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INTRODUCTION

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The papers collected in this volume were presented in the fall of 1953 at a meeting of the Conference on Research in Income and Wealth devoted to the study of capital formation.

The importance of this particular aspect of economic activity has long been recognized by economists, for it is the process of capital formation, i.e. of investing current resources to add to the economy's stock of physical assets, which has largely made possible the spectacular growth of income and productivity we have witnessed in the last two centuries. Interest in capital formation increased even further after the appearance of Keynes's *General Theory*, since investment came to be regarded by many economists not only as an essential condition for long-term growth but also as a major source of short-term fluctuations in economic activity.

The aggregate capital formation of a country is the sum of many heterogeneous components whose behavior responds to different forces and whose measurement frequently presents quite different problems. The papers in this volume deal exclusively with private capital formation and with the three major components into which this aggregate is usually broken down, namely, plant and equipment, residential construction, and changes in inventories. A fourth component—changes in stock of consumers' durable goods—which at present is frequently *not* regarded as a part of capital formation, unfortunately has been somewhat neglected in this volume in spite of the efforts made at the time the Conference was organized.

If this volume were addressed exclusively to the specialist, there would be no need to prolong this introduction further. There is, however, much in this book that ought to be of interest to the non-specialist concerned with keeping in touch with developments in this important and rapidly growing area of research. The rest of this introduction is addressed primarily to this class of readers and will endeavor to expose the thread that connects the various contributions assembled here and to highlight aspects which seem to me of broad interest and significance.

In economics, as in other empirical sciences, progress depends both on the collection of more and better data and on the develop-

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ment and testing of analytical models designed to explain the phenomena which have been measured and their interrelations. These two processes must of course proceed *pari passu* and feed upon each other, the data providing the stimulus to analytical constructions and the possibility of testing them and the theory in turn suggesting the type of phenomenon useful to measure. This division of types of research activities is reflected in the organization of the present volume—Parts I and II deal primarily with the measurement and Part III with the “explanation” of capital formation.

The first three papers of Part I are devoted to estimates of various components of capital formation and to a discussion of the underlying methods of estimation. David M. Blank and Louis Winick's new estimates of residential construction extend the official series previously available only from 1915 back to 1889; thereby they throw interesting new light on the well-known long cycle in construction activity. James P. Daly is concerned with the reconciliation and evaluation of existing series on investment in inventories—a task whose significance will be readily appreciated by the users of statistics who frequently find the plurality of estimates nearly as embarrassing as their absence. Finally, Kenneth Buckley performs a similar task with respect to aggregate capital formation, and its components, in Canada.

In the next paper, Daniel H. Brill presents estimates of the forms in which various sectors of the economy have financed their additions to the stock of fixed assets in recent years, comparing current developments with earlier patterns of financing whenever the data permit. His paper, together with Irwin Friend's comment—penetrating and frank as usual—represents an interesting illustration of the use of data provided by the so-called moneyflows analysis.

The last two contributions of Part I deal with the very serious conceptual problems that arise in the measurement of the gross and net stock of capital and hence in the valuation of “real” capital formation, which represents the change in the stock. Making appropriate adjustment for changes in the price level is always a vexing problem; but it is enormously complicated in this case by the problems of the longevity of physical assets and of quality change and obsolescence, which is especially serious for capital goods in the presence of rapid technological progress.

These problems have long plagued accountants and estimators of national income since the measurement of income, whether for a single firm or for the whole economy, requires an estimate of the

net change in stock of assets. George O. May, drawing on his long experience, presents an historical sketch of the way in which some of these problems have been dealt with by accountants since the beginning of the century. Edward F. Denison provides us with a penetrating review of the whole problem from the point of view of the economist interested in national accounts. He concludes that the only meaningful and yet feasible way of measuring the real stock of capital in existence at any point of time, say t , is to define this stock as the reproduction cost in the year t_0 of the stock of physical assets actually in existence at time t . A measure of the net stock of capital can then be obtained by writing down each component of the stock by a suitable "capital consumption" allowance determined on the basis of the current age and life expectancy of the given component. In estimating this depreciation allowance Denison would favor the declining balance rather than the straight-line method.

The method advocated by the author has undoubtedly some disquieting features, viz. the asymmetrical effect on the stock of capital so measured of technological progress which reduces the cost of a given type of equipment (or other facility) as compared with technological progress which results in making a given piece of equipment more "productive." Denison is the first to point out these features, and their implications are further analyzed in the comments of Simon Kuznets and Eric Schiff. On the whole, however, Denison's paper will be found not only stimulating but also encouraging. The method he advocates is, in fact, basically the one that underlies most of the estimates carried out so far, and his defense of this method is forceful and generally convincing.

The contributions in Part II are primarily devoted to the estimation of capital coefficients, a phase of the vast research developed in recent years under the name of input-output analysis (I-O, in abbreviated form). Other aspects of this type of analysis have been reviewed at a previous meeting of the Conference on Research in Income and Wealth, the results of which are contained in Volume Eighteen of this series. This particular phase of input-output research, bearing directly on capital formation, could not, however, be covered in that Conference (see the Introduction to Volume Eighteen).

Obviously it is impossible to give here an adequate account of input-output analysis, its goals and techniques; for this purpose the reader can turn to Volume Eighteen as well as to numerous

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other sources.¹ However, the role of measurements of capacity and capital coefficients in this analysis deserves a brief review.

Among other things I-O is a technique for estimating the level of activity required of various sectors of the economy in order to satisfy a given volume and composition of final demand—the so-called “bill of goods.” The bill of goods is a specification of the amount of “final” output, usually expressed in dollars at some stated price level, to be delivered by each sector of the economy. The final output of a sector means output which does not represent the input of other sectors; it consists essentially of goods to be delivered to consumers (including the government) and of finished capital goods. The first of these components is frequently referred to as the demand on current account and the second as the demand on capital account.

Suppose now we have an estimate of the bill of goods required on current account (this may be determined outside the system, e.g. in a war-controlled economy or by the system itself, as indicated below). If we have an estimate of the *productive capacity* of the various sectors of the economy, we can compare it with the level of activity required of these sectors by the given bill of goods and estimate necessary additions to capacity, if any. But clearly such additions require appropriate amounts of finished capital goods and thus generate demands on capital account. In order to estimate the total bill of goods we therefore need *capital coefficients* for each sector of the economy, i.e. estimates of the volume (value) of capital goods required from every sector of the economy per unit (dollar) addition to the capacity of a given sector. By multiplying these capital coefficients by the required additions to capacity, we can estimate the demand for capital goods for purposes of expansion. By adding replacement requirements—what it takes to replace the capital goods to be retired during the accounting period for reasons of physical wear and tear and obsolescence—and making appropriate adjustments for the fact that the production of capital goods itself represents a claim on existing capacity and may therefore require further additions, we can finally estimate the total bill of goods on capital account generated by the demand on current account.

¹See, for instance, Wassily W. Leontief, *The Structure of American Economy, 1919-1939*, 2nd ed., Oxford University Press, 1951, and Leontief et al., *Studies in the Structure of the American Economy*, Oxford University Press, 1953.

We started out by taking the demand on current account as given. However, this is not necessary. Ideally it should be possible to close the system and determine even the demand on current account endogenously. This is so because the level of activity of all sectors basically determines the income of the economy and this income, together with the decisions of the government sector regarding taxation and purchases of goods and services, should in turn largely determine the volume and composition of the final demand on current account.

This is briefly the role of capital coefficients and capacity measurements in the estimation of activity levels for individual industries from a given bill of final demand on current account. Capital coefficients have also been used by W. W. Leontief to construct dynamic models which aim at predicting growth rates for individual sectors.²

It should be clear by now that these concepts of productive capacity and capital coefficients are the very same that lie at the foundation of the so-called "acceleration principle," a hypothesis about the determinants of private capital formation which has been extensively utilized in recent years in the construction of models of economic growth and business fluctuations. Thus, as Harold J. Barnett appropriately stresses in his comment, the measurement of productive capacity and the establishment of stable and predictable relations between increments in output and the volume of capital formation required to build the corresponding addition to capacity are of considerable interest to economists who are not immediately concerned with input-output techniques. The only difference is that, by the nature of their technique, I-O analysts are likely to be interested in far greater detail than is generally the case for other economists.

The contributions included in the present volume are devoted primarily to the estimation of capital coefficients (a separate paper on the measurement of capacity, presented at the Conference by Raymond T. Bowman and Almarin Phillips, appeared in the May, 1955 issue of the *Canadian Journal of Economics and Political Science*). The authors are concerned both with the basic conceptual problem—see especially the contributions of Anne P. Carter and Frederick T. Moore—and with the presentation of quantitative results and description of estimating procedures for a number of specific industrial sectors: Moore for mining, John E. Hodges for

²See, e.g., *ibid.*, Chap. 3.

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petroleum, Bowman and Phillips for certain metal fabricating industries, and Carter for certain chemical processes. Finally, Robert N. Grosse and Edward B. Berman deal with conceptual and statistical problems in the estimation of replacement requirements.

After having studied the contributions assembled here, one may still be left with some qualms about the feasibility of putting to practical use, in the framework of input-output analysis, the capital coefficients so laboriously estimated. These qualms are only reinforced by the consideration that for practical applications estimates would eventually be required for many other sectors, where the difficulties of estimation might well be greater than those encountered in the sectors reviewed here. However, one cannot fail to be impressed by the high quality of the work performed by the authors, the depth and clarity of their analysis, and the courage and resourcefulness they all exhibit in grappling with a most difficult problem. While the usefulness of the specific estimates in terms of input-output analysis remains to be proved, these studies clearly represent valuable contributions to the economics of growth and of cyclical fluctuations.

The economist interested in testing the usefulness of the acceleration hypothesis is, however, concerned not only with the stability of capital coefficients but also with the timing of capital formation. Granted that additions to capacity require a certain predictable amount of investment expenditure, can we also establish sufficient regularities as to when and at what rate the additions to capacity and the corresponding investment expenditure will actually take place? This is basically the issue investigated in the remaining contribution of Part II—that of Bart G. Hickman. In an effort to answer this question the author has collected a valuable body of historical data which he then analyzes in a variety of ways. As he has shown, the data assembled, which cover many industries and a number of decades, definitely refute certain versions of the acceleration hypothesis, notably the “naive” version according to which the rate of investment would be strictly proportional to the rate of change of output (either current or appropriately lagged). On the other hand his own analysis, as well as certain “refinements” presented in my discussion of his paper, reveals a systematic and reasonably stable relation between *the rate of addition to capacity* and *the rate of utilization of capacity*. As I have tried to show in my comment, this result is precisely what we should expect on the basis of the acceleration hypothesis, when this hypothesis is properly understood and formulated in an operational form, with due consideration of the nature of the data on which the test is based.

In conclusion, it appears that the studies of Hickman and of the input-output analysts complement each other remarkably well, enhancing the significance of each type of contribution.

The problem of explaining capital formation is the primary goal of the papers assembled in the last part of this volume.

Ruth P. Mack is concerned with the study of business behavior resulting in investment and disinvestment in inventories, and its role in the cycle. Into this task she has been able to pour the extensive experience gained in her study of the shoe and leather industry. Mack offers valuable and provocative suggestions, many of which are in turn examined in the comments of Harrie F. Lewis and Hickman and in my own contribution, which is largely a commentary to her paper.

In the final paper of this volume Robert Eisner has undertaken the important and onerous task of systematically reviewing the contribution of the interview and other survey methods to the study of private investment. Such methods have been used to an increasing extent in the last two decades in the midst of considerable disagreement as to their potential worth. Eisner himself has been engaged in an interview study, some results of which are reported for the first time in his paper. He is thus in a peculiarly good position to review the work of others, comparing notes all along. In spite of his personal involvement, Eisner is acutely aware of the limitations of this technique for purposes other than suggesting hypotheses which must themselves be tested by other methods. He certainly cannot be said to overestimate the past accomplishments or the potentialities of these research tools. In fact, at least one of his discussants, James Morgan, is inclined to accuse him of the opposite position.

On the whole, a careful study of Eisner's paper and of the comments of Charles B. Reeder and Walter E. Hoadley, Jr., Morgan, and Michael Gort suggests that while the method of analysis under review has not quite fulfilled our highest expectations, it has nonetheless led to useful results and has further potentialities which, however, remain to be tested.

In conclusion, I feel that the contributions collected in this volume are not only interesting but also constructive and encouraging, indicating that a great deal of progress has been made and is in the making in this critical and yet highly complex area of economics. It is a feeling which I hope other readers will share with me.