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PREFACE

THIS PAPER REPORTS BRIEFLY some results of a larger study of cyclical fluctuations in commodity stocks undertaken as part of the National Bureau's general investigation into business cycles. It was read, substantially in its present form, before the Econometric Society in Chicago, December 30, 1947. Several passages have been expanded and a few notes added, but no significant alteration or enlargement has been attempted.

The community's stockpile of goods, which embody some quantity of labor and other resources but have not yet reached the hands of their final consumers or users, is what we commonly call the stocks or inventories of business. The goods are of the most diverse origins, physical qualities, and ultimate destinations. They are held at many stages of production by concerns performing very different functions. Wheat, hides, and bituminous coal, for example, differ significantly in the rapidity with which their supply can be adjusted to changes in demand. The risk of holding women's dresses is much greater than the risk of holding cloth, which in turn is greater than that of holding raw cotton. The speculative dealer holds stocks for a purpose different from that of the manufacturer who fabricates the material or the wholesaler who distributes the fabricated product. These differences, and many others, produce radical dissimilarities in the movements of inventories, and make the problem of detecting uniformities and framing useful generalizations extraordinarily complex. And the problem is rendered still more difficult by a scarcity of reliable statistical records.

These circumstances have conditioned the scope and character of the National Bureau's inventory research. In view of the great differences in the behavior of stocks of different types and in the factors governing their behavior, it seemed best to focus attention initially upon some important category of stocks. The category so far studied most intensively is the inventory held by manufacturers. Within this category, we have been driven to recognize several distinct types of stocks, whose relation to business cycles varies from case to case, but

that together account for the behavior of the total. The decision to concentrate effort on manufacturers' stocks has been doubly rewarding. It has enabled us to study this major block of stocks with sufficient care to reveal its complex nature. At the same time, it has enabled us to understand better the forces controlling inventories held in other branches of business.

The principal purpose of the investigation is to determine what relations fluctuations in manufacturers' stocks bear to business cycles. The study deals with both cycles in inventories and cycles in the accumulation of inventories. The plan is to use what estimates there are of manufacturers' total inventories to establish certain broad characteristics of cyclical behavior. In the process, movements in manufacturers' stocks are compared with those in stocks held by other major divisions in the economy, and the general relation between total business inventories and business cycles indicated. To gain an understanding of the cyclical behavior of manufacturers' stocks revealed by over-all estimates, I have depended on a collection of series representing manufacturers' holdings of individual commodities of many types. These commodities were divided into significant classes, the characteristic behavior of each class established, and the causes of the behavior investigated. By combining these results with estimates of the importance of the several classes, a reasonable account of the behavior of manufacturers' stocks as a whole became possible.

The present paper sets forth some of the results of this investigation and attempts to indicate their significance for business-cycle theory. In such a brief essay, however, the argument is necessarily pared to its essentials and the supporting evidence confined to examples and illustrations. A revised draft of my full report, which makes good these deficiencies, is now about completed and will be ready for publication soon.

Both in preparing this paper and in the larger investigation, I have been greatly helped by my colleagues at the National Bureau. My special thanks go to Carolyn C. Landau and Judith Moss who are assisting me in the general study of inventory cycles. The argument was greatly clarified by Martha Anderson's editorial suggestions. The charts were drawn by H. Irving Forman.

M. A.

AS INDICATED IN THE PREFACE, this essay is a condensed version of parts of a larger study. It attempts merely to outline my views on the matters dealt with, leaving the full argument and most of the supporting evidence to be presented later.

I should like to begin with a fairly commonplace idea: from the standpoint of business-cycle theory, investment is not an autonomous variable determined by factors independent of cycles. It is rather a controlling factor which is itself governed by forces inherent in business cycles. Many considerations support this view, but one of the most significant is that inventories are an important object of short-term investment. And whatever we may think about other objects of investment, inventories and inventory investment *are* closely related to current levels of consumption and production and to rates of change in them. Hence an adequate explanation of business cycles should include an explanation of how inventories behave.

To grasp how important a factor inventories are in the generation and development of business cycles, we need only examine Simon Kuznets' estimates of gross national product. These demonstrate that a very large share of the cyclical changes in gross national product has regularly taken the form of changes in the volume of inventory investment.¹ For example, during the five business cycles identified by the National Bureau between the two World Wars, the average increase in gross national product between the trough and peak years

¹ By 'inventory investment' or 'volume of inventory investment', I mean the net value of the *physical additions* to stocks in a given period, over and above any goods sold or otherwise used up. 'Inventory disinvestment', as I use the term, refers to the net value of the physical change in inventories when this change is negative. Both terms are equivalent to the first differences in inventories, that is, to the rate of change in inventories per unit of time (of course, after the effect of price changes upon the book value of stocks has been allowed for). A 'change in the volume of inventory investment' implies a comparison between inventory investment in one period and inventory investment in another, that is, a comparison between the rates of change in inventories in two periods.

A simple example will illustrate the meaning of these terms. Let the value of inventories, measured in constant prices, be \$1,000 at the end of Year 1, \$1,200 at the end of Year 2, \$1,500 at the end of Year 3 and \$1,300 at the end of Year 4. The inventory investment (or the volume of inventory investment) is \$200 during Year 2 and \$300 during Year 3. During Year 4 there is inventory *disinvestment* of \$200. The *change* in inventory investment is +\$100 between Years 2 and 3 and -\$500 between Years 3 and 4.

of business expansions was some \$12 billion in 1929 prices. The average increase in inventory investment from trough to peak years was nearly \$3 billion—about 23 percent of the average expansion in gross national product. The average share of such a variable process as the fabrication of producer durable equipment, on the contrary, was only 14 percent, that of construction only 6 percent, and that of the output of consumer durable goods, 13 percent. During contractions, the average share of inventory investment change in the average change in gross national product was even more impressive—47 percent. The other major elements of investment all cut smaller figures: producer durable equipment, 26 percent; construction, 11 percent; consumer durable goods, 19 percent.²

Since this paper is concerned mainly with manufacturers' inventories, it is pertinent to notice the part played by this category of stocks. According to Kuznets' figures, fluctuations of inventory investment by manufacturers accounted for about half the total cyclical change in aggregate inventory investment in both expansions and contractions. In other words, they were of about the same importance as changes in the volume of construction or in the output of durable producer or consumer goods taken separately.³

² These figures are based on gross national product estimates in *National Product since 1869* (National Bureau of Economic Research, 1946). Kuznets' inventory investment component is derived from inventory estimates based largely, although not exclusively, on end-of-year book value figures reported by corporations to the Bureau of Internal Revenue or on other estimates of book values at the ends of calendar years. To get estimates in constant prices, the book value figures were corrected for price changes, allowance being made for the age of inventories in each industry group and for end-of-year mark-downs. For manufacturing industries, I made revised estimates to allow for the diverse elements of cost applying to purchased materials, goods in process, and finished goods, respectively. Inventory investment in any year is the difference between the value of inventory at the end of the given year and that at the end of the preceding year after both values have been corrected for price changes. The methods by which inventory estimates and corrections for price changes were made are explained fully in my forthcoming book.

³ Similar calculations were made by Simon Kuznets in *Commodity Flow and Capital Formation in the Recent Recovery and Decline, 1932-1938* (National Bureau of Economic Research, *Bulletin 74*, June 25, 1939). The importance these figures attribute to inventory fluctuations is probably limited to the relatively short business cycles identified in the National Bureau chronology. For example, the increase in inventory investment plays a much smaller role in the long upswing from 1921 to 1929 than in the three short expansions

From the viewpoint of proximate causation, these surprising results may confidently be laid to two facts. The first is simply that the technique and organization of production and distribution in this country cause the quantity of stocks carried to be large relative to the gross national product of a year. Between 1919 and 1938 the average value of commercial inventories was about 35 percent of gross national product per annum.⁴ This means that if the physical quantity of stocks grew 6 percent in the course of a year from an assumed position of stability—which one might fairly take to be a moderate change—this would of itself involve an increase in gross product of approximately 2 percent. A 10 percent change in gross product, on the contrary, would be deemed large in any peacetime year. Thus, a moderate change in stocks can easily constitute a considerable fraction of a large annual change in gross national product.

The second fact is that during short business cycles of the so-called 'forty-month' variety, investment in stocks, measured in constant prices, tends to be at or near its cyclical maximum when output, that is, gross national product, reaches a peak. Similarly, disinvestment in stocks tends to be close to its cyclical maximum when output reaches a trough. These tenden-

and two short contractions into which the National Bureau divides this period. The same point has been noticed by Alvin H. Hansen in his *Fiscal Policy and Business Cycles* (Norton, 1941), Chapter II.

The differential importance of inventory investment in long and short cycles cannot be clearly established on the basis of our experience in the five business cycles between 1919 and 1938, for which annual estimates of gross national product and its components are now available. As indicated, however, illustrations suggesting such a difference can be found, and there are good *a priori* reasons for thinking that a difference would normally exist. Both the statistical indications and the theoretical considerations are set forth in detail in my forthcoming monograph.

The importance attributed to inventory investment by these figures is further limited by the fact that they do not (and, of course, cannot) distinguish between planned and unplanned investment. It is clear, however, that a change in output can be said to have been caused by a change in the volume of inventory investment only to the extent that the change in inventory investment was planned by the business enterprises holding the stocks. Otherwise, the change in inventory investment might simply reflect an unexpected change in demand while the change in output was due to other causes. For some further remarks on this subject, see Section III.

⁴ 'Commercial inventories' here refer to all stocks held by American business, including those held on farms. It excludes stocks held by consumers, governments, and philanthropic institutions.

cies are clearly revealed by comparisons of inventory investment—not only in the aggregate but also by manufacturers and dealers—with the National Bureau chronology of business-cycle turns or with the cyclical peaks and troughs of, say, the Federal Reserve Board Index of Industrial Production. Consequently, the contribution of inventory investment to output is positive and close to a maximum for the cycle in peak years, and its contribution to output is negative and close to a minimum in trough years. Other things being equal, therefore, the timing of the turns of inventory investment cycles during business cycles operates to maximize the contribution of changes in the rate of inventory investment to changes in output between trough and peak years of business, and between peaks and troughs.

The timing of inventory investment cycles is crucial for an understanding of business cycles. On it depends not merely the magnitude of the influence wielded by stocks in accentuating expansions and contractions, but also the answer to the moot question whether inventories are regularly instrumental in bringing these movements to an end and in setting a reverse movement going. It is unfortunate, therefore, that the only comprehensive estimates of stocks for a considerable period are annual. For from the annual data, one cannot determine with any assurance whether the peaks and troughs of inventory investment have tended to come in the very same months as the cyclical turns of business or not. As far as they go, however, the annual estimates indicate that inventory investment tends neither to lead nor to lag behind output and business at large. And our experience is that when annual data behave like this, the average lead or lag, if any, that might be revealed by monthly data covering several cycles is small—rarely longer than three months.

This observation, crude as it is, is of great theoretical interest. For it is commonly believed that businessmen tend to keep stocks in approximately constant proportion to output or sales. This notion, often encountered in applications of the acceleration principle to inventory investment, implies that inventories—not inventory investment—will move synchron-

ously with output and sales, and that inventory investment and *rates of change* in output and sales reach cyclical maxima and minima at about the same time. Indicators of output, in manufacturing in any event, show, however, that while the peak rate of change in output sometimes occurs near turns in business, it more often comes much earlier. This induces an expectation, on the theory here in question, that inventory investment will frequently turn considerably before business does; but this, as I have just said, is at variance with experience.

The same general difficulty emerges from an inspection of the *volume* of stocks (in contrast to their rate of change) over the course of business cycles. The peak and trough levels of inventories held by both business at large and manufacturers alone have regularly lagged behind the peaks and troughs of business, rather than moved in roughly synchronous fashion, as the more common theory implies. And though annual data are poor guides to timing, I think these data, supplemented by such broad monthly series as are available, justify the conclusion that the lag of the physical volume of stocks behind output is not less than six months. Thus the common theory about the relation between inventories and output is obviously in need of serious revision.

Although confusion in the literature is rampant, similar observations about the timing of inventories are not lacking. Lloyd Metzler's recent papers on inventory cycles, for example, provide illustrations of economic models based on the assumption that the cyclical turns of inventories occur later than those of business at large.⁵ His models also leave room for the fact, though they do not require, that the peaks and troughs of inventory investment occur near the peaks and troughs of business, rather than considerably earlier. Both observations are, as I have stated, in general accord with the evidence. And I suggest that the two chief problems in this area of inventory research are: (1) to determine whether inventory

⁵The Nature and Stability of Inventory Cycles, *Review of Economic Statistics*, Aug. 1941, pp. 113-29; Business Cycles and the Modern Theory of Employment, *American Economic Review*, June 1946, pp. 278-91; and Factors Governing the Length of Inventory Cycles, *Review of Economic Statistics*, Feb. 1947, pp. 1-15.

investment, which I have described loosely as turning 'near' the peaks and troughs of business, may not actually lead by a short interval and thus constitute one of the forces that together turn the business tide; (2) to explain the lag in the volume of inventories behind output and the lag in inventory investment behind the rate of change in output. A valid explanation, when attained, will be of great value. It will help provide a basis for more satisfactory predictive models, and it will furnish insight into conundrums such as the division of inventory changes into 'intended' and 'unintended' elements, without which an adequate statement concerning the role of stocks in business cycles is impossible. This paper is offered as a contribution to the second of these problems.

It is my conviction that progress toward an understanding of the cyclical behavior of stocks has been blocked chiefly by the fact that inventories have generally been treated as a homogeneous mass within which differences in behavior are not significant and to all parts of which much the same explanation is appropriate. True, one sometimes finds gross and inadequate distinctions, such as between finished and unfinished goods, or categories with nonoperational definitions such as Keynes' "working capital" and "liquid capital". By contrast, I believe that a sound explanation of the behavior of stocks can be reached only when fairly numerous categories are distinguished, and I propose to support this view by analyzing the large block of stocks—about 40 percent of the total—that is held by manufacturers.

II

The various classes of stocks held by manufacturers differ from one another with respect both to the motives that control inventory policy and to the ability of manufacturers to implement their policies promptly and completely. As a result the cyclical behavior of these classes of stocks differs materially, and the behavior of manufacturers' stocks in the aggregate is to be understood as simply the composite of the disparate fluctuations of the various parts.