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exhaustion of natural resources, the latter of major concern in the late eighteenth and much of nineteenth century economics. The *complexity* of national economies, with their diverse parts, makes quantification indispensable. The incidence of rapid *shifts* in weights (structure) and of movements in total productivity makes continuous statistical observation imperative. And the changing *social* processes, so closely related to the economic, may necessitate continuous extension of quantitative economic research to aspects of society with which the economic discipline is not currently concerned.

We can now consider some specific aspects of the task of quantitative economic research, concentrated on the national economy and directed at findings explicitly related to economic analysis—whether for history, theory, or policy. These aspects reflect the conditions under which quantitative economic research is pursued—conditions with reference to the supply of data and, to some extent, of human resources, in relation to the requirements of economic analysis.

2. CONDITIONS OF QUANTITATIVE RESEARCH

The Supply of Primary Data

The main fact of life in quantitative research on the national economy is that the supply of primary data is beyond the direct intellectual control of the scholar, in his individual or collective capacity. An economist, unlike a scholar in the experimental natural sciences, cannot isolate “pure” cases of economic and social activity on a countrywide scale. He can only simulate, by la-

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boriously transforming a huge volume of primary data, which have not been collected by him or his laboratory assistants, or at his command. His observational measurements differ from those of scientists in an observational natural science like astronomy in which measurements are based on primary data specially collected for the scholar, under his control, and derived by means of tools specially designed in response to questions posed within the discipline. Most of the primary data in economics are supplied by the economic units, acting in their individual capacity or for the economic firms and agencies. Even when data collection does not depend on the knowledge and response of the subject under observation, such huge costs are involved for the national economy that the task is beyond the capacity of individual scholars or even academic and research institutions. And, since the market for primary economic data is limited and discontinuous, profit-oriented business firms are not interested in providing them, except occasionally for some narrowly defined information on consumer demand and the like. As a result, the sovereign government and its administrative and statistical agencies are the main suppliers of primary data relating to the national economy, which they collect largely from individuals and firms, either in the course of administration or for the specific purpose of securing socially necessary information concerning the performance of the economy and society.

The primary data on national economies represent preponderantly information provided by individuals, firms, and agencies on their own characteristics and activities; and are collected, processed, and made available largely by governments. The knowledge possessed by individuals, business firms, and public agencies about their

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own characteristics and activities (sometimes assembled only in response to questions put by authority) differs widely in scope and quality. It depends upon the level of economic and social development, which determines the extent of quantification imposed by the very conditions of life and work. The willingness to provide such knowledge to an outside agency, even the authoritative government, also varies in space and time, depending upon the relation between people and government. The choices by governments of what may be considered socially necessary data may also differ in space and time. The data must warrant the effort to impose upon people the obligation to provide the information and the cost of collecting and processing it; and both such costs and the value of the returns may vary in space and change over time. Another variable is the readiness of the governments to publish the data in a form that would facilitate objective analysis, or to publish them at all.

The resulting differences in the scope and quality of primary data bear *some* relation to the needs of research directed at economic analysis. After all, some of the major problems dealt with by the latter may also be considered major by the country's authoritative agencies, and thus the collection and assembly of some relevant primary data may result. But even then there may be long lags between the identification of the problem in economic analysis, the acknowledgment of its usefulness as a guide to government action, and the collection of primary data relating to it. Furthermore, the concern of economic analysis with a specific problem bears no inherent relation to the ability to secure the necessary reliable primary data. For example, we are at present greatly concerned with the problems of the less devel-

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oped countries. In contrast with the data-rich developed countries, the supply of data for the less developed countries is still extremely meager, and much of it is of poor quality. Another example is the problem faced in the analysis of some sectors in a developed country: the paucity of reliable data on output (as distinct from input) of major sectors of service industries does not lessen the interest of economic research in them. A third illustration is the concern of economic research with the economic performance in the Communist countries, a concern which continues despite the data blackouts and other policies that limit the supply of significant information for scholarly analysis.

Several consequences follow. First, at any given time, economic research is bound by the limitations of the supply of primary data, the gaps in their coverage, and the poor quality of some of them. Some of these limitations can be overcome by exercising ingenuity in deriving approximations; and much of the effort of economic research is, in fact, invested in bridging the gaps between the primary data and the measures required by the analytical work of the discipline (of which more below). The limitations of data supply must be recognized; and it must be emphasized that the resulting measures are only approximations and should be treated as such. Moreover, it must be realized that only untested conjectures on some important problems in economic research are possible at any given time.

Second, in the longer run, the research economist can have a marked influence on the supply of primary data, for his analysis can indicate the magnitude of the problem to which the lacking data are relevant, as well as the least costly devices by which such data can be se-

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cured. By demonstrating the socially necessary character of the missing data, he can raise the probability of their inclusion in the statistical programs of the government agencies. The substantive use of economic research to point up a problem, and stress the gap in data supply, is an important prerequisite for improvement in the supply of primary data. Over the long period from the Classical school through the first quarter of the twentieth century, the failure of economic analysis to employ observational data, particularly statistics, on an extensive and systematic basis was partly responsible for the deficiencies in the supply of data relevant to many key problems. It also contributed to conspicuous errors in the long-term projections of the Classical and Marxian schools, with a consequent neglect of economic growth problems until a few decades back.

Third, because the supply of primary data frequently lags behind the emergence of problems requiring economic analysis, there is a tendency toward a succession of explosive expansions of analysis and findings that shift from one complex of problems to another. On the one hand, the emergence of economic problems unforeseen and unexplained by prior knowledge (of which more below) mobilizes whatever little analysis can be brought to bear on the problems. On the other hand, the supply of data, once mustered for the task, if with some delay, provides the empirical base for a more testable analysis of the problem. As time passes, and some adjustment to the problem is made by analysis and policy, it tends to recede from the forefront of economic research, although many questions may remain unanswered. It recedes because new problems, new "surprises," emerge and shift

the focus of preoccupation of economic analysis and research elsewhere.

Fourth, given the propensity to long swings in the focus of economic research—for example, from problems of monopoly and industrial organization to those of labor; from those of depressions to those of wars; from those of economic growth to those of urban agglomeration and inequalities in income distribution—the capacity of economic analysis to handle them depends upon a continuously available framework. This framework should help to place each problem in its proper setting and might constitute a scheme, the empirical counterpart of which could be a guide to the accumulation and organization of data and the provision of an increasingly effective basis for handling a succession of new problems. One great advantage of an aggregative statistical framework like national economic accounts (preferably with its several variants, including input-output, and covering the flows not only of output but also of labor and capital) is that it calls for a *comprehensive* and properly *articulated* (sectored) view of the whole economy. It prevents undue emphasis on any one current problem in isolation from, and neglect of, the rest of the economy; and it reveals the gaps in the data relating to all aspects and sectors, and thus is a guide for the improvement in data supply. Deplorably thin as the economic accounts may be at any given time, they provide the only empirical basis for tackling a new problem. Since national economic accounts are the empirical counterpart of the conceptual framework, of the basic notions of economic analysis, all we are saying is that an analytical framework—a well-defined view of the economy and of its relevant components in the form

of an empirically translatable system—provides the basis for continuity and direction of economic research and analysis, which are constantly being buffeted by the urgent problems of the moment.

From Primary Data to Economic Measures

Even assuming complete and reliable primary data on the national economy, a major task remains: to translate the data into economic measures, i.e., magnitudes corresponding to the clearly defined economic concepts used in economic analysis. A firm can submit a detailed record of its economic activity—the purchases of inputs (materials, labor, etc.) in quantities and prices, the volume of output, the sales in quantities and prices, etc. But all this is only raw material for a key economic concept like net output, or the productive factors involved; and thorny questions arise in converting such raw material into a finished economic measure. The economic analyst must decide whether all the payments of the firm which are treated as costs represent inputs and must be subtracted (e.g., payments of taxes); what productive factors are represented by some payments of income (e.g., the net income of the individual, unincorporated entrepreneur); whether the firm has, in addition to reporting its private costs, made allowance for social costs (e.g., land depletion in the case of farming, effect on environment in the case of the industrial plant), and hence whether its net output is the proper net; and whether the prices of inputs and outputs provide the proper weights (some may be affected by subsidies or special allocations of otherwise controlled foreign exchange, or prices of inputs and outputs may relate to

different time periods, with effects on net income as calculated by the firm).

The number, variety, and thorniness of such questions multiply rapidly as we shift from a firm to larger groupings and finally to the national economy. The very sectoring, the grouping, is not set by the primary data that come from the indivisible basic units within the society and economy. The familiar set of production sectors is a reflection of our knowledge as observers of the differences among these sectors in the raw materials used, the production processes employed, and the product turned out—differences that are also reflected in distinctive groupings among persons engaged in each sector, in their recognition of common group interests, and their differences from other groups. But a number of criteria of grouping are available to us; and differences between the institutional and the more analytical types of classification are marked (distinctions among producer and consumer goods industries, small- and large-scale sectors, competitive and monopolistic types of industries, young and old industries, among others). In aggregating firms into these larger groupings, the questions of identification of costs, duplication in output, disparities in price bases, distinction of productive factors, all gain greater importance and become more difficult to handle. Furthermore, we face additional problems: we must set the boundaries of the groups, decide on the treatment of units belonging to more than one sector, and specify the role of some sectors vis-à-vis others (e.g., of the finance sector relative to the production sectors from which it derives most of its income). Establishing the criteria for sectoring and proper aggregation is obviously a major role of economic analysis; it spells the difference between

summation of primary data by common-sense observational criteria, which usually reflect the group interests within the economic society, and the proper economic measures. To illustrate: the total tonnage of steel produced by the country's steel industry, excluding any hobby- or housewife-generated steel output (a negligible problem here, but of greater concern for other commodities and services) is a primary datum, the first step toward an economic measure. The *net* output of the industry is the next step; the net output of all producer goods (of which steel is partly one) is the further step; and, for many analytical purposes, the share of the net output of the producer goods sector in the national product is the relevant economic measure—a fair distance from the gross output of steel and of each of the other producer goods expressed in their diverse quantities.

The variety and scope of the questions just illustrated are at their greatest in connection with measures relating to the total economy—not only the customary measures of national product and its components, but also the related totals of labor force and employment, capital stock, the price level and the money supply, size distributions of income, and the like. To use the most familiar illustration, with national product or income totals viewed as properly weighted combinations of different components, we find that the major questions relate to: (1) the boundaries between economic activity and life in general (which latter may yield “products” of its own), and between market-oriented “outputs” and resulting “incomes,” which should be excluded because they do not reflect any productive contribution (problems of scope, or inclusion and exclusion); (2) the definitions of inputs and output, which are needed to avoid duplication and, in particular,

to record hidden costs in order to exclude what appear to be net returns but are merely offsets to increases in the cost of living, these increases, in turn, being due to changes in conditions *imposed* by the new technology that augments gross output (problems of grossness and netness, or final and intermediate products); (3) the weights (prices) by which the net outputs, once properly defined, are to be combined into a meaningful total, the magnitude of which is a reliable gauge of aggregate net change.²

These problems vary in form (appearance, rather than substance) with the method used to approximate nationwide net output at different levels. The problems involved in reducing gross output to net output within each production sector by estimating purchases from other sectors and internal capital consumption differ from those involved in estimating returns to productive factors (the latter properly identified and the former properly defined) within the several productive sectors distinguished; and these differ from those faced in measuring the flow of finished product into final uses (including inventories as part of capital formation). Other groups of questions arise when different types of sectoring are considered. One of the most productive of additional problems is the distinction within inputs and outputs between domestic origin and flow from abroad; another is the distribution of income among groups within the population, distinguished by size of income or by some other economic or social characteristic. Similar questions, regarding boundaries and internal weighting, if not dupli-

² For a detailed discussion, see Simon Kuznets, *National Income and Its Composition*, New York, National Bureau of Economic Research, 1941, pp. 3-60.

cation, arise when we consider stocks of productive factors, such as labor force and capital, or price indexes of different coverage. And there is the obvious corollary that the answer to the questions, for national product, for nationwide stocks of labor and capital (or for output and productive factors within separate sectors), or for prices, must be consistent if the resulting economic measures are to be unequivocal contributions to economic analysis.

That the conversion of primary economic data into economic measures requires answers to problems like those just indicated, has widespread effects on quantitative economic research. To illustrate we again use the problems connected with national product measurement. Some questions involve the definition of economic activity, the very boundaries of the economic discipline. Others involve the distinction between productive and unproductive activities, with all the complexities of the differences between private and public gains, and are thus related to welfare theory. Still others call for distinctions between input and output, and involve a theory of production, a theory of input requirements that would set the conditions under which the identified inputs tend to yield the expected output, suggest the joint products that may emerge, and would also define the finished, final products that constitute ultimate output. Finally, the valuation problems clearly raise questions concerning prices as gauges of value, of major concern in the theory of value and price.

In short, such problems—and they are only of somewhat narrower scope for some major components of national output, and of a different cast but hardly less complex for some income distributions—require, on the

one hand, a definitive statement of the ultimate goals of economic activity, with boundaries between it and other aspects of social life clearly drawn; and, on the other, a variety of theories. These theories or analytical hypotheses are concerned with private and social welfare, the identity of productive factors and the conditions under which they contribute to output, and the significance of prices as the proper gauges of the values of inputs and outputs consistent with the other theories and goal definitions. Two different formulations of the goals of economic activity and two different combinations of theories of value, production, and welfare will yield, for one country at one time, two different sets of aggregates and components. And one set of answers, applied to different national economies or to one economy at different times, may involve basic positions and hypotheses with different degrees of validity; and hence provide approximations implying different degrees of relevance.

The implications of these statements may now be summarized briefly, but emphatically, in view of their importance for understanding what quantitative economic research is about.

First, no economic measure is *neutral*, that is, unaffected by economic theories of production, value, and welfare, and the broader social philosophy encompassing them. This may seem to be merely a matter of semantics, in that we distinguish between a primary economic datum, like the price of a pound of white bread in a working class neighborhood in Detroit, and an economic measure, like the index of the cost of living of wage earners. But the distinction is a real one: a wide variety of economic measures, particularly the aggregative measures of national product, labor force, capital

stock, investment and consumption, money stock, price levels, and so on through a long list (and, as already indicated, even some measures for a single firm) rest upon a conceptual framework provided by economic analysis. They are quantitative counterparts of these concepts, and, in that sense, cannot be independent of them and of the assumptions behind them.

Economic activity, like other individual or social human activities, is purposive; its results can be meaningfully measured only in relation to some clearly defined goals and in terms of costs and returns. Primary data on output in quantity units, numbers of people, units of machinery, sales, prices, and the like are raw material for such economic measures; they are absorbed into different economic measures in accordance with the concepts and premises that assign them some relevant significance. Indeed, the key importance of economic measures, and of the economic analysis to which they are related, is that they reflect a broad consensus, sharply defined in theory and vaguely perceived in practice, on the basic purposes of economic activity and on the acceptable rules and feasible ways by which such purposes are met, i.e., goods produced, and the implicit costs and returns distributed. Of course, an immensely wide and complex body of institutional detail and technical knowledge is superimposed on this basic notion of an economic society that coexists with but is separate from others, that directs its activity at a set of socially acceptable goals that may or may not be the same in other societies, and that operates within the broad constraints of technological and social knowledge and human needs. But such institutional and technical detail assumes economic meaning only when the underlying

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institutions and sectors are viewed as part of the more general system represented by the national economy, in both its domestic and international position. Thus, economic measures for industries, regions, processes, and other aspects of economic activities are inevitably linked with the broader assumptions and theories underlying the aggregative measures relating to the national economy.

Second, although economic measures depend upon some basic assumptions as to goals of economic activity and upon theories of production, value, and welfare, they are not arbitrary. They are not arbitrary because the assumptions and the theories are not chosen arbitrarily: the assumptions presumably reflect the broad views operative within the economic societies under observation, the accepted goals of economic activity, and the accepted rules within which economic activity is channeled; and the theories are formalized reflections of relations observed in economic reality. Indeed, one might argue that limiting the choice of assumptions to those reflecting the consensus of society, and the choice of theories to those based on observable, if simplified, reality, is indispensable if any empirical counterparts are to be found and economic measurement is to be possible. It is extremely difficult to find empirical counterparts to a set of basic purposes and rules *radically* different from those prevailing—which, incidentally, may explain the weakness of empirical bases and formulations in the writings of critics who stand outside the basic framework of the economic system. An ascetic Simeon Stylites, living in the wilderness, can only deplore the material-welfare-oriented economic activity of an economically advanced society; he can hardly analyze or measure it

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unless he can translate the economic calculus into one of cursed evil (costs) and of blessed virtue (returns). But one should not neglect the value of deviant approaches: they may reflect early perception of new elements, and be the precursors of a change in the tested and accepted consensus.

Third, given the basic assumptions and theories governing economic measurement, the findings are objective in the sense that independent analysts, using the same assumptions and theories and the entire stock of relevant primary data, should produce roughly the same findings. The findings will not be identical if the concepts are not crystal clear, in which case their application by different analysts to specific situations may be different. Moreover, since primary data are never fully adequate, further discrepancies may emerge as different analysts use their imaginations to secure approximations in different ways. But the fuzziness of the assumptions and theories, once there is agreement on their essential content, should only be marginal; and deficiencies of primary data should only subject the findings to margins of error suggested by other knowledge of the magnitudes of the data gaps.

Fourth, while the basic assumptions of economic analysis and measurement remain the same over time, and while they may be sufficiently reflective of human goals to be applicable to a variety of national economies, the rules governing the attainment of such goals through economic activity may change over time or differ in space. Both the free market economies and the authoritarian Communist countries may accept the same set of goals in terms of material welfare through greater output and more equitable distribution, etc., but their rules of operation differ greatly. And related effects on noneco-

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conomic costs and benefits may lower the value and relevance of purely economic comparisons, which, in any case, are difficult because of differences in meaning of the value-price systems in the two sets of countries. But even if the basic assumption and acceptable rules of economic and social activity are roughly the same, marked changes or marked differences in technology and knowledge will affect the validity of the theories of production, value and prices, and welfare. With changing technology and knowledge, the theories that had indicated given types of feasible relations between inputs and output, prices, costs and returns, may no longer provide a proper guide to meaningful measurement. In fact, they may have been inadequate even under the earlier conditions, given the usual lag between the occurrence of social changes and its perception, which must reach a level, in relation to established knowledge, sufficient to produce changes in theory. The dependence of meaningful economic measures on the underlying theories implies, then, the possibility of continuous revision, as conditions of life change and an increasingly richer record reveals gaps in our knowledge (or "puzzles," to use Schultz's term).³—a point to which we shall return in discussing recent trends in quantitative economic research.

Economic Measurement and Economic Research

Even a complete articulated set of national product measures is, like the more qualitative descriptive data that are an indispensable complement, raw material for

³ Theodore W. Schultz, "Human Capital: Policy Issues and Research Opportunities," in *Economic Research: Retrospect and Prospect, Vol. VI, Human Resources*, New York, National Bureau of Economic Research, 1972.

quantitative economic research. Quantitative economic research is the combination of economic measures, with inferences based on them and on relevant complementary data, that seeks to interpret, generalize, or predict economic performance. A brief comment on these three functions of economic research (interpretive, generalizing, and predictive) may clarify matters.

A statement typical of the interpretive function of economic research, presents the measures of aggregate output, at constant prices assumed to reflect the relevant weights, for a given country over a given period; it points to the associated shifts in production structure, in order to specify the loci of growth and stagnation, and thus to interpret the significance of the growth in relation to some accepted goals of economic activity; and it evaluates the record in terms of the specific conditions and disturbances that might have affected it, relative to some long-term "normal" or capacity growth level. In evaluating the system of associated changes, the interpretive function is an attempt at a *preliminary* classification and appraisal of the new, or newly recorded, or newly analyzed experience, in the light of basic assumptions on goals and rules of social life and of the broader knowledge of economic relations embodied in economic theory.

A statement typical of the generalizing function of economic research might be the familiar Engel law. That law, properly phrased, tells us that *at any given time*, within free market economies, the proportion of income spent on food (both income and food appropriately defined) declines as we shift from the lower to the higher income-per-capita (or per consuming unit) groups. The "generalization," indicating the conditions under which the statement holds, can be associated with some exo-

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genous assumptions (demonstrable outside the economic realm) as to the characteristics of different human needs, and hence of demand for correspondingly different goods. The generalizing function of economic research is thus an attempt to distinguish the common and invariant elements at different places or different times (or both), and by thus distinguishing the invariant from the variant, and the stable and continuing from the fluctuating and transitory, to provide the basis for a clear association with the sources of economic changes or differences. Hence, it provides the basis for estimation of policy effects or for realistic prediction.

All generalizations involve implicit predictions, in the sense that, if the conditions under which the generalization is valid persist, so will the generalization. But the specification of differences in space and, particularly, of changes over time within which the generalization was found to hold, and is assumed to hold at least sufficiently to make predictions useful, is not easy. A generalization may be based on a wide variety of tested economic measures, be subject to no exceptions within the range of available data, and have behind it a highly plausible set of interconnections among economic, and between economic and social, variables. Yet the formulation, in sufficiently general and still testable terms, of the full set of limiting conditions under which the generalization was found to be valid is difficult. The additional judgment as to the possible persistence of the generalization that would warrant a realistic prediction might be viewed as almost a separate task—although in a way it is the final test of the generalization. None is complete unless the conditions of its service as a base for realistic prediction are indicated.

Quantitative Economic Research: Trends and Problems

Economic research involves, for any one of the three functions, a combination of various economic measures with other more qualitative data; and "quantitative" in the description of economic research is a matter of comparative emphasis on the type of data involved. In interpretation, economic measures are combined with other data in an attempt to classify the newly measured, or remeasured, segment of economic experience, in relation either to some basic assumptions of social purposes and rules (which often lead to re-examination of the conceptual bases of the measures themselves) or to existing knowledge of the properties of various components of an economic system and the interrelations among them. In generalization, a wide variety of economic measures and of complementary data are used in an attempt to distinguish the relatively invariant from the rest, and associate both types of changes or differences with various groups of determining factors. And, of course, predictions combine the presumptively established generalizations with additional measures and related data selected as suitable bases for extrapolation.

It follows that each of these functions, and indeed every study in quantitative economic research, requires a mixture of economic measures and other qualitative but observational data, and a range of past generalizations and hypotheses that provide the context within which new interpretations, or new generalizations, or new predictions can be made. There is no such thing in economic research as a *simple fact*, meaning an economic measure independent of basic assumptions and extant hypotheses; nor is there pure description or measurement, meaning a portrayal of economic events in terms of simple facts as just defined; nor mere accumulation

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of facts without theory, meaning a listing of these simple facts. The basic assumptions with respect to goals of economic activity and accepted rules within which economic activity is channeled, if not always precisely stated, are clearly implicit in the measures used; and any new experience can, after adequate interpretation and evaluation, stimulate re-examination of past definitions and measurement conventions. The theoretical hypotheses concerning relations of inputs and outputs, prices, etc. may be formulated broadly, but they are clearly involved. Their formal embodiment into a system of equations, fitted to a limited stretch of observable and measured economic experience, does not represent a generalization, but only another type of interpretation, of preliminary classification, with reference to a set of hypotheses more formally, and hence more narrowly, defined. In short, there is a mixture of basic assumptions, theoretical hypotheses, economic measures, and observable qualitative evidence in all three functions of economic research, in all quantitative economic research.

Needless to say, economic research studies differ in emphasis. But one should note the preponderance in resources involved and possibly in terms of results—although reduction to comparable units is difficult—of the interpretive type of economic research. The reasons are obvious. To truly test a generalization involves a supply of primary data and economic measures that, in its coverage of relevant conditions sufficiently different to test for significant invariance, is prohibitively demanding. And most empirical generalizations for which an analytical basis has been easily formulated (there is no difficulty in generating a wide variety of plausible hypotheses) have proved, in fact, to be based on so limited

a universe that exceptions are all too readily observed (which applies to the Engel law and to many other such generalizations). This means that most "predictions" are on equally shaky ground, useful as they may be as a substitute for complete ignorance or for too capricious a choice of parameters for policy consideration. In view of the changeable and variegated economic universe with which empirical and quantitative research has to deal, there is natural reluctance to orient investigation directly to the ambitious task of establishing generalizations or making predictions.

To attempt empirical research in order to *test* theoretical hypotheses that result from thought-experiments is hardly sensible. These hypotheses formulate rules of behavior of individuals and firms, identify and classify productive factors, types of technological change, and the like, to provide enormously enlightening demonstrations in which socioeconomic performance, or change, or fluctuation, can be derived from the rationally expected action of the numerous members of economic society, tied usually through the market. But unless closely linked to successive levels of economic measurement, hardly feasible until recently and difficult even today, such hypotheses can only suggest how economic change or performance is *possible* under highly simplified conditions, not how the results are shaped in testable magnitudes that permit distinction between the common and the differing elements. If the thought-experiments yield some measurable concepts and classifications, it is interpretive economic research studies that use the economic measures based on these concepts and classifications, in the attempt to evaluate and interpret a stretch of economic experience. It is by means of such studies,

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and often with the help of a modified and more precise definition of the concepts, that interpretive economic research does in fact test the relevance of the concepts and of the presumptive relations among the elements represented by the concepts. But the intention is to use, not to test, the established concepts and underlying assumptions in interpreting new or newly measured experience. The result may be a re-evaluation of the underlying concepts and theories. It is the interpretive economic research of recent decades that led to questioning of the concepts of material capital and undifferentiated labor as the key productive factors, and stimulated the great interest in investment of human capital (the field surveyed in the Schultz paper mentioned earlier) and in the disaggregation of material capital in terms of vintages.

Given the rapid changes in economic processes and structures and the dependence of these processes, viewed in the longer run, on social and technological concomitants, it is hardly surprising that the interpretive function of economic research predominates. It employs assumptions and theoretical concepts that are sufficiently broad to permit adequate variability in institutional and technological innovations, and to leave the analysis free to question the basic premises of the measures, the classifications of factors, the distinction of production sectors, the treatment of prices as weights, and the like. It also permits observation of distinct patterns of change over time that allow for differences in interrelations between the short and the long run, rather than having all change lumped into a single complex qualified only by stochastic disturbances. The degree of formality of the models used in interpretation of limited stretches of economic experi-

ence, particularly new stretches or newly measured ones, is set by the balancing of gains from a formal set of parameters against losses. The losses are not slight if the formal model conceals revealing deviations by impounding them in anonymous variance, or if modifying any part of the model involves long scrutiny and heavy costs. When the changing economic reality is teaching us something new at a rapid rate, the costs of formalizing prior limited knowledge by dint of a variety of assumptions (substitutes for knowledge that is lacking) may be too heavy, and the gain from having results amenable to formal tests of uncertain relevance may be too slight.

3. RECENT TRENDS IN QUANTITATIVE ECONOMIC RESEARCH

Quantitative economic research on the broader aspects of the national economy, dealing with the growth and structure of national product, its origin and distribution, is dependent upon a supply of primary data sufficient for a variety of meaningful economic measures. These, combined with complementary data and relevant hypotheses, can then be interpreted and eventually serve as a foundation for at least partial generalizations and tentative predictions. In turning to trends in quantitative research of this broad type since World War II in this country, I must limit the discussion to studies that employ national product and related aggregates, largely for the analysis of short- and long-term changes in the performance of national economies. This performance is viewed in relation to the commonly accepted goals, e.g., adequate growth, freedom from disturbing fluctuations, equitable distribution of gains, the least painful distribu-