118	121	123	131	126	110	116	122	124	127	130	122
1929	136	135	129	122	126	110	122	129	122	123	127	109	124
1930	105	104	110	106	106	102	98	95	97	98	87	96	100
1931	87	86	91	93	89	88	82	80	80	75	62	68	82
1932	68	62	57	60	53	57	53	61	55	53	47	52	57
1933	50	54	42	46	48	54	60	56	53	54	55	50	52
1934	50	53	57	66	62	59	58	58	54	57	56	52	57
1935	62	63	65	66	66	67	70	67	66	68	72	70	67
1936	71	73	71	70	70	75	74	74	76	77	80	88	75
1937	80	78	80	74	76	75	74	72	72	70	67	72	74
1938	68	59	61	64	66	64	63	64	65	70	71	70	65
1939	70	68	67	65	73	69	68	67	74	73	75	70	70
1940	74	71	71	75	75	71	74	72	73	80	85	85	76
1941	83	83	86	88	89	92	92	93	94	99	101	99	92
1942	96	94	95	92	96	96	97	98	103	100	95	89	96
1943	96	101	93	114	107	115	122	128	145	133	128	115	116
1944	126	137	146	143	149	139	160	150	162	168	172	145	150
1945	126	116	133	137	166	164	152	157	154	169	145	142	147
1946	183	167	174	169	185	162	184	209	204	164	227	199	186
1947	204	176	197	198	193	229	212	197	179	200	216	238	203
1948	232	207	190	231	240	213	239	240	229	230	231	215	225
1949	219	186	189	192	200	190	208	209	204	223	231	224	206
1950	240	213	250	244	270	276	267	293	331	327	314	307	278
1951	310	281	311	320	325	315	321	332	296	343	342	335	319
1952	319	303	308	308	322	325	345	330	339	353	366	364	332
1953	365	354	348	353	363	361	355	363	366	366	366	364	360
1954	363	364	364	361	368	370	376	378	379	380	381	382	372
1955	384	383	384	384									

* 1926 = 400 billion dollars.

chasing power stream at a later date is apt to be insufficient to absorb goods currently being produced, and consequently, production and prices are apt to be adversely affected at a later date.

The bank debit figures as presented by the banking authorities have limited usefulness for telling the state of business. This is because they are "disturbed" by financial transactions. The Reserve Board crudely attempts to "remove"

these financial transactions by separating the debits in financial centers from other areas. But financial debits arise outside the centers and the financial areas are also significant trade areas; and so many important business transactions are missed by this simple separation. Actual elimination from the debit total of financial transactions—checks written for stock, bond and speculative commodity market transactions, dividends, interest, life insurance premiums, pension funds, government receipts, and payments of loans—is the only satisfactory way of avoiding their distorting influence. These eliminations have been made in the series shown in Table I. Since 1938 such a corrected debit series (called business or productive spending) has been published weekly.[35] This series is proportional to the total value of business during the preceding week. This measure of business spending has a slight lead in the business cycle not shown by debits outside New York. It can be profitably used with indexes of new orders, demand and supply to identify and forecast turning points in commodity and stock prices, production, employment, and national income.

3. THE METHOD OF COMPARATIVE PRESSURE

The ratio of inventories of raw materials to production of finished goods, or months' supply as it is often called, has long been used by purchasing agents as a guide to the future of raw materials prices. Even better results are obtained by using the ratio of inventories of raw materials to new orders for finished goods.

Customers' net balances may be defined as bank deposits minus loans. When this balance is increasing, bank depositors have more "free" money, a condition which increases pressures for more investment and frequently leads to an increase in consumer purchasing power and so in demand for consumers' goods.

Such ratios or differences may be called comparative pressure indexes. They show the extent to which economic pressures are building up or decreasing. There are, of course, hundreds of ratios or differences that can be constructed to indicate changing economic pressures.

Pressure indexes are basic to satisfactory explanations of the demand for capital goods or equipment. For example, a weighted average of railroad carloadings today and a pressure index constructed as the ratio of seasonally corrected carloadings to cars owned by the railroad (or better to cars in serviceable condition) gives a reasonably satisfactory forecast of cars that will be ordered by the railroads six months to a year from today.[36] Again, a weighted average of electric power consumption and the difference between consumption and generating capacity can be combined into a highly satisfactory predictor of utility equipment production[37] or expenditures.

[35] Roos, *Economic Measures*, 1938, Line (16). The basic ideas are presented in Roos, *Dynamic Economics*, 1934, Chapter XIII, where a generalized equation of exchange is developed. The series of *Economic Measures* is reproduced for the period 1919–1939 on p. 19 of Roos, *Investment Management in an Unstable Economy, loc. cit.*

[36] Roos, *Charting the Course of Your Business*, p. 82.

[37] C. F. Roos and Victor S. Von Szeliski, "The Demand for Durable Goods," *Econometrica*, 1943, pp. 116–121; and Roos, "The Demand for Investment Goods," *American Economic Review*, Vol. XXXVIII, 1948, pp. 317–318.

The new orders or demand for capital goods as a whole (or the later series of producers' expenditures) can be satisfactorily forecast by a function of (1) a composite index of new orders for consumers' goods, construction materials, supplies, and capital goods and (2) the ratio of these new orders to productive capacity. The formula is chosen so that demand for capital goods varies almost linearly with the ratio of new orders to production when the ratio is less than 85 but increases geometrically when the ratio is greater than 85.

In the boom stages of a business "cycle" composite new orders are at a level which is more than 85 per cent of capacity and, during this phase, new orders for capital goods (and the later series producers' expenditures) advance rapidly. The boom goes on until production reaches a point within five per cent or so of capacity, prices advance more rapidly than consumers' incomes, consumers' demand at retail levels out, inventories become excessive relative to this demand or to working capital or to both, capacity to produce rises, new orders for consumers' goods level out, and the ratio of combined new orders to capacity increases. At this stage new orders for capital goods decline sharply. This decline is followed by a decline in new orders for consumers' goods.[38]

The extent of the decline depends upon (1) the degree of previous excesses or pressures, (2) the rate of change of the money supply, (3) the fiscal policy of the government, (4) special stimuli to demand such as tax reduction, change in availability and cost of credit, change in depreciation policies for tax purposes, war or preparations for war, and change in immigration policies.

At the bottom of the cycle, retailers and wholesalers inventories are so low relative to sales that they lose sales. To protect their trade position, they increase their new orders even though they expect the increase in ordering to result in inventory losses. These increases in new orders, however, firm the price level, the feared loss does not materialize, and a new upward cycle begins.

This explanation explicitly involves neither the long-term interest rate nor the profitability of enterprise. It does, however, involve both implicitly, for the ratio of new orders to capacity is itself a good forecaster of both profits and the demand for new long-term money.[39] As the ratio of new orders to capacity increases it becomes increasingly easy to sell goods, prices firm or rise, and at the higher volume and firm-to-higher prices, profits also rise. In fact, as new orders approach the 95 per cent of capacity level, profits spectacularly advance, as do also stock prices.

Business demand for money can be readily calculated from the ratio of new orders to the working capital of corporations[40] and the ratio of this demand combined with government and bank demand for funds to the supply of money yields a good demand criterion or forecaster of bond yields.[41]

[38] Roos, *Economic Measures, Basic Charts*, 1938.

[39] Also the new issues used in forecasting by Leonard P. Ayres, *op. cit.*

[40] Roos, *Economic Measures*, 1938.

[41] C. F. Roos and Victor S. Von Szeliski, "The Determination of Interest Rates," *Journal of Political Economy*, Vol. L, 1942, pp. 501–535; see also William H. Dunkak, Philip E. Albrecht, F. LeRoy Spangler, John Roche, and Julius Sedlmayr, "Stocks, Bonds and Interest Rates," *Determining the Business Outlook*, New York 1954; and Roland Robinson, "Fore-

The difference between consumers' stocks of a durable good like automobiles and an optimum-ownership level calculated from the number of households, disposable income, price, and months needed to pay instalments indicates the pressure of the new-owner market. For some products such as washing machines, the optimum-ownership level is quite a bit less than one per household. For other products, like radios, the optimum-ownership level is nearer four—one for the living room, one or more for the bedrooms, one for the automobile, and in some cases one or more for the country house, the rumpus room, or bar. In the case of automobiles, the optimum-ownership is close to one per household since the few households that have more than one just about offset those that have none.

The difference between the housing inventory and the number of households is a good pressure index of the long-term demand for new housing.[42] Over the short-term, disposable income as it affects the degree of doubling up (multiple family occupancy of a single unit), and credit conditions may be more important in determining actual construction.

Every ratio of consumers' expenditure to a consumption function based on (disposable income)$^{\alpha}$, where α is the elasticity of expenditures, is a pressure index. It may not always be helpful in forecasting direction of change or deviation, but it is always a warning of new factors, temporary or permanent. Sometimes one can determine that the new forces are temporary, as in late 1950 when purchasing power was temporarily boosted by a non-recurring national life insurance dividend, cashing of savings bonds, and an abnormal increase in consumers' loans during July, August, and September. In many instances the divergence yields important forecast information.[43]

4. THE OPINION POLL METHOD

Each of the techniques described in sections 2 and 3 is used by the officers and advisers of one or more large corporations in the United States. Consequently, a

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casting Interest Rates," *Journal of Business*, 1954, pp. 87–100. The authors of the last two papers seem unaware that many of the questions they raised were answered twelve years earlier in the Roos-Von Szeliski paper.

[42] Roos, *Dynamic Economics*, 1934, p. 80. This study applies only to St. Louis. For a calculation of housing inventory and long-term building need for the United States as a whole, see Roos, *General Outlook for the American Economy, 1954–1974*, New York, 1954, Chapter VIII, "Construction Activity," pp. 109–136, and Table VIII-D.

[43] Roos, *Economic Measures*, November 9, 1950, p. 109, contained the following forecast: "Strength in capital goods and in construction . . . will support the economy while consumers' goods industries are undergoing correction of excesses stemming from the Korean-stimulated buying." And in *Economic Measures* for February 8, 1951, the following appears on p. 31: "Such abnormal buying sprees as that in department stores in January typically last only a few weeks before the trend turns down, because sales must inevitably be geared to income, and anticipations of this income consequently must be short-lived. Now that price controls have been clamped on, sales are apt to drop, since (1) the expectation of price increases, which has been a reason for forward buying, no longer is a threat to the average customer; and (2) stores will not place on their counters for sale those goods which they purchased to sell at prices above the ceilings now in force."

poll of businessmen on the outlook for business would be a composite of forecasts based on these or related methods, trend projections, cycle analyses, and guesses. If the naive forecasts cancelled each other out, the poll average would be in the direction indicated by the leading indexes and pressure indexes. If they did not cancel out, the forecast would either be random or depend upon the events and economic conditions which led to a panic or irrational mass decision on the part of the uninformed. Finally, if a majority of businessmen (or consumers) follow the method of trend projection, as there is good reason to believe, the opinion polls are apt to yield results that could be obtained by simple trend projection.

With the problem put this way it is not surprising that any outsider by simple projection of the most recent level might have done as well as the Railroad Shippers forecasts of freight requirements.[44] Using this naive method the average error for 93 quarterly forecasts extending from the middle of 1927 to the middle of 1950 was 5.53 per cent whereas the average error for the Shippers was 7.79 per cent. The Shippers "failed to anticipate the actual reversal in the fourth quarter of 1929, the first of 1933, the fourth of 1937, the fourth of 1944, and the fourth of 1948." They also failed to forecast the sharp upturn in mid-1936 and in 1941. They were too optimistic during periods of declining business and too pessimistic during periods of rising business. These conditions and the pattern of error in the period 1929–1949 indicate that the forecasts were dominated by trend projections. Indeed, it has been shown that the Shippers forecast formula corresponded to the naive one that the next quarter would be higher or lower than the corresponding quarter a year earlier by $\frac{6}{10}$ of the change that had occurred during the past twelve months.[45]

Somewhat better results over a short period of time have been obtained by the respondents to mail polls conducted by the magazine *Fortune* since May 1947. The only really serious error was the forecast for the second half of 1947. Respondents in every industry expected on the average, for this period, a mild contraction which definitely failed to materialize. The anticipations for the durable and non-durable manufacturing industries, as well as the implicit forecast of private national income, indicated correctly the direction of change in every one of the remaining seven semi-annual periods. The average expectation underestimated expansion in almost every instance where expansion actually took place, and in several instances, notably for the second half of 1949, overestimated contraction.[46]

The *Fortune* poll is, broadly speaking, a large sample of high executives of

[44] Thor Hultgren, "Forecasts of Freight Movements" in *Short-Term Economic Forecasting*, National Bureau of Economic Research, New York, 1955. See also, Robert Ferber, "The Railroad Shippers Forecasts: A Case Study in Business Expectation," Bureau of Economic and Business Research, University of Illinois, 1955; and Franco Modigliani and Owen H. Sauerlender, "Economic Expectations and Plans of Firms in Relation to Forecasting," *Short-Term Economic Forecasting*, National Bureau of Economic Research, New York, 1955.

[45] Robert Ferber, "The Railroad Shippers Forecast: A Case Study in Business Expectation." *loc. cit.*

[46] F. Modigliani and Owen H. Sauerlender, "Economic Expectations and Plans of Firms in Relation to Forecasting," *loc. cit.*

medium and large firms across the country. Usually four to five thousand have mailed replies. The rate of total non-response is large, but among those who respond the rate of refusal on individual questions is low. According to Modigliani, "the rate of refusal on the question relating to expected sales in the respondents' own firm has been in the order of 1 per cent, and on the questions relating to general business condition it has been only slightly higher, around 3 per cent." In the case of the Dun and Bradstreet Survey, which involves personal interviews as explained below, the corresponding figures were very much higher. This suggests that *Fortune* tends to get replies from those who have well-defined opinions on general business conditions.

If several hundred respondents of *Fortune* indicated the correct moves, and the expectations of the others were nearly zero, the directions shown by the survey would be correct, but the magnitudes of change would be too small, as they were. The 1947 *Fortune* miss can probably be explained in terms of a bias introduced by a weak stock market and the extreme bearishness of some economists such as those in the Department of Commerce which was sufficient to outweigh correct forecasts made by the few.

Dun and Bradstreet conducted 16 surveys of business expectations between the spring of 1947 and July of 1951. Between the middle of April and the end of July, 1949 four surveys were conducted at intervals of about four weeks. The response to these four surveys was similar and sizeably wrong. For durable and non-durable goods manufacturing industries "the forecasting record of the Dun and Bradstreet surveys is decidedly worse than that of *Fortune*, and similar in many respects, to that of the Shippers survey. Once more, we observe that in 'level' or 'falling' periods, the anticipations over-estimated sales, whereas in rising periods they under-estimated them. . . . The average size of the responding concerns is smaller for Dun and Bradstreet."[47] There are indications that the smaller firms have the poorer forecasting record.[48] This is, however, an expected result since careful business forecasting is expensive.

The United States Department of Commerce and the Securities and Exchange Commission have been making quarterly and annual surveys of planned business investment since 1945. Roughly 2500 respondents participate in these surveys. These anticipatory data "provide a useful tool for short-term projections both in dollar and, more particularly, in real terms. . . . The most important reasons for this are first, that investment decisions as reflected in business programs involve commitments some time in advance and, second, that many of the factors which modify these decisions for individual firms tend to offset in the aggregate."[49]

[47] Modigliani and Sauerlender, *op. cit.*; see also Millard Hastay, "The Dun and Bradstreet Surveys of Businessmen's Expectation," a paper presented at the 1954 Montreal meetings of the American Statistical Association. Hastay is much less hopeful than Modigliani that these surveys will yield useful forecasts.

[48] Irwin Friend and Jean Bronfenbrenner, "Business Programs and Their Realization," *Survey of Current Business*, December 1950, pp. 11–12.

[49] Irwin Friend and Jean Bronfenbrenner, *op. cit.* and "Business Investment Programs and Their Realization," *Short-Term Economic Forecasting*, National Bureau of Economic

But lest the reader be carried into ecstasy by this discovery he should recall that producers' expenditures for plant and equipment are late in the business cycle. Construction contracts precede expenditures for plants by many months and plans are drawn and approved even before contracts are let. New orders for machinery and equipment precede production of these goods and these new orders are, themselves, preceded by changes in new orders for consumers goods and the ratio of production to capacity.[50] Furthermore, the accuracy of anticipated expenditure leaves much to be desired. While the anticipations for manufacturing were correct with respect to trend in 1947 and 1948, the errors in magnitude were sizeable in both years and even the trend was incorrect in 1950 despite the fact that new orders for capital goods were already rising sharply by January, 1950 when the survey was made.

The McGraw-Hill survey of planned expenditures for plant and producers durable equipment covers much the same ground as the government survey but is available earlier. The surveys began in 1947 and report in November of each year expectations for the following year. Less than 500 companies respond but these account for about 60 per cent of the investment of the most important capital-consuming industries. The surveys reveal investment plans and lay stress on analyzing the reasons behind the plans. Nevertheless, the surveys have been widely used for forecasting purposes.

For all industry, the planned expenditures reported by McGraw-Hill agreed rather well with actual expenditures except for the years 1948 when respondents planned 6 per cent more than materialized, 1950 when they planned 20 per cent less than actual, and 1951 when they planned 14 per cent more than actual. The miss for 1948 is explainable by the fact that the Congress during that year reduced personal income taxes and this stimulated demand.[51] The error made for 1950 was probably similar to a slightly smaller error in the government survey of expectations for the same year as explained above. The over–optimism of 14 per cent for 1951 was undoubtedly a result of the failure of respondents to anticipate the Chinese entry into the Korean War and the attendant restrictive controls on private investment. It should scarcely be necessary to add that if conditions change, operating plans must also change.

German businessmen are no better than American in forecasting changes in trends. German industrialists appear to have one-month prediction horizons in mind even when pertinent questions refer to a two-month interval. And the

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Research, New York, 1955. See also Garfield V. Cox, "Forecasting Expenditures for Plant and Equipment," *Journal of Business*, January 1954; and L. J. Paradiso, "Economic Projections of the U. S. Department of Commerce," a paper presented in 1954 at the Montreal meetings of the American Statistical Association.

[50] Roos, *Economic Measures*, 1938, Basic Chart 3.

[51] C. F. Roos, *Hearings Before the Committee on Finance, United States Senate*, March 1, 1948, pp. 136–156. The prediction was made at the Hearing that a lowering of the income tax would result in greater demand for both consumers' and capital goods.

percentage of businessmen's correct estimates increases, once a persistent uniform trend has been established.[52]

In most European countries estimates of future capital expenditures form an integral part of the national budget. In Belgium and Sweden, surveys of intentions similar to those made in the United States are regularly undertaken. In the United Kingdom, Norway, and the Netherlands, where war damages were great, government control of investment has been far-reaching. In these countries statements regarding planned outlays have, in general, been targets considered feasible. Through 1954 none of these countries had caught up with the deferred demand created during World War II and there have, therefore, been no reliable tests of the accuracy of the surveys. The forecasts could all have been made with comparable accuracy by simply projecting trends.

In Canada, surveys of investment intention have been made annually since 1945. The first survey covered manufacturing, mining, central electric stations, and telephone companies. By 1951 the survey had been extended to cover all private and public sectors of the Canadian economy, including business, housing, institutional and government investment. One capital expenditure survey is undertaken at the end of the year when intentions for the following year are recorded and another is taken at mid-year. The year-end survey attempts rather full coverage and includes returns of fifteen to twenty thousand business firms. The mid-year survey is based on a 10 per cent sample of the number of firms but covering about 50 per cent of the dollar total of investment intentions. The mid-year survey is designed to obtain information not only on the changes in capital expenditure plans that have occurred in the preceding six months but also the reasons for the changes. Percentage differences between realizations and intentions have varied from +40 in 1945 to −3.4 in 1949 when there was no recession corresponding to the one in the United States. The 1945 experience can be excused on the ground that Canadian business firms import much of their durable equipment and they may not have realized how difficult post-war delivery would be. This may also have been a factor in 1946 when the error was +22.5 per cent. But if we except these years, the others scarcely represent a test since total expenditures were higher in each year and simple trend projection would have given comparable results.[53]

Apparently, economists have again let themselves follow a fad. When the survey technique is used, the average opinion is necessarily no better than an average of the forecasts made by a wide variety of systematic methods and guess work. If there is no bias in the number (or volume) guessing, the trend will be determined by the few who do make plans and carry them out. Bias is almost certain, however, to enter at both the top and bottom of a cycle, for otherwise

[52] Oskar Anderson, Jr., Rainald K. Bauer, and Eberhard Fels, "On the Accuracy of Short-Term Entrepreneurial Expectations," a paper presented at the 1954 Montreal Meeting of the American Statistical Association.

[53] O. J. Firestone, "Investment Forecasting in Canada," *Short-term Economic Forecasting, loc. cit.*, believes the record good.

the cycle would be discounted and smoothed. Put another way this means that the trend projectors will dominate the forecast at the turns. Consequently, at the cyclical turns, where the forecast is crucially important, the survey technique is very likely to yield an incorrect forecast. In view of the present state of forecasting techniques of businessmen, the technique of surveying investment intentions thus has very limited validity and value.

Since 1946 surveys of consumers' buying plans for a year ahead of durable goods and housing and of the financial conditions of consumers have been made at the beginning of each year, for samples ranging from 2,900 to 3,600 cases.[54] The purposes of the consumer surveys are twofold: (1) to assess recent and current developments, and (2) to provide data for studying functional relationships between different variables, that is, the testing of hypotheses about economic behavior. A single survey yields spatial or cross-section data and consecutive surveys yield time series of such data.

Information is lacking concerning contingent expectations which consumers may have had in mind when replying about their plans and how changes in the contingencies would be met. Indeed, the contingencies may not even have been in the consumers' minds.

Within these limitations, "the evidence to date indicates that, in general, individuals are not very sensitive to small changes in prices and incomes, that their responses to economic happenings are frequently unsophisticated and emotional and are limited by lack of knowledge and certainty. Forecasting that assumes a rational 'economic man' aware of the full range of economic choice open to him can easily go astray. Recent experience indicates that consumers tend to respond somewhat slowly to economic changes that are small or that affect them only indirectly. Threats of shortages will get a strong reaction but prospects of small price changes appear to have little effect on durable goods purchases."[55]

The Survey Research Center conducted reinterviews in January–February, 1949 after a year had elapsed since original interviewing and with another sample in October, 1949 after nine months had elapsed between the two interviews.

[54] These surveys made by the Survey Research Center of the University of Michigan are sponsored by the Board of Governors of the Federal Reserve System, and articles presenting the results have appeared each year in the *Federal Reserve Bulletin*. See particularly, "Methods of the Survey of Consumer Finances," *Federal Reserve Bulletin*, July, 1950, and the appendixes, June, 1947 and June, 1949. See also, Roe Goodman, "Sampling for the 1947 Survey of Consumer Finances," *Journal of the American Statistical Association*, Vol. 42, 1947, pp. 439–448; George Katona, *Psychological Analysis of Economic Behavior*, New York, 1951; and George Katona and Eva Mueller, *Consumer Attitudes and Demand*, Survey Research Center, University of Michigan, 1953.

[55] Irving Schweiger, "The Contribution of Consumer Anticipations in Forecasting Consumer Demand," *Short-Term Economic Forecasting*, National Bureau of Economic Research, 1955. See also, George Katona, "Variability of Consumer Behavior and the Survey Method," Chapter II of *Contributions of Survey Methods to Economics*, New York, 1954, edited by L. R. Klein; and Robert Ferber, "Planning in Consumer Purchases—Durable Goods," *American Economic Review*, Vol. XLIV, December, 1954, pp. 854–874, and especially pp. 871–873.

The reinterviews involved 655 cases with the one year interval and 590 more with the nine months' interval.

The reinterview data for the first study show that 5.3 per cent had reported a definite or probable intention to buy a new automobile and another 2.6 per cent had reported indecisions; but 6.1 per cent had bought new cars. Again 2.9 per cent had reported a definite or probable intention to buy a used car and another 3.3 per cent had reported indecision; but 8.7 per cent had bought a used car. Essentially the same results were obtained for the second study. "There is no certain basis on which one could say that the 'undecided' group should or should not be ignored. The 'definitely will buy' group are a group more certain of realizing their intentions than any other but only at about the 50 per cent level."[56] Following is a breakdown of expectancies among 1948 car purchasers:

Expectancy	Bought	
	New Car	Used Car
Definitely will buy new	2.4%*	0.4%
Probably will buy new	0.4	0.1
Undecided about buying new	0.2	0.3
Definitely will buy used	—	0.8
Probably will buy used	—	0.6
Undecided about buying used	—	0.3
Don't expect to buy new or used	3.1	6.2
	6.1	8.7

* Per cents are out of the total reinterview sample.

This table and others not reproduced here show that there is a sizeable group that expected to purchase, yet did not; and also a sizeable group that did not expect to purchase, but did.

Those whose purchase expectancies materialized experienced a stable to improved financial situation and those who became unpredicted purchasers experienced a well-off condition or an unexpected improvement or both. Prominent among the factors which upset consumer predictions was income change.

"It would seem that prediction of individual behavior, with as simple an instrument as was used, is somewhat futile if not naive. The approach which is obviously more fruitful and theoretically sensible is to regard the responses as meaning a market condition which might be regarded as partly evidencing general psycho-economic forces facilitating and making for car purchasing. From this point of view the interpretation of prediction necessarily includes the current and subsequently developing economic conditions."[57]

[56] John B. Lansing and Steve B. Withey, "Analysis of Consumer Demand from Repeated Interviews," *Short-Term Economic Forecasting, loc. cit.*

[57] Lansing and Withey, *op. cit.* See also L. R. Klein and J. B. Lansing, "Decisions to Purchase Consumer Durable Goods," a mimeographed paper, Survey Research Center, University of Michigan, 1954. For an early effort to integrate market survey data with economic conditions see C. Stafford Brown, *Market Analysis—Something New, Something Better*, Econometric Institute, New York, 1945.

Indications are that those not reporting an expectancy in the first interview tend to make more spontaneous decisions. Also a check on expectancies of persons previously expecting to purchase but not doing so indicates that a sizeable group still maintain their expectancy to purchase, especially at the time of the second reinterview study which involved only a nine month interval. Seemingly a fairly large percentage of those giving expectancies to buy did not take their answers seriously; for among the non-realized expect-to-buy-new-car group, 46 per cent did not recall any such expectancy. In the similar group previously reporting expectancies to buy used cars, 84 per cent did not recall any such consideration.

The Surveys of Consumer Finance also involve expectancies for refrigerators, furniture, radios, and television sets. Over-all predictive efficiency on these items of smaller expense is generally worse than that on automobiles. Therefore, the most favorable criticism that can be made is that data on intentions to buy should be used with considerable caution.

But what about the "success" of the survey in indicating higher demand in 1949 than in 1948 even though income was lower? What about the further "success" in 1951 of indicating lower demand for consumers' durables even though income was higher? Finally, what about the fact that survey data indicated higher demand in 1953 than studies based on time series?

Part of the answer to each question seems to be that the average consumer, like the average businessman, is a guesser rather than a scientific forecaster. If changes in basic determinants of demand are small, these guessers have an average expectancy of zero. Consequently, the trend is determined by the few who can, and do, plan on the basis of what they confidently expect to happen to (1) their incomes, (2) their marital status, (3) their stocks of goods, (4) prices, and (5) their ability to pay instalments.

5. ECONOMETRIC METHODS

A time series study of demand for automobiles based on the factors (1) supernumerary income (disposable income less the cost of subsistence living), (2) number of households, (3) consumers' stocks of cars and their age distribution, (4) prices, and (5) credit conditions as measured by months to pay, showed late in 1948 that consumers' stocks would be far below the optimum ownership level even if personal incomes should decline, credit should be restricted slightly, and the rate of formation of new households should decrease. Consequently, the demand for new cars in 1949 would be above 1948 production levels.

The Survey of Consumers' Finances pointed to 1953 sales levels of consumers' durable goods higher than those forecast by the time series technique. Thus, it indicated less saturation of markets than the time series study, which, however, was based on the assumption of a 510,000 undercount of households.

Manufacturers generally had higher expectations than those indicated either by the time series method or the Survey of Consumers' Finances and pushed production up sharply. By the end of 1953 inventories of consumers' durable goods were unwieldly and production was declining sharply.

Hundreds of dynamic studies of demand, ranging from flour, sugar, and other

foods through textiles and apparel to consumers' durable goods such as television sets, refrigerators, and automobiles, have been made.[58] For food items such variables as disposable income, number of consumers as calculated from the age structure of the population, cost of living, and price indexes of closely competing commodities usually are sufficient. For these perishable goods, consumers' stocks play negligible, short-term roles. In demand studies for semi-durable goods such as textiles and clothing it is usually necessary to add variables measuring consumers' stocks and fashion changes. For consumers' durables, a function of households replaces population as a variable, consumers' stocks becomes an essential variable as does price per month, i.e., consumer credit conditions. The function of households may be simply the per cent of electrically-wired homes in the case of refrigerators or several times the number of households as in the case of radios.

For purposes of forecasting, the *ceteribus paribus* of the demand function must be assured; that is, the explanation must be reasonably complete and the variables must be combined in such a way that intercorrelations of dependent variables are insignificant. This last condition may mean that two highly correlated variables such as the price of food and the cost of living are combined as a simple or weighted ratio or average and this new synthetic index is used as an independent variable in the regression equation.

Such dynamic demand laws show stability with respect to statistical constants[59] whereas correlations of aggregate consumers' expenditures with (1) disposable income alone, (2) disposable income and price alone, (3) disposable income, price, and population, and (4) disposable income, price, population, and a smooth time trend, do not.[60]

The fact that demand for consumers' durable goods is quite variable in the

[58] These are largely unpublished studies made by the Econometric Institute for its clients. Some, like *Dynamics of Automobile Demand* and *Demand for Power Lawnmowers*, have been published by clients. Some have appeared in *Forecasting Sales*, 1947, National Industrial Conference Board, New York. See also Roos, "Review of *Forecasting Sales*," *Journal of the American Statistical Association*, Vol. 43, 1948, pp. 163–165. Some of the demand studies are reproduced in Econometric Institute basic reports for the industries: food, textiles, shoe and leather goods, rubber, chemicals and drugs, retail trade, paper, petroleum and fuels, and electrical equipment. In general, the studies were made possible by special data on end uses and prices furnished by clients. These data are, of course, related to the input-output data of Wassily Leontief, *The Structure of the American Economy 1919–1939*, New York, 1951, p. 264; and Leontief, "Interrelations of Prices, Output, Savings and Investment," *Review of Economic Statistics*, Vol. XIX, 1937, pp. 109–132. See also the extensive bibliography of the United States Bureau of the Budget entitled, *Interindustry Bibliography*, 1953, and the six supplements published to November 1, 1954.

[59] The reference is to the studies of the Econometric Institute, see footnote 58. Reference should also be made to James H. Lorie, "Forecasting the Demand for Consumer Durable Goods," *Journal of Business*, January 1954, pp. 62–70.

[60] Robert Ferber, *A Study of Aggregate Consumption Functions*, National Bureau of Economic Research Technical Paper 8, 1953; and Arthur F. Burns, *The Instability of Consumer Spending*, 32nd Annual Report, National Bureau of Economic Research, 1952. About one hundred aggregate consumption functions have been fitted to data for the United States; see G. H. Orcutt and A. D. Roy, "A Bibliography of the Consumption Function," University of Cambridge, mimeographed release.

business cycle should have long ago discouraged the hunt for a magic formula of aggregate consumption. Indeed, an *aggregate consumption function*, stable with respect to its statistical constants, cannot be constructed in terms of the variables, disposable income, price, population, and a smooth time trend, if individual demands depend upon the variables used in the Econometric Institute's studies. Simple multiplication of the individual demands by the corresponding prices and summing yields an "aggregate demand function" which is much more complex.

The problem of constructing an aggregate consumption function is further complicated by the usual classification by economists of new housing as an investment good, whereas its economic behavior is that of a consumers' durable good.[61] Demand for new housing, as in the case of demand for any consumers' durable good, depends upon (1) disposable income, (2) households, (3) consumers' stocks, (4) prices, and (5) credit conditions as measured by the down payment and months to pay out. But demand for new housing, unlike the demand for other consumers' durable goods, because of long periods of time to pay off mortgages, also depends significantly upon the long-term interest rate, a situation which accounts for the classification of housing as an investment good. Yet this classification has greatly complicated the problem of determining both consumers' expenditures and savings via regression functions, and is a root cause for the failure of some post-war econometric models. High "investment" by the consumer in new housing necessarily means high personal savings. If consumers' durable goods like kitchen cabinets, stoves, refrigerators, and radio antennas are built into the house, they may find their way into consumers' savings; but if the same goods are later purchased by the consumer, they are expenditures.

Another savings-expenditures difficulty has arisen because data for financial and business concerns are pooled in the gross national product accounts. Therefore, increases in bank savings may offset decreases in other business savings, without any change appearing in the GNP accounts. Yet such a situation has had profoundly deflationary effects on the national economy. Still another difficulty has arisen because investments of unincorporated businesses in inventory, plant, and equipment is treated as personal savings. For these and still other reasons beyond the scope of this paper, the author has had no confidence in GNP models as an aid to forecasting.[62]

Producers' expenditures for durable equipment is preceded on the average six months by an index constructed from new corporate purchasing power, the long-term interest rate, and the ratio of prices of consumers' goods to prices of capital goods. This new corporate purchasing power is comprised chiefly of (1) capital consumption allowances (depreciation, obsolescence, fire and other damage, and depletion), (2) corporate profits retained in the business, and (3)

[61] Roos, *Economic Measures*, 1938, Chart 2.

[62] For some further objections to the GNP accounts see, Daniel H. Brill, "The Flow of Funds Approach to Savings and Investment," a paper presented at the September 12, 1954 meeting of the American Statistical Association.

new corporate financing. It also includes tax refunds, a part of personal savings (unincorporated businesses), and the sale of corporate treasury-owned securities for cash. However, the first three above account for most of new corporate purchasing power and the other items are correlated with their sum.

Let D = demand for capital goods; Π = corporate profits after taxes; i = long-term interest rate; P_1 = prices of consumers' goods; P_2 = prices of capital goods; N = new financing; C = capital consumption allowances; γ = the percentage of corporate profits retained in the business; and P = corporate purchasing power. Then $P = \gamma\Pi + C + N$.

Prior to World War II, there were no data on capital consumption allowances. Sketchy data on new financing indicated that it was highly correlated with corporate profits. Therefore, if C were relatively constant or correlated with Π, corporate profits after taxes could be used as a "proxy" variable for P and we could write

$$D = A_1 \frac{\pi}{i} \frac{P_1}{P_2} + A_2.$$

An extraordinarily good fit was obtained when the function $\frac{\Pi}{i} \frac{P_1}{P_2}$ preceded D by six months.[63]

During the war years, 1942–1945, producers' expenditures for durable equipment were, of course, below the levels indicated by the formula. However, this was a necessary corollary of the wartime controls. Although the predictor led the predictand by only six months, the predictor itself could be readily forecast another six months.[64] Consequently, producers' expenditures for durable goods could be forecast rather well for one year ahead. Indeed, one could make a reasonably good eighteen-month forecast if he also had good indexes of new orders for consumers' goods and theoretical demands for consumers' non-durable goods and consumers' durable goods.

The formula was first used in mid-1945 when it indicated record high expenditures for producers' durable equipment in 1946. It continued to point to an upward trend in these expenditures until mid-1948 when a downturn for 1949 was indicated. By the end of 1949 the composite index was again pointing to an upturn. However, the actual decline in 1949 was less than indicated and the actual rise in 1950 was greater. In each succeeding year the spread between the actual and the calculated levels has increased.

In the meantime, however, reasonably good estimates of capital consumption

[63] C. F. Roos, "The Demand for Investment Goods," *American Economic Review*, Vol. XXXVIII, 1948, pp. 311–320. See also Colin Clark, "National Income at its Climax," *Economic Journal*, Vol. 47, 1937, p. 308.

[64] Roos, *Investment Management in an Unstable Economy*, New York, 1940, pp. 21–24; and Roos and Von Szeliski, "The Determination of Interest Rates," *Journal of Political Economy*, 1942, pp. 501–535. A more complete study which took into account the additional factors of changes in the proportion of long-term and short-term securities outstanding, changes in total debt, and changes in insurance and pension fund reserves appeared in *Economic Measures*, March, 1952, Basic Chart 16.

allowances,[65] new financing, and corporate profits retained had become available.[66]

These data confirmed the hypothesis that corporate profits was a good "proxy variable" for corporate purchasing power prior to 1942. With the advent of World War II, however, and the accompanying certificates of necessity which permitted rapid amortization of the cost of new facilities, capital consumption allowances began to rise sharply from the previously relatively stable $7.75 billion annual level. These capital consumption allowances were given a further boost by the Korean War and a new round of certificates of necessity; and in consequence they have risen monotonically to date. At the end of 1954 they were at an annual rate of nearly $30 billion. Moreover, the percentage of profit retained has risen sharply from the 35 per cent of 1941 to about 50 per cent so that γ has ceased to be a constant.

Consequently, it is now neither valid, nor necessary, to use corporate profits after taxes as a "proxy variable" for corporate purchasing power. The real variable, statistics for which are now available, yields an excellent fit for the pre-1948 period and, of course, a very much better one since 1948.

Let $E(t)$ = producers' expenditures in millions of dollars during the year t; $\Pi(t)$ = corporate profits after taxes; $I(t)$ = corporate purchasing power defined as corporate profits retained + new financing + depreciation and obsolescence; P_1 = prices of manufactured goods; P_2 = prices of metals and metal products; i = long-term interest rate as measured by Moody's yield for Aaa bonds; and $x(t)$ = $(\Pi\ P_1/iP_2)_{t-6}$, where the subscript, $t-6$, refers to the time interval six months previous.

Then, the equation of demand (using revised data on expenditures and profits) for the study based on corporate profits after taxes as a proxy variable is

$$E(t) = .022857x(t) + 2200.$$

For the period 1928–1947, corporate profits, the proxy variable, was related to the true variable, corporate purchasing power, by the formula

$$\Pi(t-6) = .74I(t-3) - 3259.$$

Consequently, by substitution the formula for $E(t)$ becomes

$$E(t) = [.016914I(t-3) - 74.49]\ (P_1/iP_2)_{t-6} + 2200.$$

Table II, calculated from this formula, shows a good agreement between demand for producers' durable equipment and actual expenditures for the period 1929–1954 except (a) for the year 1929 when corporations were using funds for call loans, (b) during World War II when wartime controls held actual expenditures below demand, and (c) during 1946 and 1947 when there were substantial shortages of steel.

[65] Income Supplement, *Survey of Current Business*, 1950.

[66] Sergei P. Dubrovolsky, *Corporate Income Retention, 1915–1943*, National Bureau of Economic Research. See also, *Conference on Research in Business Finance*, National Bureau of Economic Research, New York, 1952.

TABLE II

PRODUCERS EXPENDITURES FOR DURABLE EQUIPMENT VS CORPORATE PURCHASING POWER, INTEREST RATES AND COMMODITY PRICES

Year	Capital Consumption Allowances	Undistributed Profits	New Capital Issues	Corporate Purchasing Power I(t)	BLS Prices (1926 = 100)		AAA Bond Yields	$R(t) = \frac{Pi}{iP2}$	R (t − 6)	I (t − 3)	Calculated Producers' Expenditures	Actual Producers' Expenditures
					Manufactured Products	Metals & Metal Products						
1928	8400	2300	5209	15909	95.9	97.0	4.55	21.74				
1929	8617	2446	7800	18863	94.5	100.5	4.73	19.87	20.8	18125	7027	5850
1930	8541	−3010	4350	9881	88.0	92.1	4.55	20.99	20.43	12127	4869	4465
1931	8166	−5366	1500	4300	87.0	84.5	4.58	22.46	21.73	5695	2675	2839
1932	7615	−5967	300	1948	70.3	80.2	5.01	17.49	19.98	2536	1569	1593
1933	7161	−2426	160	4895	70.5	79.8	4.49	19.66	18.58	4158	2123	1589
1934	7112	−1615	152	5649	78.2	86.9	4.00	22.50	21.08	5461	2577	2304
1935	7235	−669	401	6967	82.2	86.4	3.60	26.41	24.46	6638	3124	3066
1936	7496	−217	1061	8340	82.0	87.0	3.24	29.10	27.78	7997	3888	4169
1937	7746	48	1138	8932	87.2	95.7	3.26	27.94	28.52	8784	4313	5095
1938	7783	−916	903	7770	82.2	95.7	3.19	27.24	27.59	8061	3918	3644
1939	7838	1174	420	9432	80.4	94.4	3.01	28.31	27.78	9017	4367	4180
1940	8148	2443	762	11353	81.6	95.8	2.84	30.00	29.16	10873	5391	5531
1941	9041	4914	1040	14995	89.1	99.4	2.77	32.35	31.18	14085	7305	6942
1942	10155	5178	647	15980	98.6	103.8	2.83	33.57	32.96	15734	8516	4343
1943	10866	5996	408	17270	100.1	103.8	2.73	35.31	34.44	16948	9507	4027
1944	12007	5698	753	18458	100.8	103.8	2.72	35.70	35.51	18161	10462	5438
1945	12549	3597	1347	17493	101.8	104.7	2.62	37.10	36.40	17734	10407	7654
1946	11666	7656	3889	23211	116.1	115.5	2.53	39.72	38.41	21782	13490	10733
1947	14118	11721	5115	30954	146.0	145.0	2.61	38.58	39.15	29018	18499	16667
1948	16494	13011	6651	36156	159.4	163.6	2.82	34.54	36.56	34856	21031	19110
1949	18431	8329	5558	32318	151.2	170.2	2.66	33.38	33.96	33278	18785	17833
1950	20516	12934	4990	38440	156.8	173.6	2.62	34.47	33.93	36910	20855	21135
1951	23469	9607	7120	40196	176.0	189.2	2.86	32.52	33.50	39757	22332	23177
1952	25304	8081	8716	42101	175.0	189.5	2.96	31.18	31.85	41625	22351	23307
1953	27226	8921	8495	44642	173.6	195.5	3.21	27.66	29.42	44007	21907	24378
1954	29500	7600	7900	44800	175.6	197.2	2.90	30.69	29.18	44761	22118	22150

In June, 1953, this calculated demand for domestic producers' durable equipment expenditures indicated a level substantially below that prevailing and, in 1954, expenditures dropped back to the calculated demand. The econometric index levelled out early in 1954 and by mid-year pointed to an increase for 1955 over the then current level.[67] It continued to rise through 1954 and by the year's end producers' expenditures for durable equipment were also rising.

[67] Roos, *Economic Measures*, June 10, 1954. The demand series for producers' durable equipment is published monthly. The demand formulation here differs radically from that of Colin Clark, "A System of Equations Explaining the United States Trade Cycle, 1921–1941," *Econometrica*, Vol. 17, 1949, pp. 93–123. Failure of Clark to include corporate taxes in his model explicitly is a root cause of the failure of his model in 1954.

Reference should be made to Friedrich A. Lutz and Vera C. Lutz, *The Theory of Investment of the Firm*, Princeton, 1951, in which there is some discussion of the dependence of the rate of equipment installations over time on demand and cost conditions.

Although this formulation of demand for producers' durable equipment seems at first sight to be quite different from that presented in section 3, the difference is superficial. In the first study the ratio of new orders for consumers' goods to capacity used is a good forecaster of both corporate profits and the ratio of prices of consumers' goods to prices of capital goods. Moreover, the ratio of new orders to capacity is related to the demand for business loans and so also to the long-term interest rate. The ratio of new orders to capacity, however, is an earlier index than profits and prices, and so a longer forecast is possible by its use.

Both demand formulations for capital goods presented here challenge the Keynesian School on essential points. Whereas Keynes and his disciples supposed that investment depended primarily on psychology or business sentiment which he assumed were unstable, these analyses show definite predictable behavior patterns and offer means for forecasting the orders actually placed, that is, for getting behind the psychology. Thus, the businessman is not the capricious individual of Keynes in whose hands "the duty of ordering the current volume of investment cannot be safely left."[68] The second formulation indicates a delayed effect of change in the long-term interest rate and offers a dynamic "explanation" of why the marginal efficiency of capital is apt to be different from the interest rate.

Furthermore, if capacity is not changing, increased consumer spending is apt to lead to an increase in new orders for consumers' goods and this in turn to a rise in new orders for capital goods about six months later. Consequently, Keynes notwithstanding, consumer spending *can* initiate changes in employment and income; for the induced change in investment has to be added to the consumption which Keynes thought increased by less than income.[69]

This, however, is not a place to argue the merits or deficiencies of Keynes' ideas. Such a task would involve analyzing side by side his whole work with the previous, partly supporting but largely contradicting, dynamic theories of the present author,[70] and the similarities and dissimilarities shown in the works of Frisch, Davis, Kalecki, Tinbergen, Tintner, and others.

Economic forecasting is similar to the forecasting of the average and flood stages of a river at a particular point or for a particular stretch. For the latter

[68] J. M. Keynes, *The General Theory of Employment, Interest and Money*, 1936, p. 320.

[69] *Ibid.*, p. 96.

[70] C. F. Roos, "A Mathematical Theory of Competition," *American Journal of Mathematics*, Vol. 47, 1925; "A Dynamical Theory of Economics," *Journal of Political Economy*, Vol. XXXV, 1927; "The Problem of Depreciation in the Calculus of Variations," *Bulletin of the American Mathematical Society*, Vol. 34, 1928; "A Mathematical Theory of Depreciation and Replacement," *American Journal of Mathematics*, 1928; "Some Problems of Business Forecasting," *Proceedings of the National Academy of Sciences*, 1929; "A Mathematical Theory of Price and Production Fluctuations and Economic Crises," *Journal of Political Economy*, 1930; "Securities," *Stabilization of Employment*, 1933; "Theoretical Studies of Demand," *Econometrica*, 1934; and "The Economic Theory of the Shorter Work Week," *Econometrica*, 1935. There are other differences in later works such as *NRA Economic Planning*, 1936; *Money, Men and Machines*, 1953; and the various articles and pamphlets referred to in this paper.

one would go upstream, count the tributaries, and estimate their capacity, measure the porosity or absorption power of the soil of the watershed, determine what is happening to the forests and vegetation that retard the flow of waters from the snows, the normal rains, and the downpours. One would want to know whether the rate of run-off is likely to increase or decrease; whether silt is filling up the tributaries and so reducing their capacity or whether the channel is being scoured and its capacity increased; whether dams and other obstructions are increasing capacity; and so forth. The problems of economic forecasting are solved by going upstream to

1. Count the tributaries that converge to make total economic activity and determine the time position of each tributary,
2. Determine the influence of changes in past birth rates and current death rates on the number of persons and households,
3. Estimate the normal capacities to consume under the existing mores and physical assets,
4. Determine the capacity to produce and how this is related to normal capacity to consume,
5. Determine the influence of changes in technology on consumption and production,
6. Measure the influence of changes in money conditions,
7. Understand how and why the businessman decides to add to plant and equipment, and
8. Understand why decisions are made to build homes, erect stores, office buildings, etc.

The modern econometrician approaches the problem of forecasting business with a tested theoretical background, and a library of studies involving both simple and complicated economic interrelationships. He knows how changes in various statistical series are timed with respect to changes that have already occurred in other series. He possesses the mathematical and statistical training that is required for interpolating and filling in important gaps in data, for spotting inconsistencies in data and for isolating from trends such complex seasonal and cyclical tendencies as may exist. The modern econometric forecaster with knowledge of the mathematical theories of probability and likelihood is able to identify with assurance points at which new systematic or non-random factors put in their appearance. The modern econometric forecaster, viewing the economy as an elastic membrane in disequilibrium, is forever on the alert to identify new impressed forces that might reinforce or negate his forecasts. He knows that certain strong forces can importantly modify trends and is therefore constantly measuring the intensities of new forces as they appear. And this constancy of observation enables him to identify turning points well ahead of the average citizen.

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