II

**Staff Reports
on Research
Under Way**

1. ECONOMIC GROWTH

Productivity, Employment, and Price Levels

The behavior of prices and wages and their relation to productivity, employment, and economic growth is the focus of a group of studies at the National Bureau aided by a grant from the Alfred P. Sloan Foundation. The problem of inflation in recent years has drawn public attention to the movements of prices. Much still needs to be learned about the economic effects of price movements and the results of national policies like wage-price guidelines. The range of the Bureau studies is broad, covering an examination of the reliability of the available price data, analysis of the historical behavior of prices, tests of various theories of that behavior, and construction of econometric models of the determination of prices, costs, and productivity.

In addition to looking into the effect of the changing composition of price indexes on the movements they exhibit, Fabricant is examining some questions concerning price trends and economic growth and national policies to stablize prices.

Stigler and Kindahl have compiled data on actual wholesale prices paid by buyers and have made comparisons with the corresponding prices collected by the Bureau of Labor Statistics based on reports of the sellers. Their study is completed and is undergoing review. Cagan is focusing on short-run fluctuations in prices and questions of their flexibility in adjusting to short-run changes in demand and supply conditions. Nordhaus is working on a model of the interrelationships between prices, costs, and productivity. Robert Gordon is exploring the hypothesis that previous estimates drastically understate the growth of private nonresidential fixed capital over the period 1929 to 1948, and that this explains the otherwise perplexing failure of the capital stock to rise in keeping with the growth in real private output.

The behavior of productivity and of the factors influencing it is the subject of two other studies. Kendrick is updating his earlier work on productivity to extend the data and the analysis through the first half of the 1960's. Nadiri and Rosen are developing an econometric model to take account of interrelationships among adjustment lags in the amount of capital, labor, and materials used by firms to produce the desired output when changes in demand occur.

Some of these studies are reported in greater detail immediately below. Fisher and Temin's historical analysis of early agricultural productivity is reported under "Regional Studies."

Phillip Cagan

Price Trends and Economic Growth

During the year work continued along several lines.

An investigation of some aspects of wage-price guidepost policies was briefly reported on at the meeting of the American Statistical Association in August, 1968, in the course of a discussion of wage, price, and productivity data for economic policy. The report was published in the Proceedings of the Business and Economic Statistics section. I expect to have the fuller report ready shortly.

Another paper, "The General Price Level and the National Accounts," was presented at the meeting of the International Association for Research in Income and Wealth that was held in Israel during August 1969.

A third paper, "Inflation and the Lag in Accounting Practice," was presented in April, 1969, at the University of Kansas, at a conference on "Contributions to Accounting by Other Disciplines." While accountants have been discussing the matter for decades, accounting practice in the United States does not yet recognize changes in the purchasing power

of money. Virtually all accounting reports setting forth the profits of business enterprise, although otherwise carefully prepared and audited, fail to say anything about changes in the general price level.

A report on the wage-price guideposts study, and a briefer note on the study of the lag in accounting practice, follow.

Wage and Price Guideposts in a Growing Economy. Information on changes in the level and structure of prices and related changes in productivity and other economic quantities — the information with which we are concerned in our studies — has direct relevance to various important questions of policy raised in the United States and other industrial nations troubled by inflation. Among these are questions on incomes policies and the wage-price guideposts that are used in carrying out these policies — such as those constructed by the Council of Economic Advisers in 1962 and rejected by the new Administration in 1969, but still very much under discussion here as well as abroad.

The guideposts, as we have all come to know, were designed to assist in controlling inflation by specifying how individual prices and wages should behave. Various criticisms can and have been made of the guideposts. However, it is difficult to judge the logical validity of the criticisms except by uncovering the theoretical assumptions underlying the guideposts. And it is difficult to judge the practical significance of the doubts raised by the criticisms except by recourse to empirical material. The paper I am completing on "Wage and Price Guideposts in a Growing Economy" is an effort in this direction. The paper pursues an analysis sketched in a section of my article on "Productivity" (recently published in the *International Encyclopedia of the Social Sciences*) and presents the relevant factual evidence in the necessary detail.

Put briefly, the main conclusions are these: The general guideposts developed by the Council of Economic Advisers are questionable theoretically, as well as rough in a quantitative sense. They could be redesigned and improved, but it is doubtful that any amount of improvement would result in guideposts that deserved

to be called general and were at the same time reasonably adequate.

The source of the difficulty is the dynamic character of our economy. It is a growing economy undergoing continuous adjustment. True, the CEA's general guideposts do take cognizance of this, but the recognition is insufficient. Allowance must be made for exceptions. These could not be just a few exceptions: they would have to be many. Indeed, for the guideposts to work properly in a dynamic economy, *most* prices and wages would have to be regarded as entitled to exceptional treatment. It is obvious, however, that if the guideposts are to be practical instruments of policy, they must be reasonably simple and reasonably general. To allow any exceptions means complicating the rules, gathering special information, and setting up an administrative procedure. To allow many exceptions would multiply the need for special information by a large factor and impose a heavy, if not intolerable, administrative burden on governmental authorities and also on those who would be seeking exceptional treatment. That is why the CEA virtually abandoned the exceptions or "modifications" it specified in its original formulation of the guideposts in 1962.

Let me spell this out a bit. The "trouble" with our dynamic economy — from the standpoint of incomes policies — is that it is a system of parts that is continually undergoing adjustment. Economic development leads to and requires adjustments in innumerable ways. Most kinds of products increase in volume, as we might expect in a growing economy, but they do so at diverse rates, with new products growing very rapidly, and obsolescent products often declining. Everywhere input declines in relation to output, but in some types of production total factor productivity rises very rapidly and in a few it rises so slowly that the change is barely visible. Everywhere the proportions of capital to labor input change as technology advances and the supply of capital rises more rapidly than the supply of labor, but the degree of change in input-mix differs among different types of production. Everywhere, further, production units change in size, in degree of specialization, and in still other respects. For

these and other reasons, resources are continually being reallocated among processes, products, firms, industries, and regions. Thus, while the rate of economic growth is measured by change in the aggregate real product, economic growth is revealed also by change in the composition of real national product, whether classified by industry, or final product, or otherwise. That is why we often speak of economic growth as a process of industrialization, or urbanization, or increasingly large-scale production.

Economic development means not only a rising trend in real national product but also fluctuation in its rate of growth. Nowhere and at no time is growth ever smooth. There are many reasons why this is so, not all of which are inherent in the process of growth, but surely a major factor is the unavoidably erratic rate of technological change and the unpredictable forms taken by such change. The fluctuations that result appear not only in the total national product; they are found also in the relations among the components of the national product. Investment rises and falls more than consumption, as is common knowledge; investment in some directions rises and falls more or less than investment in other directions. We all recognize that the course of our economy's development has been smoothed to a significant degree by stabilization policy and by various changes in the structure of the economy. But while growth is now smoother, it can hardly be said to be free of fluctuations. We have not yet experienced anything approximating "equilibrium growth."

These long- and short-term shifts in the relations among outputs, inputs, industries, regions, and so on, are accompanied by shifts in the relations among prices and wages. Indeed, as every economist understands, the two sets of shifts are intimately bound together. In a dynamic economy, then, there is also diversity among price movements and among wage movements. General rules regarding prices and wages cannot deal with this fact.

It is true that the modern income policy is vastly superior to the flat freeze of prices and wages too often used to deal with inflation.

Because the guideposts conform to certain tendencies inherent in the process of growth, they are more sophisticated than a freeze. They allow — indeed, they encourage — the general level of wages to rise more rapidly than the general price level, and they allow for changes in relative prices. But although they provide for some of the adjustments required by economic change, they do not provide for as many as are necessary.

For government to guide wages and prices properly in a dynamic economy would require a vast body of information, of which the productivity indexes that constitute the guideposts are only a fragment — more information than is now available, more than could conceivably be obtained at a reasonable cost. Nor could the information be utilized efficiently if it were obtained, for this could be done only with a system of equations that no economist — in or out of the centrally planned economies — has yet been able to construct, namely, an econometric model of a dynamic Walrasian type.

To be more specific, consider the implications for the validity of the general wage guidepost of a few of the characteristics of a growing economy.

The general wage guidepost "calls" for increases in hourly compensation in every industry to be limited to the trend rate of productivity growth for the economy as a whole. With the general price level steady, this is supposed to give labor a constant share of the rising national income. On certain assumptions — which are specified and critically examined in the paper — holding labor to a constant share will accomplish the objective of avoiding a cost-push on prices, and at the same time assure an equitable distribution of the national income between labor and capital. But in a growing economy, investment in education and other forms of training increases. When workers become more knowledgeable and better trained, they are in a position to raise their earnings by moving from lower- to higher-paying occupations. If, then, the wage in each job moves up with national productivity, and in addition wages move up because workers shift to better-paying jobs, the average level of wages must rise

more rapidly than national productivity. If the general price level does in fact remain constant, the share of labor in the national income will rise, not remain unchanged. If constant shares are required for price stability and equity in distribution, national output per man-hour is not an appropriate wage guidepost.

The wage guidepost is inappropriate, further, because it calls, in effect, for an unchanging industrial wage structure. When the average level of training is rising, however, the supply of trained workers must be increasing more rapidly than the supply of untrained workers. Barring an offset in the form of a relative increase in the demand for trained workers caused by technological change ("nonneutral technological change"), this means that relative wage rates will be changing. In particular, the wage rate of trained workers will be falling in relation to the wage rate of untrained workers. These and other long-term changes in the occupational wage structure have in fact been the experience here and abroad, and they are reflected also, to a degree, in changes in the industrial wage structure. In addition, as is well known, responses of the wage structure to shorter-term changes in supply and demand are pronounced. No wage guidepost that gears the average wage of every industry to a single index can guide wages properly. The general wage guidepost must allow for relative wage changes, just as the general price guidepost allows for relative price changes. The allowance need not be nearly as great for wages as for prices, but it is necessary, and to make it requires information not now available.

Another characteristic of a growing economy is a generally rising volume of tangible capital per worker, but with the rate of change in the capital-labor ratio differing among industries. Notwithstanding this, the general price guidepost assumes that all industries experience similar rates of change in their capital-labor ratios. It ignores nonlabor inputs other than tangible capital, as the Council did when, in its 1968 Report, it measured price change by the implicit gross product deflators. The price guidepost calls, in effect, for the average price

of an industry to parallel the labor cost per unit of product of the industry.

There are inputs other than labor and capital, however, and these may not be neglected, as the evidence makes clear. The flows into industries of raw and semiprocessed materials, components, fuel, supplies, and services produced by other industries are seldom negligible inputs. The interindustry relations manifested by these flows cannot help but change as technology and relative factor supplies change and shifts occur in relative costs of production. Power production taken over by central stations is an obvious example; construction becomes the job of general contractors; motors for machines and appliances are provided by specialized industries. As a result, an industry's input of materials — which, of course, is a short-hand term for all the "unfinished" outputs it secures from other industries — changes in relation to the industry's output, and the prices of the materials it consumes change in relation to the prices of the products it sells. The general price guidepost does not and cannot allow for these various changes. Conceivably, the changes could be offset by the changes in capital-output ratios to which I have just referred, for capital and materials are substitutes for one another. But there is no reason to expect an exact offset.

Finally, economic growth occurs not only because more is obtained from a given input, but also because new products and better products are produced. This is precisely the reason why there are no indexes of output, productivity, or even prices, for many individual industries. Economists are learning to estimate the importance of quality changes by the "hedonic" and other methods associated with the names of Court, Griliches, and Cagan, but we are still far from having the information required by the price guideposts.

All this is not to say that more or less satisfactory or even arbitrary guideposts cannot be used as instruments of policy. It does suggest, however, that when they are used, powerful economic forces will seek to resist and circumvent them. To the extent that the guideposts

are enforced, the adjustments required by economic growth will be impeded and distorted; and in the end the rate of economic growth will be diminished.

This view of the guideposts is supported by quantitative estimates of their deficiencies. The estimates are derived, of course, from available data. Whether the data are sufficient for acceptable estimates, and whether the estimates, if acceptable, justify the conclusions, is something readers should be allowed to judge for themselves. For this reason, the estimates will be presented in detail in the paper.

I should add that no final judgment on the deficiencies of the guideposts may be made without comparing them with the deficiencies of other ways to do what the guideposts attempt to do.

Inflation and the Lag in Accounting Practice. The lag in accounting practice raises three main questions. The first asks how to adjust the accounts in order to make more helpful the information on which public and private decisions and policies are based. The second question is concerned with the magnitude of the adjustments, had they been made over the period since 1929. Some relevant estimates bearing on this question are given in Chart II-1. The third question asks whether users of conventional accounting reports are actually misled

Chart II-1

Profits After Tax, Nonfinancial Corporations,
Before and After Adjustments for Changes in the
General Price Level, 1929-68

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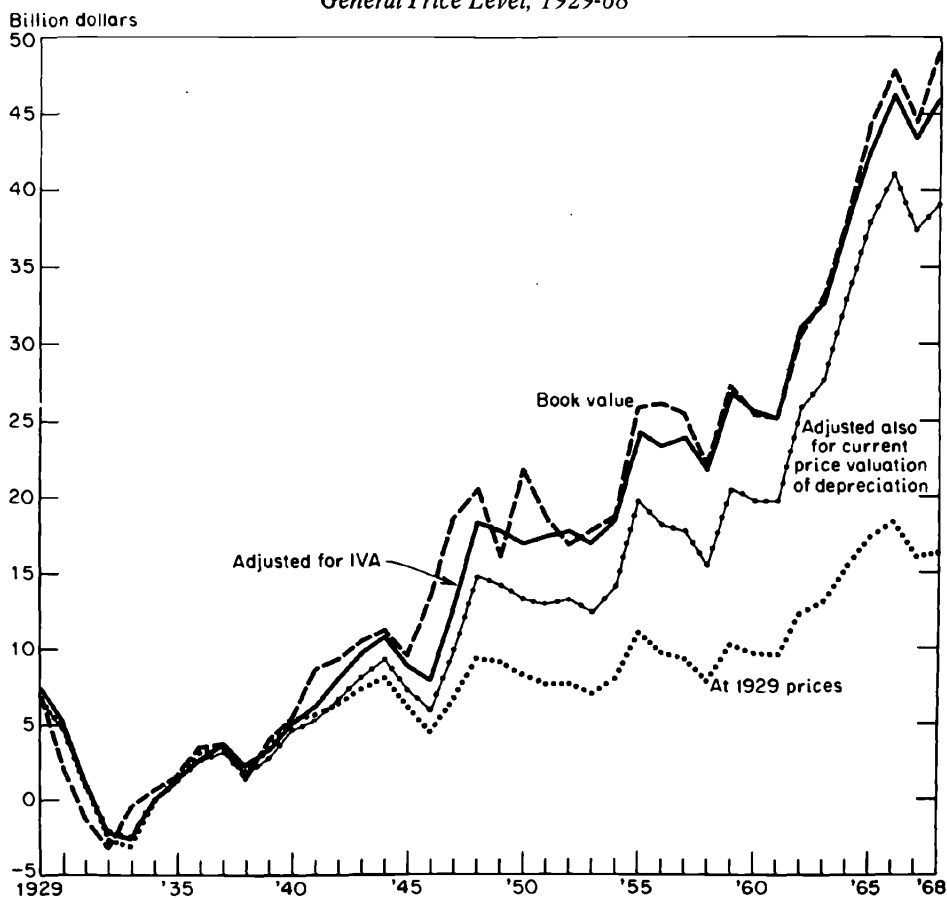
by them during periods of rising general price levels and, if so, how seriously.

It seems clear that few people take the figures in these reports at their face value. But this means that the reports fail to satisfy a vital need for information as well as they could were they adjusted to recognize changes in the general price level.

<div align="right">Solomon Fabricant</div>

The Behavior of Industrial Prices

The manuscript of our study is now being reviewed by the Board of Directors and meanwhile we are making a thorough revision of the draft. The monograph contains the following chapters:

1. Introduction and Summary
2. The Emergence of "the" Problem of Industrial Prices
3. The Price Data: Procedures, Characteristics and Limitations
4. The Nature of the Price Indexes
5. Comparison of Indexes for Individual Commodities
6. Indexes for Commodity Groups and for All Covered Prices
7. The Dispersion of Price Movements

The final chapter is one which has not been alluded to in previous annual reports. It seeks to explain the diversity of movement of prices of individual reporters (buyers) primarily as the result of the economies of search for information on prices. The explanatory power of the economics of information is high.

<div align="right">George J. Stigler
James K. Kindahl</div>

The Behavior of Prices in the Short Run

Contrary to the traditional assumption of economic theory that prices are determined by marginal cost, many discussions of market behavior assume that prices move to a large extent in-dependently of demand and supply conditions. Prices in concentrated industries are said to be administered according to a "target return" or fixed mark-up formula. Price changes are often said to have an upward bias, contributing to creeping inflation, while in many theoretical models prices are assumed to be fixed so long as output remains below capacity, or to depend solely upon wages.

As a rationale for many of these views of price behavior, one can formulate a theory of inflexibility in which price changes entail costs and therefore are made infrequently. There would then be deviations from marginal-cost pricing in the short run. The possible importance of these views is that inflexibility of prices can prolong periods of disequilibrium in the economy and contribute to fluctuations in output and employment. Such behavior can also contribute to creeping inflation, if firms incorporate anticipations of inflation into the setting of prices and the built-in trend is unresponsive to short-run changes in market conditions. Price inflexibility can thus complicate public policies to stabilize the level of employment and prices.

While price inflexibility is often complained of, it is hard to measure reliably and is not at all well documented. The main purpose of this study is to assess the flexibility of manufacturing prices.

Two tests have been designed. The first is to determine whether price movements show a lagged response to changes in demand and supply conditions, approximated by changes in average cost per unit. Average cost is affected by nearly all the factors which affect prices, though not always in the same direction; this presents some difficulties. The other test is based on an implication of infrequent changes in prices, namely, that they will adjust more completely to market developments regarded as fairly long lasting than to those regarded as temporary and soon to be reversed. As a basis for distinguishing the two kinds of developments, we treat changes in average cost as long lasting when due to wage increases and as temporary when due to changes in output. Not all changes in output will be regarded as temporary

by any means, but many due to fluctuations in demand will be. The test involves an estimation of the different effect on prices of the two kinds of changes in average cost.

The data cover fifteen industries — those for which Thor Hultgern compiled reasonably comparable series on price, average cost per unit, output, and wages for his 1965 book on profits.[1] The data are extended here through 1966. These data permit a cross-section analysis of industries (which avoids certain problems of time-series regressions) and separate estimates for different stages of the business cycle.

The statistical analysis is not yet complete. Preliminary results provide some, though quite limited, support for a special price inflexibility theory. There is virtually no lag longer than the quarter time unit of the data. The second test, however, reveals some, though not strong, evidence that prices respond less to temporary than to long-lasting disturbances. A preliminary report on the study has been completed.

Phillip Cagan

Problems in the Measurement of Nonresidential Fixed Capital

Previous capital stock estimates by Goldsmith, Kuznets, and the U.S. Office of Business Economics (OBE) imply that the U.S. capital-output ratio has displayed an unusual pattern of long-term trends. Although private output and capital grew at roughly the same rates before 1929 and after 1948, between those dates a 57 per cent increase in real private output was achieved with a growth of only 1 per cent in the private nonresidential capital stock. How did the U.S. economy succeed in producing so much extra output with so little apparent addition to its stock of plant and equipment during this twenty-year period? One hypothesis is that the answer lies neither in the subtleties of economic theory or econometrics, but

through the correction of serious measurement errors in the capital stock estimates.

In recent months I have published two studies, one proposing a new construction price deflator and the other presenting estimates of government-financed capital operated by private industry. Taken together, the revisions proposed in the two studies produce a substantial change in the time path of the capital-output ratio in the U.S. manufacturing sector.[1] As shown in Table II-1, existing official estimates indicate that the 1929-48 decline in the capital-output ratio was 165 per cent more rapid than in the recent 1955-65 period, whereas the new estimates suggest a more moderate excess of only 35 per cent. The revisions for the non-manufacturing sector, although substantial, are less dramatic than for manufacturing.

The next step, for which data collection has been almost completed, will examine the possibility of a third major source of error in capital stock estimates. The hypothesis is that capital goods service lives lengthened during the 1929-48 period and have shortened since then. All previous studies have assumed fixed service lives, which implies that an enormous amount of capital was retired between 1929 and 1948. In fact, the *postponement* of retirements may have been the most important single factor allowing output to grow rapidly during the 1940's. Previous investigators have shied away from this problem because of an apparent lack of data, a situation which I am now attempting to rectify. The data problems are such that at best only a rough idea of trends can be obtained. Precise yearly estimates cannot be constructed.

Since changes in the ratio of productive capacity to a perpetual-inventory capital stock may be partly due to changes in service lives, one indirect approach to the problem is the estimation of capacity by industry. My hypothesis on lifetimes implies that the ratio of capac-

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[1] Hultgren, *Costs, Prices, and Profits: Their Cyclical Relations,* New York, NBER, 1965.

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[1] See Robert J. Gordon, "A New View of Real Investment in Structures," *Review of Economics and Statistics,* November 1968, and Robert J. Gordon, "$45 Billion of U.S. Private Investment Has Been Mislaid," *American Economic Review,* June 1969.

ity to a perpetual-inventory measure of capital increased substantially during both the 1930's and 1940's, and less rapidly during the post-1948 period. Information for the 1930's is particularly important in order to test the alternative hypothesis that the increase in the ratio of capacity to capital was due to technological or structural changes during World War II. No capacity or utilization estimates have previously been attempted for the pre-1947 period. Reasonably good estimates can be obtained without difficulty for some industries, once scattered pieces of data have been collected, but for other industries only an approximate guess can be made.

Among the manufacturing industries for which I have now collected capacity or utilization data (for the period since World War I) are flour milling, textiles, paperboard, printing, petroleum refining, cement, steel, and other primary metals industries. Data in the nonmanufacturing sector have been collected for mining, railroads, electric utilities, and office buildings. Although the collection of utilization data from separate sources raises problems of consistency across industries, examination of the time pattern of capacity growth requires only that the definition of utilization within a given industry remain unchanged over time. Utilization is not being estimated for the service

TABLE II-1
Effect of Revisions to Estimates of the Growth of the Gross Private
Capital-Output Ratio in U.S. Manufacturing,
Selected Intervals
(annual average percentage rates of growth, all series in 1958 prices)

Version[a]	1929-48	1948-55	1955-65	1929-65
1. Official deflator	-2.68	-1.42	-1.01	-1.97
2. New deflator	-2.08	-.62	-.56	-1.37
3. New deflator	-1.28	-.73	-.95	-1.09

Source: Robert J. Gorden, "$45 Billion of U.S. Private Investment Has Been Misland," *American Economic Review*, June 1969, Table 4.

[a]In versions 1 and 2, government-financial private capital is excluded; in version 3, it is included.

TABLE II-2
Alternative Estimates of the Age Structure
of U.S. Equipment in 1958

	OBE Perpetual Inventory (Bulletin F Lifetimes)	McGraw-Hill (Sample Survey)
Percentage installed		
Before 1945	15	48
1945-49	29	19
1950-57	56	33
Total	100	100

Source: OBE and McGraw-Hill data.

industries, where "capacity" is more closely related to labor than to capital input. Preliminary estimates indicate that the ratio of capacity to capital rose substantially during both the 1930's and 1940's. A useful by-product of this research will be the publication for the period 1920-50 of utilization indexes, which should be helpful in econometric investigations of price and profit behavior. The utilization stage of the study was completed in June 1969.

In addition to this indirect approach to the service-life problem, some direct information is available. I have collected a few scattered hints about the lifetimes of individual pieces of equipment. Another valuable source of information is the age breakdown in the *American Machinist* inventory of machine tools, which has been conducted every five years since 1925. Other surveys of equipment by age group have been conducted by McGraw-Hill, the American Textile Machinery Association, and the ICC (for railroads). Additional detailed evidence is available for office buildings. All of the age distribution data suggest that the service lifetimes of capital have been seriously underestimated, particularly in the period immediately after World War II. Table II-2, for example, compares the McGraw-Hill age distribution data with the estimates calculated by the OBE using perpetual inventory methodology and the assumption of a constant lifetime; the data suggest that the OBE calculation seriously overestimates retirements. Systematic analysis of these service-life data will be performed as soon as the utilization study is completed.

Several papers have been prepared in the past year as part of my research project on capital estimates. One paper, "The Disappearance of Productivity Change," is a critique of the theoretical framework underlying a recent paper on productivity change by Zvi Griliches and Dale Jorgenson. Another paper, "Measurement Bias in Price Indexes for Capital Goods," which was presented in August 1969 to the Israel Conference of the International Association for Research in Income and Wealth, complements my earlier work on construction-price deflators with an

examination of bias in the official U.S. equipment price deflators. I am also continuing to contribute to the improvement of U.S. construction price indexes as a consultant to the Office of Business Economics.

Robert J. Gordon

Postwar Productivity Trends, 1948-66

At the end of 1968, Maude Pech and I had completed all of our estimates of outputs, inputs, and productivity in the U.S. economy, by major sectors and industry groups, for the years 1948 to 1966. I have finished writing an appendix describing the sources and methods underlying the estimates, which are presented in eighty basic tables. Before the end of 1969, I plan to have a draft of the manuscript describing the results of the study. In addition to summarizing the trends and movements of the chief variables, this draft will contain an analysis of the interrelationships between productivity and selected variables in the total private domestic economy and by industry groups. The analysis will, however, be limited in scope in order not to delay unduly the publication of the volume.

John W. Kendrick

Interrelated Factor Demand Functions

The purpose of this work is to integrate investment and employment functions and to link both of these with capacity considerations, i.e., hours of work per man and utilization of capital equipment. Thus, we specify and estimate a complete dynamic model for all input demand functions, which allows interactions and feedbacks among these variables over time, and which integrates other work into a unified structure.

The model has been fitted to aggregate manufacturing data and the results are very good. Implied distributed lag responses show that physical capital is relatively fixed compared with other inputs and that the primary role of

variations is to maintain output levels in the face of slowly adjusting capital stocks. This is consistent with our a priori hypotheses. These results are also capable of accounting for the low estimates of employment-output elasticities found in previous studies of the short-term employment function. In those studies, large short-run returns to scale for labor seem to be due to omission of input utilization rates, particularly the rate for capital.

A paper summarizing the model and its estimation has been completed and will be published in the *American Economic Review*. In the meantime, we have been engaged in data collection and processing in an attempt to disaggregate the model for two-digit industry classifications. We shall then attempt to account for any interindustry differences that emerge. Potential explanatory variables will be differences in the level and variability of output inventories and differences in transactions costs in factor markets. If this work proceeds expeditiously, we shall attempt to introduce production price determination and factor supply conditions into the model.

This research began while we were research fellows at the Bureau in 1967-68 and is currently supported by general funds.

<div align="right">
M.I. Nadiri
Sherwin Rosen
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The Initial Differential Incidence of Income Tax Reforms

While numerous proposals for revision of the present income tax structure are made from time to time, as in recent hearings of the House Ways and Means Committee, little work has been done on the analysis of what such proposals would do to the incidence of the tax system. While some reform proposals involve only minor modifications of the tax structure, others, such as the proposals of the Carter Royal Commission on Taxation in Canada, would result in a radical restructuring of income taxation. The purpose of this project is to build a general model of the initial differential incidence of changes in the income tax system which can be used to analyze the effects of any new or existing tax reform proposals.

To be reasonably broad in scope, it is necessary to specify the range of potential reforms that need to be considered. Accordingly, some time has been spent examining currently proposed alternatives to the present system and defining some further alternatives. The results of this work have been circulated as working papers.[1] Because of the wide menu of proposals contained within its reform program, the recommendations of the Carter Commission have been used as a starting point in these analyses.

Because a number of different meanings are assigned to the term "incidence" in the literature, it is necessary to define how this word is used in this study. By the "initial differential incidence" of an income tax reform will be meant the changes in the distribution of income and wealth that would result from the substitution of one income tax system for another within the first year or two of the tax substitution.[2] The effect of this definition is to ignore subsequent changes in the distribution of income and wealth resulting from changes in the allocation of capital which would be induced by the initial effects of the tax change.

The initial differential incidence of a tax change is the result of several interacting factors: (1) the initial impact of the tax change on income of different types received by house-

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[1] The papers are "The Objectives of Taxation and the Carter Commission Proposals," "Income Tax Reform in Canada: A Reply to Professor Bittker," "Problems in Applying the Carter Proposals to the Taxation of Farmers and Family Businesses," and "The Value of a Comprehensive Tax Base as a Tax Reform Goal," available as Working Papers 6815, 6821, 6822, and 6824 from the Institute for the Quantitative Analysis of Social and Economic Policy, University of Toronto.

[2] The importance of analyzing the differential incidence of a tax subsitution is elaborated in Section 1 of Bossons and Shoup, "Analyzing the Effects of Large-Scale Changes in Fiscal Structure: A Proposed Systems Approach," in Part I of this report.

holds and other decision units, (2) the effect on incomes of the initial adjustments of product prices, output, and wages to these tax changes, and (3) the capitalization (in changed asset prices) of changes in after-tax income allocable to different types of capital assets. As a result of the last factor, the redistributive effects of a tax change will in general be partly in the form of lump-sum transfers of wealth and partly in the form of continuing transfers. The continuing transfers exist both in the form of changes in income from capital allocable to inframarginal investors and in the form of noncapitalizable changes in income from wages and other sources.

At the present time, only the first and third factors are being analyzed; what is thus currently being examined is the initial change in income and wealth which a tax change would engender if product prices, output, and wages did not adjust in response to the tax change. This research is based on the use of computer programs which were developed to utilize large-scale cross-sectional samples of individual tax returns.[3] Samples of close to 100,000 tax returns for each of the years 1962, 1964, and 1966, obtained from the Brookings Institution and Internal Revenue Service, are being used with these programs to analyze changes that would occur within the household sector. Changes in incomes allocable to other sectors are being analyzed using aggregated published data.

The major specification problems involved in analyzing the initial changes in income and wealth resulting from a tax change, in the

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[3]Cf. Bossons, *A General Income Tax Analyzer,* Studies of the Royal Commission on Taxation, Number 25, Ottawa, Canada, 1968. A somewhat less flexible set of programs have been developed by George Sadowsky and others at the Brookings Institution for the more limited purpose of analyzing the impact of the tax changes on incomes assuming no capitalization of income changes allocable to financial assets. These programs have been used to estimate the effect on incomes of many of the important Carter Commission proposals in Pechman and Okner, "Application of the Carter Commission Proposals: A Simulation Study," *National Tax Journal,* March 1969.

absence of product price-output-wage adjustments, are: (1) to specify the relationship between components of assessable income reported on tax returns and components of financial wealth, and (2) to specify the elasticities of portfolio adjustments with respect to changes in the relative after-tax rates of return of different classes of financial assets. A first draft of a monograph on estimating the cross-sectional distribution of income and wealth is nearing completion. In addition, a paper is being prepared on the implications of these estimates for the initial redistributive impact of the Carter Commission proposals if they were enacted in the United States.

John Bossons

Trade Effects of Substituting a Value-Added Tax for the U.S. Corporate Profits Tax

My time at the National Bureau has been divided between serving as secretary to the Tax Studies Committee (whose work is described in Part I of this report) and studying the effects of a change in tax structure on U.S. foreign trade. The particular change in tax structure on which I have concentrated is the substitution of a value-added tax, on the destination principle, for the corporate profits tax, although other tax substitutions could be considered within the framework of the analysis. Since this tax change has been advocated as an effective policy device to improve the U.S. balance-of-trade position, the study focuses on short-run changes in export and import levels. This objective is selected on the premise that in a fixed exchange-rate system the balance of payments is a short-run problem. The analysis therefore does not take up many of the longer-run effects which might be expected to result from this tax substitution, such as its effect on the growth path of the economy.

The first step in the analysis has been to construct a multisector, general-equilibrium model in which to make the tax substitution.

From this model the expected direction of change in exports and imports can be obtained, given certain assumptions about domestic factor mobility, price flexibility, and monetary policy in the short run. The second step is to determine by industry the changes in tax liability resulting from the tax substitution. These changes can then be related to those industries which export or compete with imports to determine the magnitude of the incentives for industries to change their outputs of exports and import-competing goods. The final and most difficult step is to determine the expected magnitude of change in exports and imports, given the institutional constraints and the size of the relevant parameters for the U.S. economy.

Although the value-added/corporate profits tax substitution, among others, has been proposed for a number of countries, the substitution has never been made. This failure is due in some part to uncertainty as to the effects on an economy of so substantial a change in tax structure. My study is designed to reduce this uncertainty by submitting one of its outcomes — the balance-of-trade effects — to an economic analysis based on available data and estimates of relevant parameters.

Bruce L. Petersen

Tax Policies for Economic Growth

This project, which has yielded two conference volumes and three monographs, suffered two serious losses during the past year. One was the untimely death of Challis Hall and the other, the resignation of Norman B. Ture, who had served as director of the project from its inception. Ture has, however, undertaken to complete revision of Hall's preliminary draft and to expand the analysis. That study, entitled "Corporate Taxation and Corporate Growth Policies," is the last in a series of three concerned with the taxation of business income and the effects on growth. The two volumes already published in this series are Ture's own study of *Accelerated Depreciation in the United States, 1954-60* (published in 1967) and the study of

Tax Changes and Modernization in the Textile Industry by Thomas M. Stanback, Jr. (published in 1969).

In the area of the personal income tax, two studies have focused on top business executives, whose role is deemed to be crucial in the growth process. Wilbur Lewellen's *Executive Compensation in Large Industrial Corporations,* published last year, explores the effects of taxation on the amount of remuneration received by business executives. The second study, still under way, is an analysis by Daniel M. Holland based on a series of interviews examining the effects of taxation on executive effort. He reports below on the status of his work. Still another study is concerned with income from unincorporated business. Its purpose is to determine whether a significant bias in the tax treatment of these incomes results from the size of their fluctuations, and to examine the effects of alternative averaging provisions. This study, undertaken by C. Harry Kahn, has been long delayed by problems with the data derived from a sample of Wisconsin state income-tax payers and by programming difficulties. The data problems have been resolved, and the prospects for overcoming the programming barriers have now improved through the active assistance of John Bossons, University of Toronto, who should also be able to benefit from these materials in the project he has undertaken for the National Bureau.

Hal B. Lary

Effect of Taxation on Personal Efforts

I have continued to work on my study of the effects of taxation on the effort of business executives. The analysis is based on a total of 125 interviews with business executives drawn from the following categories: (1) chief executives of large companies, i.e., companies numbered among the top fifty in manufacturing and the top twenty in utilities and in finance; (2) chief executives in smaller companies; (3) middle management; (4) a cross section in two

rapidly growing cities; (5) scientists or engineers who went into business.

Two chapters, partly experimental in nature, have been drafted. One of them is woven around subsample 5 above and covers the responses of these individuals to all the questions that were pursued in the interviews. The other chapter is organized around the responses of all classes of executives to a particular set of questions – those related to the effect of a tax on potential income as an alternative to the current income tax. In other words, the first approach is a cut through all the responses by subsamples of executives, and the other is a cut through all the executives by classes of responses. Partly as a result of this experiment, but on methodoligical grounds as well, I have decided to prepare most of the manuscript on the lines of the second approach.

Yet a chapter on scientist-engineers is not without merit; these particular executives, though small in number in our sample -- five in all -- are quite homogeneous, and about them a meaningful story can be told. Though various qualifications need to be made, I am convinced that a real tax effect, perhaps best describable simply as "encouraging," has operated on these engineer-scientists who have gone into business. The one feature of the tax structure that has been particularly important for them has been the lower tax on capital gains. The encouraging effect of this differential clearly shows up at a number of key points in the research-based enterprise's life cycle.

As noted, the second of the chapters, completed in rough draft, embodies the approach I intend to use in most of the manuscript; i.e., to organize the discussion around the responses to a series of related questions. This particular chapter sets forth and analyzes the answers to questions on the anticipated effect of tax on potential income alternative to the income tax as presently structured. The purpose of these questions was to ascertain the strength of the "subsitution" effect allegedly exercised against effort by the current income tax. For most executives there seemed to be no evidence of such an effect. But for some, a relatively small number, an effect tending to deter effort could

be inferred. In most cases, the degree of discouragement did not appear to be important. And, somewhat surprisingly, the strongest effect of the present income tax seemed to be an extension of working life (i.e., a deferring of retirement) operating to expand the supply of executive effort.

Our evidence drawn from interviews, however, does not really permit so bald a summary of findings as that briefly sketched above. A goodly portion of these two chapters is devoted to setting out the evidence and explaining how we have interpreted it, as well as to caveats on the conclusions we have reached.

Daniel M. Holland

Empirical Models of U.S. Economic Growth

The purpose of this project is to construct an econometric model of the U.S. economy capable of tracing the growth path over reasonably extended periods of time. Since the focus is on growth and on the dynamic properties of the economy, the research approach is somewhat different from that usually taken in short-run forecasting. For example, inventory investment, which plays a major role in cyclical fluctuations, is a much less important variable over longer periods of time. The functions included in the model must therefore be designed to abstract from the sharp, cyclical movements in inventories. On the other hand, additions to the stock of capital and the resulting effects on productivity must be explicitly included in the model. This, of course, is a factor which can normally be ignored in short-run forecasting.

The process of completing the model can be broken down into at least four major steps: (1) specification, (2) estimation, (3) testing, and (4) application.

At present, work is proceeding on both specification and estimation. In anticipation of one probable application, the specification of the model is being coordinated with the work being undertaken by the tax committee under

Bossons and Shoup. For purposes of that proposed study, the model will eventually need to include a rather complete monetary sector and a set of equations explaining movements in industrial prices. Also, the model should incorporate as many policy variables, particularly tax rates, as is feasible. Some of these requirements can be met most efficiently through later extensions of the model, but some need to be taken into account in the original specification. For example, it is clear that almost from the outset the model should incorporate considerable industry detail. This, in turn, implies that some disaggregated production relations, such as those used in input-output analysis, will be necessary. Indeed, one of the principal problems now being investigated is finding a way to combine dynamic production theory with input-output analysis.

Estimation of the parameters in the model is now being carried out using standard national income accounts data. Although the estimation employs quarterly data, these are being averaged over several periods to reduce the impact of short-run fluctuations. Though a rather simplified version of the model is now being used in the estimation, the results will be useful in testing some of the dynamic characteristics of the basic macroeconomic model. Most of this type of testing will be carried out through simulation analysis. That is, the model will generate a time series of estimates for each of its principal variables, and these will be compared with the observed data to see how well the model replicates the behavior of the actual economy. Following the estimation and testing of the aggregate relationships, the model will be expanded to incorporate as much industrial detail as is feasible.

David T. Kresge

Markets in Stocks and Transactions Costs: Their Macroeconomic Implications

Most of my work as a Research Fellow at the Bureau this year deals with the implications of the existence of markets in stocks and the role of transactions costs in such markets. In this connection I wrote four papers.

1. Static Analysis of Alternative Nonstationary Macroeconomic Models
2. The Determination of the Stock of Reserves and the Balance of Payments in a Neo-Keynesian Model
3. An Approach to the Study of Barter Versus Money Economies
4. A Note on the Macroeconomic Effects of Changes in the Tax Structure

In the first paper I examine, within a closed-economy macroeconomic model, the role of a market in which existing stocks of physical capital can be traded. In the second, I study the implications of assuming that international capital movements are stock portfolio movements rather than simply flows per unit of time. The third paper shows that the existence of transactions costs — or, more fundamentally, the existence of trading or exchanging as a resource-using activity — is a *sine qua non* for studying the structure of markets in an economy. The fourth paper was prepared in connection with my participation in the work of the Tax Studies Committee of the National Bureau.

Work in progress includes the following: (1) Further study of the macroeconomic implications of the existence of markets in stocks; some of this work is being undertaken jointly with Thomas Sargent. (2) Extension of the model presented in the second paper to allow for floating exchange rates and for an endogenous, rather than exogenous, "rest-of-the-world." (3) Jointly with Yoel Haitovsky, a study of the use of auxiliary information to supply estimates of missing observations in regression analysis.

Neil Wallace

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2. NATIONAL INCOME, CONSUMPTION AND CAPITAL FORMATION

The Design of Economic Accounts

A manuscript entitled "The Design of Economic Accounts" is currently in press. This study proposes and analyzes possible changes in U.S. national economic accounts, and is designed to provide more meaningful information on the operation of the economic system. Both the present U.S. system of national income accounts and the proposed United Nations system are examined in some detail. On the basis of a critical evaluation of deficiencies in the two, an alternative system is proposed and illustrated for the year 1966. The main differences in the proposed system are: 1) inclusion of capital accounts for both households and government, 2) recognition of the fact that enterprises as well as households and government engage in consumption activities, 3) clarification of the distinction between the household and enterprise sectors of the economy, with the enterprise sector defined to encompass economic activities taking place in the market sector of the economy. The proposed system would put 1966 gross national product at $903 billion, compared with the U.S. Department of Commerce estimate of $743 billion measured on the conventional basis. Net national product would also be larger with our system, but proposed and conventional estimates are much closer for NNP.

The proposed revision of the national accounts has been designed to facilitate the potential use of microdata sets which are becoming available for specific sectors of the economy. Since our household sector measures only the activity of legitimate household units and does not include organizations such as nonprofit institutions, microdata on, e.g., tax returns and employment can readily be fitted into the framework of the proposed system. Mrs. Helen Stone Tice is currently exploring the availability of suitable microdata sets which could substantially add to the usefulness of national economic accounts.

Richard and Nancy Ruggles

Studies in the National Income Accounts

The major parts of the study on imputations in the national economic accounts will be completed during the coming year. Harold Wolozin has written a first draft of his essay on volunteer labor and is working on a series of suggested revisions; Elizabeth Simpson is preparing revised estimates of the value of unpaid household work and is writing up the results; Jennifer. Rowley has made estimates of the opportunity cost of school work and will revise and expand an earlier paper on the subject; and we have completed estimates of the imputed rental value of nonbusiness capital goods and several types of final expenditures charged to current expense by business. By this winter, after finishing the postwar productivity trends study, I plan to edit the various essays on imputations and write a summary paper. Our present thought is to submit this collection of essays for possible publication as one of the *Studies in Income and Wealth* series.

Research on total investment, capital, and economic growth is progressing. Estimates of gross and net investment, and the associated gross and net stocks of capital, in current and constant dollars for the period 1929 to 1966 are largely completed. In the latter half of 1969, we plan to finish a report on sources and methods. During 1970-71, we shall analyze the behavior of the various time series, in the aggregate and by sector, and write up the results of the study.

John W. Kendrick

Household Capital Formation and Savings

One part of this project is aimed at the development of *ex ante* measures of household savings and the improvement of *ex ante* measures of durable goods expenditures. This work is about at the stage where we can begin to examine the preliminary results of experimental field surveys. Data from the first wave of interviews, conducted in May and June 1968, have now been completely edited, coded, and transferred to tape. Further processing to correct a number of identifiable errors is almost completed. The first reinterview was completed in November and December 1968, with close to 95 per cent of the original 4,500 cases successfully reinterviewed, and the results have been edited, coded, and transferred to punchcards. The second reinterview was conducted in May and June of this year, and the editing and coding process has just begun. Two more reinterviews are planned.

Tabulations from the first interview, while of limited analytical use, show some interesting and encouraging features. The data are consistent with the proposition that information on savings anticipations has predictive value. The mean values of actual (1967) and anticipated (1968) savings do not differ markedly (anticipated being somewhat higher), and both are at what appears to be a reasonable level relative to the incomes of the families interviewed — roughly 10 per cent for this relatively high-income sample. Second, the distribution of actual savings has considerably greater variance than the distribution of expected savings. Since actual savings can be viewed as planned savings plus or minus an adjustment for unexpected changes in financial circumstances, one would expect a greater frequency of both very low (or negative) and very high savings in the distribution of actual than of expected savings. The May 1968 data show this characteristic.

It is also encouraging to note that nonresponse rates have been held to reasonable levels, so that it will be possible to maintain quite respectable sample sizes even when all relevant variables are included in the analysis. Only about 10 per cent of the respondents were unwilling to provide any useful information on asset holdings or changes in holdings, whereas about 75 percent provided all or virtually all information requested; many of the remaining households provided sufficient information to be included in at least some parts of the analysis. We hope to complete a preliminary report based on the first reinterviews shortly after the data become available on tape. Much of the preparatory work required for analysis of the materials has already been done.

The other phase of this project — analysis of the time-series behavior of household savings and purchases of durables — has proceeded rather slowly during the past year. We have spent a good deal of time in attempting to construct a satisfactory empirical proxy for expected income. It now appears that the most satisfactory measure involves: (1) a first approximation based on a simple autoregressive equation; (2) use of this estimate in a partial adjustment model in which expected income in period t is a weighted average of actual income in t and the autoregressive estimate of income in t-1; and (3) a further adjustment taking into account a variable trend in the growth rate of income during the postwar period.

A manuscript dealing with net investment in consumer durable goods should be ready for review within a few months. One interesting feature of the model is the estimated size of the income elasticity of demand for durables. Our results suggest that income elasticity is lower than most previous studies have indicated. The main reason for this result is the presence of a variable for credit terms (average contract maturity). The model suggests that the much greater relative increase in stocks of durable goods than income during the last two decades is a consequence of lengthening contract maturities over the period rather than of a highly income-elastic demand. The implication is that future increases in durable goods stocks will be smaller relative to income unless contract maturities continue to lengthen as they have in the past — which seems doubtful — or unless the maturity effect is inherently transitory.

Avrohn Eisenstein has responsibility for processing the experimental survey data.

Paul Wachtel, who has been a research assistant on this project for the past two summers, has joined the staff on a full-time basis for the coming year and will be working on the durable goods investment model.

At the Census Bureau, John McNeil and Thomas Stoterau have been concerned with the design of the experimental survey and are co-authors with me of a paper on preliminary results for the August meeting of the American Statistical Association.

The National Science Foundation has approved a two-year extension of the original project and provided a grant to help cover the costs. The U.S. Bureau of the Census is cosponsoring the project and has provided the resources needed to carry out the experimental field surveys as well as other personnel and computational resources.

F. Thomas Juster

Philanthropy

Two manuscripts, which bring the study to completion, have been approved by the Board of Directors for publication and are now in press. These are the late Frank G. Dickinson's report on "The Changing Position of Philanthropy in the American Economy, 1929-59," and Ralph L. Nelson's "Economic Factors in the Growth of Corporate Giving," which will be published jointly with the Russell Sage Foundation. Solomon Fabricant's general essay on "Philanthropy in the American Economy," serves as an introduction to Dickinson's report.

The study of philanthropy was financed by the Russell Sage Foundation.

Solomon Fabricant

Measurement and Analysis of National Income (Nonincome Income)

Catalyzed by developments in tax structures which bear heavily upon reported income, there has been a growing transformation of claims to product toward forms not regularly recognized as income. The term "nonincome income" is used to denote this category of items, which may include capital gains (both realized and unrealized), expense accounts, stock options, services of productive stock owned by government and by consumers, investment in education, and productive use of leisure. Such flows would be classified as income by the economic theorist but are not usually so classified in national income accounting and empirical economic analysis.

As initially conceived, this research was to be a comprehensive pilot study of nonincome income consisting of:

1. Theoretical analysis to delineate items and categories of nonincome income significant to measurement of the level and distribution of income and product aggregates and to the estimation of economic relations in which such aggregates are involved.

2. Actual measurement of the items and categories so delineated, to form the basis for a preliminary re-estimate of national income and personal income and various aspects of their distribution.

3. On the basis of the new measures of income, product, and wealth, econometric re-estimation of key economic relations such as consumption functions, investment functions, and production functions, as well as simultaneous system models of the entire economy.

Arthur Treadway has been associated in the over-all direction of the project, while research in specific areas has been undertaken by several graduate students at Northwestern University.

Michael McElroy has been working on estimates of aggregate capital gains and losses accruing annually in the United States over the postwar period. Distribution of capital gains and losses over income classes will be attempted for at least several selected years. Effects on

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measures of income inequality and consumption behavior will be explored.

Robert Wallace is concentrating on the value of investment in education. He is obtaining and will subject to intensive analysis data from Project Talent,[1] which may reveal both some of the effects of education upon various measures of educational achievement and the relation between these measures of achievement and subsequent income. Estimates of income and product in education will be tied to some

notion of the discounted value of future returns from education.

Wolfhard Ramm is working on the valuation and estimation of returns to household investment in tangible assets. This is primarily an empirical analysis of the production of consumption services by households. The initial work is concentrated on automobiles.

Allan Mendelowitz is undertaking work on depreciation and capital consumption with a view to developing a consistent series unaffected by the changing tax laws.

Robert Eisner

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[1]A survey of 100,000 high school students conducted by the American Research Institute (Palo Alto) in 1960, with follow-ups in subsequent years.

3. URBAN AND REGIONAL STUDIES

Urban Economic Studies

Our Urban Economic Studies can be divided into two parts. One is a long-range effort to develop simulation models for explaining changes in urban spatial structure. The initial stages of this effort have been funded by the Department of Housing and Urban Development, and this modeling effort is well under way. The second part of the research deals with other urban problem areas. We have begun two projects in these areas and are planning others.

The HUD grant provided for a survey and critique of land-use modeling in transportation planning. This survey included a detailed examination of land-use modeling in five metropolitan areas: (1) Puget Sound, (2) Southeastern Wisconsin, (3) Atlanta, (4) Detroit, and (5) San Francisco. This survey, which we regard as providing a useful critique of land-use modeling, has been completed and accepted by HUD.

Research for the land-use modeling study has proceeded in two separate but related directions. The first is an attempt to obtain improved and more complete econometric

estimates of the determinants of location and other aspects (tenure, single family vs. apartments dwelling, and size of unit) of residential and industrial choice. The second direction involves some preliminary efforts to develop "abstract" models which simulate the land and housing markets. At present, most urban land-use models depend on a series of restrictive and static long-run equilibrium models for their theoretical justification. Our hope is that more complex and useful models based on more realistic assumptions can be developed by computer simulation.

The urban economic studies group has also begun to examine other urban problems. So far, Raymond Struyk has almost completed a study of the effects of state tax transfers on local government in New Jersey, and David Gordon has begun a study of the employment problems in ghetto areas.

Progress in each of these research efforts is detailed below, followed by reports on work in the closely related area of regional studies.

John Kain

The objective of this research is to extend and to test empirically the basic theoretical framework of "the classical residential location model." The theoretical extension is along two main lines. The first is in suggesting "decision variables" (i.e., characteristics of decision-making units) which either affect locational preferences or represent constraints upon choices. Examples of the "decision variables" which will be considered are income, race and sex of household head, number of employed members in the household, and stage in a family's life cycle or family size. The second extension is in allowing decision-makers to exercise their choices among locations which differ according to housing quality, pre-existing land uses, public services, social amenities, and the degree to which the transportation system links the various locations to each other. The most important linkage provided by the transportation system is that between residential locations and various places of employment. Each of the categories which cause locations to differ from each other is represented by a number of variables. For example, housing quality is represented by size, age, and physical condition (among other variables); and public services are represented by the allocations of community budgets to each of several municipal services, including schools, police and fire departments, sanitation, and so on.

The general form of the model to be empirically tested is:

$$P_{ijk} = F_{jk} (X_i, t_{ji})$$

where

P_{ijk} = the proportion of workers who work at workplace j and who are in the kth socioeconomic category (according to the decision variable) and who live at residential location i.

X_i = a vector of variables which characterizes residential location i according to housing quality, land use, public services, and social amenities.

t_{ij} = a vector of variables which characterizes the transport linkages between residential location i and workplace location j by various transport modes.

The subscripts of F indicate that there is a different function for each combination of workplace location and socioeconomic category. The equation thus describes the pattern of residential locations for each combination of j and k as a function of the characteristics of residential locations and the characteristics of the transportation system.

The data to be used in testing the model come from a variety of sources. Information on the dependent variables is from the transportation land-use study initiated in 1963 by the Southeast Wisconsin Regional Planning Commission (SEWRPC). Data on housing quality and social amenity levels are from the 1960 Census of Population and Housing. Public service data are from a number of state and local government sources in Wisconsin and the Milwaukee metropolitan area. Data on land use and transportation system characteristics are also from SEWRPC.

At present work is going forward on creating final forms of the dependent and independent variables and on firming up the theoretical framework of the analysis. The data should soon be in a form which permits initial regression analysis to be done.

Stephen Mayo

Household Residential Choices Over Time

We plan in this study to estimate a variety of econometric models relating to housing choices. The data for the project were collected and made available to us by the Bay Area Transportation Study (BATS). These data have never been analysed and permit consideration of a number of hypotheses that could not be tested previously.

The BATS sample provides a workplace and residence history for 3,182 Bay Area households. The sample data includes the structure

type, rent or value, number of rooms, lot size, and type of tenure of both the current and former residences of the households. Using these data, we hope to model the following aspects of behavior:

1. The decision to move: This would build on the work by Sherman Maisel. Maisel's analysis was based on the Census one-in-a-thousand tape and was seriously restricted by the data limitations of that source. Our study should benefit from having more complete information about household characteristics relevant to this decision, including changes in employment locations.
2. Tenure choice: ownership or rental.
3. Choice of neighborhoods: In many respects this is the most difficult dimension of choice to model because of the difficulty, indeed, perhaps impossibility, of producing a single-valued measure of either absolute or relative location. Our present plan is to employ several measures of location and changes in location. The most obvious of these relate to location or changes in location with respect to the workplace and distance from the central business district.
4. Choice of housing characteristics: Some of the relevant, measurable dimensions are: (a) structure type; (b) lot size; (c) dwelling unit size (number of rooms); (d) housing expenditures (value or rent); (e) neighborhood characteristics.

The sample is rich in detail, but enormously complex. Thus the process of data preparation, validation, and the development of working tapes is long and arduous. While BATS did make validity checks in the original data, this verification was far from complete. We have written programs to make additional checks and have almost completed the corrections. Initial working tapes will be ready soon, permitting analysis of the above questions to begin.

James Brown
John Kain

Determinants of Industrial Location Within Metropolitan Areas

This study seeks to determine those factors most important in the intrametropolitan location decisions of manufacturing establishments, and then to use the quantitative information on these factors in the construction of a predictive model of future locations. Using the experience of earlier researchers as a base, we have largely devoted the past several months to putting the problem in an appropriate theoretical context and examining the implications for the formulation of an empirically testable model.

At the same time, preliminary steps toward actual empirical work have been under way. Since the location decision within a metropolitan area is most easily analyzed by examining those factors determining the relocations of firms within metropolitan areas, we have been trying to determine which areas offer the best sample of relocators, along with necessary additional information. For this purpose the taped data generously donated to the Bureau by Dun and Bradstreet are proving most useful. These tapes contain information on establishment location, employment, activities by SIC codes, and several other variables. Comparison of the annual tapes provides relocation data on a national scale. The completion of these steps and analysis of the results will permit the selection of one metropolitan area in which the location decisions can be studied in depth on an experimental basis.

The coming months will be devoted to further data acquisition and assembly and then to the testing of alternative specifications of the theoretical model. Several hypotheses relevant for the other aspects of the urban studies project, especially the residential location modes, will be tested. Franklin James is assisting me in this project.

Raymond J. Struyk

Experiments in Residential Location Equilibrium Modeling

The efforts under this portion of the project are directed toward finding efficient algorithms which will allow us to find fast solutions to the equilibrium problem of residential location when several employment centers exist in an urban area. The real world problem depends on household preferences, neighborhood characteristics, incomes, and a trade-off between transportation and these alternatives. The classical theoretical models by Alonso, Muth, Wingo, and Mills all address themselves to this problem but the assumptions which are basic to these models are too restrictive to be of great use in urban simulation problems. Among these assumptions are: (1) all employment is located at the center; (2) housing is homogeneous in every quantity except quantity of land space; (3) the quality of land space is homogeneous; (4) no housing stocks exist; (5) there is no segregation or discrimination.

Another basic problem in the search for efficient algorithms relates to the type of mathematics which must be employed The calculus solutions to the classical problem, while providing valuable insights, are almost useless for the types of data which must be employed in urban studies. The massive amount of data which must be handled demands that various aggregations (usually land area aggregations, such as groups of blocks or census tracts) be made before the problem can be handled without excessive computer costs. This leads directly to mathematical techniques which have the ability to handle noncontinuous functions. Differentiability requirements can rarely be maintained.

Several approaches are being investigated and developmental work is being tested with synthetic data. Basic errors in the approach are more easily discovered with synthetic data than samples of real world data due to the fact that real data react to many exogenous factors. After testing is completed and the alternative approaches are narrowed, actual data from some of the major cities in the continental United States will be used for simulation effectiveness tests.

Royce Ginn
Mahlon Straszheim

The Effects of State Transfers on Local Government in New Jersey

This study, conducted partially under the auspices of the National Bureau, has been a pilot effort to provide quantitative information on the nature of state-local relations as revealed by the state grant-in-aid program in New Jersey. The study was conceived and executed as a complement to similar treatments of the parallel federal-state relations.

Two aspects of the state-local relationship were considered. First, criteria for the distribution of grants-in-aid were examined; of the two primary allocation criteria, need and fiscal effort, grant-allocating formulas based on local fiscal effort were proposed as meeting several basic objectives, including equalization of public service levels, avoidance of aid-local tax substitutions, and a tendency to correct imbalances in the allocation of resources resulting from spill-outs of benefits of public goods. In this regard, it was found that state grants to the counties, made largely for welfare related services, were distributed in a manner consistent with the fiscal effort measures used as the appropriate criterion. Education grants to schools did not exhibit this consistency, however, nor were they significantly associated with the income level of the community. The second aspect of the relationship studied was the extent to which state grants may have stimulated localities to provide certain services. The results of the simultaneous equation system used in this part of the study generally reinforced the findings of the first section. State aid to counties was found to result in substantial increases in locally financed services, although at an increased cost to the state. The less restrictive methods of allocating aid for educational services, however, have resulted, in large

measure, in a substitution of state for locally provided funds in the school districts.

The major results in some ways have confirmed our a priori expectations. At the same time they have raised a number of additional questions in the area of federal-state-local fiscal relations. One is whether alternative legal formulas used in other states to distribute grants-in-aid yield results substantially different from those obtained here. Another pressing question concerns the efficiency and effectiveness of a state government as a disburser of federal aid to lower levels of government. The results of this pilot study give a pessimistic response to this question, at least for education. More complete and precise answers to these questions may be forthcoming from the fiscal relations research currently being proposed at the National Bureau.

Raymond J. Struyk

Employment and Unemployment in Urban Ghettos

I have just begun work on this project, which is supported in part by a grant from the Economic Development Administration, and have not yet isolated a set of specific hypotheses for exploration, but my research will undoubtedly evolve out of the following collection of general concerns:[1]

1. Manpower training programs may represent increasingly inappropriate policy responses to the problems of ghetto "hardcore" unemployment. It may be increasingly true that the patterns of unemployment and unstable employment among disadvantaged workers are dominated not by their inabilities

to find work — by their supply of labor characteristics and handicaps — but rather by their refusals to work in certain kinds of jobs — by the nature of the demand for unskilled labor. To the extent that that may be true, the pattern of demand for labor must be changed before or along with the pattern of labor supply.

2. If the above observations are in fact true, manpower planners necessarily require information about the kink or minimum supply price in the supply of labor functions of particular ghetto workers. Defining job quality in terms both of wage and skill content, there must be some inflection point above which quality ghetto workers will be willing to accept and remain on the job.

3. If such an inflection point could somehow be specified, then manpower planners also need to know exactly how many of such jobs above a minimum quality the economy needs to produce to alleviate the differential severity of unemployment and underemployment in the ghettos. And if such a number of minimum quality jobs could be specified, one also needs to know under what kinds of circumstances the economy actually could produce or generate that additional number of minimum quality jobs.

4. One of the interesting notes about American economic history is that a new "disadvantaged" immigrant class of workers has always been available to fill the lowest strata in the American wage and occupational ladder. When the stream of foreign immigrants finally ended, northbound blacks replaced the foreigners at the bottom. Now, in several senses, and perhaps simultaneously with the wave of southern blacks' migration to the North, women are also filling in at the bottom. In every case, the act of movement — of immigration, northward migration, or entry into the labor force — generated or grew out of a sense of hopefulness that previously uncomfortable situations would be improved. That hopefulness itself produced a patience with menial employment that allowed the new "disadvantaged" workers to tolerate the lower strata of jobs.

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[1]Many of these speculations grew out of several small projects on which I worked last year. See P. Feldman, D.M. Gordon, and M. Reich, *Low-Income Labor Markets and Urban Manpower Programs: A Critical Assessment,* forthcoming research monograph, U.S. Department of Labor; and D.M. Gordon, "Income and Welfare in New York City," in *Public Interest,* summer 1969.

Now, the ranks of the most disadvantaged workers in the country are increasingly dominated by ghetto-born blacks, workers whose history has not spanned an act of hopeful movement or migration. They have been born into, lived with, and tend to expect inferior status. Together with the "black power" movement, this lack of hopefulness probably also produces a lack of tolerance for menial work because there is no expectation that this generation or even the next generation can move up the occupational ladder.

The point of such speculation is that the American economy may be approaching a point unique in its history, when its most disadvantaged workers are not willing to fill its least desirable jobs. If that moment comes, the implications for the entire structure of the labor market and the economy will obviously be profound.

David Gordon

Regional Economic Studies

Regional differences in economic and social conditions are a subject of interest in many of our studies: as a substantive topic where the explicit purpose of the study is the explanation of particular regional differences, and, more commonly, as a methodological input where bodies of regional data are used for cross-sectional analyses of economic relations. In the second case, the subject matter is not inherently linked to a regional context, but the analysis contributes to the understanding of regional phenomena.

Progress in several explicitly regional studies is described below in the reports dealing with regional wage differentials, migration patterns, and agricultural specialization. A grant from the Economic Development Administration of the U.S. Department of Commerce provides much of the support for these studies; it also serves to strengthen (by supplying additional financial support in certain cases) the concern with regional dimensions and implications of our ongoing research on urban problems and related

subjects, such as human resources, health levels, income distribution, labor force, unemployment, and the functioning of social institutions. The work in these other fields is reported elsewhere in this volume.

Jacob Mincer

Differentials in Hourly Earnings in the United States

Substantial variation in hourly earnings among employed persons is a well-known and highly significant characteristic of the U.S. economy. Earnings differentials are the principal source of income inequality and are a major determinant of the geographical movement of population and industry. Among the major differentials that have attracted wide attention are those associated with region, city size, color, sex, and education. Conflicting views concerning the magnitude of these differentials and the reasons for them lie at the heart of many controversies concerning the efficiency and equity of the U.S. economic system. Reduction or elimination of the differentials has been the stated purpose of many federal, state, and local laws passed during the past decade.

In an earlier study of regional and city-size wage differentials[1] attempts were made to control for color, age, sex, and education. In the present study, occupation and industry (classified by extent of unionization) are also introduced as control variables. The study covers all nonfarm employed persons, including salaried employees and the self-employed; it also includes all nonfarm industries and occupations. The major objectives of the study are:

1. To show the extent to which each differential is in some sense "pure" and the extent to which it is "explained" by correlation with other variables, e.g., how large is the regional differential after allowing for differences in city size, education, and other variables?

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[1]See Victor R. Fuchs, *Differentials in Hourly Earnings by Region and City Size, 1959,* Occasional Paper 101, NBER, New York, 1967.

2. To examine the interaction between the various factors influencing hourly earnings, e.g., is the city-size differential more important for whites or for nonwhites, for males or for females? Does the regional differential vary with color or education?

3. To try to use the various interactions to derive some general propositions about the differentials and to suggest hypotheses for further testing, e.g., does the regional differential vary systematically with the skill level? Is this related to relative supplies of labor? Does the city-size differential vary with age? If so, why? More complete information about these interactions should increase our understanding of the factors responsible for earnings differentials.

4. To perform similar analyses for differentials in average annual hours per person and to attempt to relate these to the differentials in average hourly earnings.

5. To provide a base line against which changes in differentials can be measured. When the data from the 1970 Census become available it should be possible to conduct numerous tests of the impact of the civil rights, education, and other legislation of the 1960's.

The basic source of data is the one-in-a-thousand sample of the 1960 Census of Population. The calculations of earnings and hours have been completed and we are now running regressions across groups of workers cross classified by various characteristics. Elizabeth Rand and Bonnie Garrett are assisting me in this project.

Victor R. Fuchs

Interregional Migration Flows

Research on the distribution of Southern migration, by race, has led to a consideration of the determinants of Southern net migration. In particular, John Kain and I have been concerned with the interaction of economic and demographic forces in the nonmetropolitan areas of the deep South. The emerging model relates net migration from these nonmetropolitan counties to the potential expansion of the labor force, the contraction of agricultural employment, and the expansion (or contraction) of nonagricultural employment. The model as estimated for 1950-60 breaks into two parts. The first estimates the distribution of nonagricultural employment expansion and of agricultural employment decline by race. These equations assume a racial quota system in the distribution of employment gains. The second part of the model uses these distributions in relating black and white net migration to the employment and demographic data.

Perhaps the most interesting findings to date come from stratifying the sample into three subsamples that correspond roughly to Hill counties, Piedmont counties, and Black Belt counties. This stratification indicates that black migration is most similar to white migration in the Hill counties. In other areas black migration is more dependent than white migration on the simple growth of the labor force, with employment expansion having a much smaller "holding" effect. It is noteworthy that relative to the size of their black population the Hill areas have a much higher percentage of new nonagricultural jobs going to the black labor force.

In order to gain a more complete description of the employment distribution process, the nonagricultural equation was disaggregated into broad industry groups. These disaggregated equations indicated that the quality of jobs going to the black labor force was also highest in the Hill areas. This would suggest that not only the availability of employment but also the quality of that employment is relevant to the migration of blacks from the deep South.

Joseph Persky

Regional Specialization in American Agriculture: Wheat, 1867-1914

Wheat has always been a major commercial crop in the United States, and the expansion of wheat production has been an important factor in the economic growth of the country. The geographic expansion of the country and the growth of regional agricultural specialization

contributed significantly to the rise in productivity in wheat growing. This study is one of several that have tried to evaluate the significance of this factor.

Interregional trade was important to the antebellum economy, and Douglass North made this trade the basis of his explanation of antebellum economic growth. Fishlow has questioned this point, as far as trade between the West and South is concerned, and stressed the limited volume of exchange between these two regions.[1] The limitation of his analysis is that it ignores prices and therefore the opportunity cost of trade. It is not enough to know how large trade was; we must know what the cost of doing without it was. For this, we need regional supply curves.

Parker and Klein (1966) tried to evaluate the importance of the small westward movement in the rise of labor productivity in wheat production by evaluating the costs of growing wheat in 1910 in the regions used in 1840. Their method, however, implied that the supply of wheat in each region was infinitely elastic. This assumption is clearly invalid, and we need an explicit measure of the elasticity of supply of wheat to evaluate the importance of regional shifts in production.

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[1]See Douglass C. North, *The Economic Growth of the United States, 1790 to 1860,* Englewood Cliffs, N.J., 1961, p. 103, and Albert Fishlow, "Antebellum Interregional Trade Reconsidered," in *The American Economic Review,* May 1964.

We are estimating state-by-state supply functions for wheat for the late nineteenth century. (Data are not available for the antebellum period.) Our purpose is to measure the elasticity of supply within states and to see if the state supply functions can be combined into regional ones or a national one. Our results show that states did differ among themselves, that the elasticity of supply of wheat was closer to one than to infinity, and that there was a considerable lag in the farmers' response to prices. The lag helps to explain the rural unrest of the 1890's and the rise of Populism.

Using revised data of the U.S. Department of Agriculture, we have experimented with different forms of the supply function and tried a variety of variables and lag structures. We have been quite successful in explaining the proportion of farm land planted to wheat on the basis of a simple lagged response to relative prices and to relative change in the yield of wheat. We have not been successful in explaining the total amount of land farmed, despite experimentation with many possible variables: the pace of settlement was too even for us to get results with our present methods.

We have constructed aggregate supply curves for various regions and for the United States as a whole in order to see the effects of the westward expansion.

A draft of the study has been completed and is now being typed.

Peter Temin
Franklin Fisher

4. HUMAN RESOURCES AND SOCIAL INSTITUTIONS

The National Bureau's research program in the human resources and social institutions area has expanded at a rapid rate during the past year. The groundwork and much of the stimulus for this accelerated effort lies in the framework of human capital analysis developed by Gary S. Becker and now being explored by Becker in association with other members of the Bureau staff.

Ongoing research under Becker's direction consists of three separable program areas. The relation between human capital and the personal distribution of income is being examined by Jacob Mincer, who is analyzing the influence of both schooling and postschooling investment on the structure and time profile of earnings. Barry Chiswick is studying the influence of differences in the distribution of schooling on

differences in the inequality and skewness of the income distribution between countries and regions. The studies by Mincer and Chiswick are reported separately below, and will be published in a single volume along with Becker's 1966 Woytinsky Lecture at the University of Michigan.[1] The volume is expected to be ready for press in late 1969.

Gilbert Ghez, Robert Michael, and Becker are examining the influence of human capital on consumption and labor-supply decisions. Ghez's study, based on Becker's household production function model,[2] is designed to explain variations in consumption with age. It emphasizes the interdependence over the life-cycle between consumption decisions and labor-supply decisions. Becker's companion study uses the household production function model to examine life-cycle patterns in the amount of time spent in the labor force. Michael's study focuses on the influence of the human capital variable on consumption; the stock of human capital is viewed as influencing the efficiency of the household's production function for goods and services.

Both the income distribution and consumption-labor supply studies are being financed with the aid of a grant from the Carnegie Corporation.

The third program area introduces economics into the analysis of legal problems. Isaac Ehrlich is studying the influence of economic incentives on the rate of participation in illegal activities. His hypothesis is that the frequency of illegal (criminal) behavior is responsive to relative gains and costs as visualized by potential participants. William Landes is analyzing the economics of the judicial system, and is developing an economic model to study the frequency of pretrial settlements, and the effects on the demand for trials of judicial procedures like the bail system.

During the past year the National Bureau has begun a new series of studies on selected aspects of the relation between the stock of human capital, as reflected by educational attainment, and economic or social behavior. These studies are being financed with the aid of a grant from the Carnegie Commission on the Future of Higher Education, and are being directed by F. Thomas Juster.

One set of studies will deal with the influence of educational attainment on specific types of behavior which have measurable, though not necessarily direct, economic consequences. In this area, we plan to begin an exploration of the possible influence of education on savings and time preference, and to reorient ongoing National Bureau research to examine the influence of education on the propensity to engage in various types of criminal activity, on the distribution of consumption over the life-cycle, on the distribution of consumption expenditures, on labor force participation rates, and on geographic wage differentials. In addition, we are hoping to explore the relation between education and the allocation of time, and the relation between education and the propensity to participate in community affairs, religious activities, and social activities. As indicated, many of these studies will draw extensively on work already in process at the National Bureau. Others, especially the proposed study of savings behavior and time preference, will represent new research efforts.

A second group of studies, reported below in detail, will analyze the economic returns to education, especially to higher education. One study, being conducted by Paul Taubman and Terence Wales of the University of Pennsylvania, will focus on examination of the net returns to education corrected for the relation between "ability" and earnings. To date, Taubman and Wales have concentrated on uncovering new sources of basic data that can be used to examine this relation directly. A number of promising leads have been developed, including a small sample of upper-echelon

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[1] Published under the title *Human Capital and the Personal Distribution of Income,* Institute of Public Administration, University of Michigan, 1967.

[2] The household production function model is developed in G.S. Becker, "A Theory of the Allocation of Time," *The Economic Journal,* September 1965.

corporate officers for whom extremely good in-come data are available, a sample of very high ability persons for whom several decades of in-come information have been obtained, a small sample who were college freshman in the 1930's and for whom an earnings history was obtained in the 1950's, a sample from an on-going experimental savings survey being con-ducted jointly by the National Bureau and the U.S. Bureau of the Census and for whom an ability measure can probably be obtained, and a sample of approximately 10,000 men, origin-ated in 1943, for whom earnings history and educational attainment is now being obtained via a special follow-up survey. It thus appears that the relation between ability, education, and earnings can be examined directly in a number of different samples. In addition, the question can be approached indirectly via independent evidence on the extent of the ability-education correlation at different dates in time supplemented by analysis of the direct relation between education and earnings.

A second study in this area is being con-ducted by Sherwin Rosen of the University of Rochester. Rosen will focus on development of a model for explaining changes in the stock of human capital over time, with particular emphasis on the role played by depreciation and postschooling investment. The empirical evidence which bears on this relation consists of age-earnings profiles. Earnings tend to be reduced with age because of depreciation on human capital, and to be increased because of postschooling investment; what we observe is the net effect of the two forces. The problem is to disentangle the separate effects of depreci-ation and net investment.

In addition to these broad programs in the Human Resources and Social Institutions area, a number of related studies are being conducted by Research Fellows who will be in residence at the NBER for the 1969-70 academic year. The Research Fellows, and their areas of research, include:

V.K. Chetty of Columbia University, who is engaged in a study of educational production functions designed to measure the contribution of educational inputs (teachers, physical facil-ities) to various measures of school output;

Finis Welch of Southern Methodist Univer-sity, who is analyzing the relation between farm output and the education of farm operators with a view to identifying the specific educa-tional skills that seem to be responsible for the productivity of formal education;

Lewis Solmon of Purdue University, who will be participating in the study, discussed above, of the relation between educational attainment and savings; and

John Hause of the University of Minnesota, who will be joining the staff at the end of this year to work on the relation between earnings, ability and education using a unique collection of Swedish data.

F.Thomas Juster
Gary S. Becker

Human Capital and the Personal Distribution of Income

Investment in Human Capital and the Structure of Earnings

My work on the effects of schooling and age on the size-distribution of earnings, which started as an updating of earlier findings, has broadened considerably in both analytical and empirical scope. The human capital approach leads to a unified, though not exhaustive, inter-pretation of the structure of earnings between and within groups of workers defined by schooling and age. In this framework, the size-distribution of earnings depends on: (a) the distribution of investment in schooling and rates of return on it: (b) the distribution of postschool investment, such as on-the-job training, over the life-cycle and among indiv-iduals, and the rates of return on such invest-ments; (c) the correlations between schooling and postschool investments; and (d) the cor-relations between investments and individual earning capacities.

The empirical analysis employs data for 1959 from the Census one-in-a-thousand sample. Levels, dispersions, and skewness para-meters within cells and aggregates display

systematic patterns, intelligible in the light of the human capital model. Some of the more interesting explorations and findings are: (a) the importance of distinguishing between age and experience as determinants of earnings; (b) choice of a function which relates earnings to schooling and age; (c) possibilities of estimating separate costs and rates of return to schooling and postschooling investments; (d) positive correlations between postschool investments, schooling, and earning capacity; (e) discrimination between "random shock" and human capital models of income inequality; (f) transformations from personal to family income-size distributions; and (g) estimates of the quantitative importance of investment in human capital as a determinant of total income inequality.

Jacob Mincer

Interregional Analysis of Income Distribution

This research project investigates the effect of human capital on the inequality and skewness of income (or earnings) of adult males. A human capital model is developed which relates the natural logarithm of income to years of training and the rate of return from training. Since data on training other than formal schooling are scarce, the empirical analysis uses years of schooling attended.

The functional relation derived from the model can be used to generate an estimate of the rate of return to investment in schooling. That is, the regression equation

$$LnY_{s,i} = Ln\hat{Y}_o + \hat{r}S_i + \hat{U}_{s,i} \qquad (1)$$

is employed, where: (1) $Ln\ Y_{s,i}$ is the natural log of income of the ith person after S_i years of schooling; (2) $Ln\hat{Y}_O$ is the estimate of the natural log of the average zero schooling level of income; (3) $\hat{r}$ is the estimate of the adjusted rate of return from schooling; (4) $\hat{U}_{s,i}$ is the residual. Potential sources of bias in $\hat{r}$ are analyzed.

Calculating variances, equation (1) becomes

$$Var\ (LnY_s) = (\hat{r})^2 Var\ (S) + Var\ (\hat{U}) \qquad (2)$$

Thus, the variance of the log of income, a commonly used measure of relative income inequality, is related to the rate of return from schooling and the inequality of schooling.

Cross-sectional interregional analyses for the United States (white and all males), Canada, and the Netherlands, as well as international comparisons among the United States, Canada, Puerto Rico, Mexico, Israel, and Great Britain indicate that:

1. Schooling can explain a considerable proportion of the variation in the log of income in a region (often 15 to 20 per cent), and frequently a larger proportion of differences in the variance of the log of income across regions (up to 50 per cent).

2. Across areas, either the rate of return or schooling inequality, or both, are positively correlated with the inequality of income, the explanatory power of schooling and the residual variance.

3. There does not appear to be any systematic relation between the rate of return and the inequality of schooling.

The functional relation between income and schooling that is derived from the model can be utilized for an interregional analysis of the relationship between the level of income and income inequality. The model predicts a positive correlation. The observed simple negative correlation for the United States and Canada becomes a positive partial correlation when the rate of return and schooling inequality are held constant. The effect of migration on the correlation between the rate of return and the level of income is analyzed. Analytical explanations of these relationships are presented.

Measures of skewness are calculated for observed income, predicted income, and residual income for the United States and Canada. It is found that:

1. Schooling can produce a considerable amount of skewness in the distribution of income.

2. The rate of return, schooling skewness, or both, are positively correlated with the observed, predicted, and residual skewness. The predicted skewness is positively related to the observed skewness.

3. There does not appear to be a systematic relation between the rare of return and the skewness of schooling.

Analytical explanations are also presented for the skewness relationships.

Barry R. Chiswick

Human Capital and Consumption

Consumption, Working Time and Age

This study is designed to explain how consumption varies with age; i.e., to uncover the determinants of life-cycle consumption patterns. The framework of analysis is somewhat different from the standard Fisherian model, and was first laid out by Gary Becker in his "The Allocation of Time and Goods Over Time" (unpublished manuscript, June 1967). It emphasizes the interdependence between life-cycle consumption and life-cycle labor supply decisions.

Specifically, it is assumed that individuals at each year of age engage in nonmarket activities, that is, they produce nontradable commodities such as travel, good health, or house cleanliness. To produce these commodities, they use as inputs the services of market goods and their own time. Market goods and services such as airline services, doctors' advice and prescriptions, or vacuum cleaners do not in general provide utility directly, but only insofar as they contribute to meet the more basic needs which enter individuals' preference function.

How does the demand for market goods vary with age? Since much time is used in consumption, variations in the price of time with age must surely affect consumption decisions. They do so in two ways. First, a rise in the wage rate is a rise in the price of consumption time relative to market goods. Hence, when the wage rate is rising with age (due in part to on-the-job training, in part to increasing information about labor market conditions), individuals tend over time to substitute market goods for consumption time in their nonmarket production. Similarly, when at later years of age the wage rate is falling (due to poorer health and to increasing obsolescence of acquired skills), the demand for market goods relative to consumption time tends to fall.

Second, a rise in the wage rate implies a rise in the (shadow) price of household commodities. Hence, individuals facing a zero rate of interest and exhibiting neutral time preference would tend to consume less nonmarket commodities tomorrow than today when their wage rate is rising, and would tend to have a rising commodity consumption profile when the wage rate is falling.

Changes in the derived demand for market goods depend therefore on changes in the wage rate with age. The direction of the wage rate effect depends on whether the factor substitution in production dominates or is weaker than the commodity-substitution effect. Interest rate effects may also be present. Positive interest rates reduce the incentive in favor of consumption today, thereby imparting an upward tilt to all consumption paths.

By contrast, in the absence of unexpected changes in income, the life-cycle pattern of consumption in the standard model would be completely independent of the pattern of income: with zero time preference, consumption would rise with age if and only if the rate of interest were positive.

Regressions were estimated in order to test for both wage rate and interest rate effects, based on data from the BLS 1960-61 Survey of Consumer Expenditures. Households were cross classified by age, education, and race. Within each education-race cell, average consumption of market goods, average earnings, and average family size were computed by age of head. Since individuals differ in their wealth position and no measure of lifetime income is available, only the variation in average consumption by age within the education-race group was studied. Family size was included in the regres-

sions because consumption and earnings data in the BLS survey pertain to families. The interest rate effect may be measured even in the absence of data on interest rates by age; it is reflected in the variation of consumption by age not accounted for by the variation of earnings and family size by age of household head.

Results to date indicate positive and highly significant wage rate and interest rate effects. The coefficients are very stable across education and race groups. Adjusted R^2s are on the order of 0.9. If the assumption of perfect foresight is taken seriously, the estimates imply that a 10 per cent rise in current annual earnings, holding age, family size, and lifetime real income constant, raises annual consumption by approximately 2 per cent. This may be regarded as an underestimate of the effect of a "temporary" rise in earnings, since a rise in current earnings, holding earnings at other years of age constant, would raise lifetime real income and hence consumption. Further, one finds that if wage rates and family size were independent of age, consumption would grow with age at a rate of less than 1 per cent per year due to positive interest rates; this may be taken as prima facie evidence that the elasticity of substitution in consumption is relatively small.

Work is under way to estimate substitution elasticities and interest rates faced by consumers.

Gilbert R. Ghez

Determinants of Time Spent in the Labor Force

This study is a companion to that reported on by Ghez, and concentrates on the implications of the same model for time spent in the labor force. The model predicts that this time would rise initially with age as the wage rate rose, hit a peak before the wage rate did, and then decline. The percentage increase or decrease in working time with respect to a 1 per cent rise (or decline) in the wage rate would be a weighted average of the elasticities of factor and commodity subsitution discussed in Ghez's report.

The model is being tested with data from the one-in-a-thousand sample of the 1960 Census. A typical example of the results obtained so far is the following:

$$\log L_j = 5.726 + 0.236 \log E_j - 0.003j$$
$$\quad\quad\quad\quad (8.39) \quad\quad\quad (-7.22)$$

$$\bar{R}^2 = .62, DW = 1.66$$

where L_j and E_j are estimates of the average annual hours worked and annual earnings in 1959 of white male high school graduates at age j where j runs from 22 to 65, the terms in parentheses are t values, $\bar{R}^2$ is the adjusted coefficient of determination, and DW is the Durbin-Watson statistic. The negative coefficient of j is supposed to measure the discouraging effect of a positive rate of interest on hours worked. In contrast with time series studies, there is a positive relation between hours worked and earnings over a lifetime, essentially because there is no "income effect" over a lifetime.

Both studies and the following one by Michael have been financed by a grant from the Carnegie Corporation. I have received assistance from Gilbert Ghez, Haim Ofek, and Robert Michael.

Gary S. Becker

The Effect of Education on Efficiency in Consumption

This project investigates the effects of human capital on consumption. The specific questions being asked are: How (or through what mechanism) might one's stock of human capital influence one's behavior as a consumer? Under what conditions might this influence have some discernible pattern, thus making the impact on consumer expenditure patterns subject to prediction? If an observable and systematic effect is identified, what implication, if any, does it have regarding the rate of return on investment in human capital?

The theoretical model developed to deal with these questions makes use of the concept

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of a household production function as developed in Gary S. Becker's "A Theory of the Allocation of Time," *The Economic Journal,* September 1965. The act of consumption is viewed as a productive activity in which the household produces several desired commodities by using its own time and purchased market goods as inputs. In this context the stock of human capital (or specifically the level of formal education) is viewed as an "environmental variable" which affects the productivity or efficiency of the production process without itself being a direct factor of production. Through its impact on the marginal products of the direct inputs, education can alter the relative prices of the various commodities and the real income of the household. The effect of education on the household's real income and relative prices is somewhat analogous to the effect of new technology on relative prices and real income in an economy, although in general it is shown that education might raise or lower marginal products and thus real income.

Imposing the assumption of factor- and commodity-neutrality, the direction and magnitude of education's effect on nonmarket or consumption efficiency can be deduced from its effect on consumer expenditure patterns. Under conditions specified by the model, and holding the household's level of permanent money income constant, it is shown that more educated consumers will shift their consumption expenditures toward (away from) goods with income elasticities greater than unity if education increases (decreases) nonmarket productivity. Thus, from knowledge of the partial elasticities of expenditures with respect to permanent money income and with respect to education, estimates of the impact of education on nonmarket productivity can be obtained. Clearly, any addition to real income which education contributes through nonmarket efficiency should be incorporated into a more complete estimate of the return on the investment in education.

The empirical investigation in this study involves estimating modified Engel curves for a dozen or so consumption categories — food, tobacco, clothing, medical care, etc. — where the expenditure on the item is the dependent variable, and the household's permanent money income, level of education of the head of the household, and a few other factors are the set of explanatory variables. The data used are the 1950 and 1960 BLS Consumer Expenditure Surveys. The households are grouped by several of the explanatory variables, and cell means are used for all variables.

To summarize the results from the 1960 BLS data: for two-thirds of the market goods and for 60 to 80 per cent of the total expenditures the findings are consistent with the hypothesis that the effect of education on nonmarket efficiency is a neutral and positive one. Including all categories of consumption, the correlation between the "income" elasticities and the "education" elasticities weighted (and unweighted) by expenditure shares is + .18 (or + .37); the implied elasticity of real income (through nonmarket efficiency) with respect to education is + .08 (or + .49). This elasticity suggests that a 1 per cent increase in education raises real income by about 1/10 of 1 per cent (or 1/2 of 1 per cent), aside from its effect on money earnings. Thus, this nonmarket effect appears to be approximately 10 per cent (or 60 per cent) of the magnitude of the market or earnings effect.

The results obtained from the 1950 data, as well as from an additional body of data, support the conclusion that education has a small, but consistently positive effect on real income. Additional study currently in progress will disaggregate the consumption categories into approximately sixty items from the 1960 BLS survey.

Although this study is exploratory and its conclusions tentative, the results imply that differences in human capital exert a systematic influence on consumer behavior, and that this influence can be analyzed and quantified. The investigation suggests the existence of a positive nonmarket effect of education on efficiency in consumption, which should be given consideration as part of the return on an investment in human capital.

Robert T. Michael

Economic Returns to Higher Education

The purpose of this study is to quantify the monetary returns from investment in higher education. Our focus differs from that of existing studies primarily in that we attempt to separate the effects of innate ability from those of education, and to distinguish income arising from the skills inculcated by education from income arising via discrimination by the firm in favor of the more educated.

To date our research has concentrated on the formulation of appropriate theoretical and statistical models, and on the location of data required to accomplish our research goal.

If people are paid their marginal products, and if there are no psychic or risk differences associated with occupations, it would be possible to determine the effects of education on income by studying a relation such as: $Y = aE + b(AB)$, where Y is pretax earned income, E is number of years of schooling (perhaps adjusted for the quality of schooling), and AB is innate ability as measured, for example, by IQ. (The equation is assumed to be standardized for other variables such as age and place of residence.)

In most samples, measures of ability are not available. If ability is omitted, the equation $Y = a'E$ can be estimated, where a' is a biased estimate of a. The expected value of a' can be shown to be equal to $a + bc$, where c is obtained from the regression $E = d + c(AB)$. In order to obtain an estimate of a for use with the 1960 Census and other samples that do not have measures of ability, we have developed the following method.

We have estimated c for various time periods. First, we used information from the World War I Army Alpha tests. Second, we have been able to locate at least a dozen studies in which students were tested at a given time, and then reinterviewed up to fifteen years later. On the basis of these data we have concluded that c has changed significantly over time. In the post-World War II era, c is much larger than in the 1920's.

This finding is of importance not only in terms of measuring the effect of various policies

designed to encourage more education for the more able, but also in terms of quantifying the effects of education on income. In contrast to past studies it implies that different ability adjustments are needed for different age classes (in the 1960 Census). This finding also enables us to obtain estimates of a. For any age group the estimate of a', the gross education coefficient, is equal to $a + bc$. If c is different for two age classes, there will then be two estimates of a'. But if c is known, we then have two equations for the two remaining unknowns, a and b. This approach is used in regressions currently being computed from the 1960 Census.

Census data can also be used to analyze information on ability by occupations. This method involves the use of occupation as the basic unit of observation, thereby combining Census data on education and income with First and Second World War data on IQ.

Finally, it is possible to study samples that contain all the relevant information. We have found a number of older surveys for which the original data on education, ability, and income are still available. We plan to reanalyze these data in a fashion consistent with our over-all model. We also plan to study two bodies of data — the Terman sample of gifted children and the Lewellen sample of top executives of leading corporations — that contain various individuals' income profiles for up to twenty years.

Besides separating out the influences of innate ability, we also will try to account for nonpecuniary income differences, and the undesirable (from society's viewpoint) use of education as a screening device. The most promising approach to both these problems is to compute income regressions for occupational classes and then measure the aggregate influence of education as a weighted average over these occupational classes.

Paul Taubman
Terence Wales

Some Aspects of the Supply of Human Capital

This research is concerned with postschool accumulations of human capital, i.e., accumulation undertaken while individuals are working. It is known that this type of capital constitutes a large portion of the total and it is important to examine it more closely. The point of departure is to emphasize the role of firms as suppliers of human capital. We consider that firms engage in *joint production,* that is, human capital output is a by-product of production of market goods. Firms produce physical output and sell it on product markets, but also produce human capital (at some cost) and often sell it to employees. The cost of production is the foregone output necessary to produce it. This type of human capital production takes the form of increased knowledge about production processes and learning by experience, as well as outright training services such as those received by apprentices.

There are two distinct aspects of the problem. First, some human capital has market value to firms other than the ones who produce it, and this capital can be sold to employees. "Sales" take the form of wage payments below opportunity costs as employees accumulate capital. Once optimum accumulation paths are determined, implications for age-investment profiles are immediate. It is also possible to infer depreciation and obsolescence to this type of capital from age-earnings profiles, and this will be done for various educational and other classifications. The analysis also has implications for production function estimation, observed cyclical variation in labor productivity, and wage subsidization of formal on-the-job training programs — which are currently being proposed to aid nonwhite workers.

Second, some investments are entirely specific to the firm and have no alternative uses. For example, specific capital output may take the form of additions to knowledge that shift the investing firm's production function without changing the production functions for other firms. The problem is to determine the firm's optimal accumulation of such capital. This analysis has implications for the phenomena of "progress functions" or learning from experience. It turns out that rational intertemporal allocation of resources "produces" what appears to be secular improvements in total factor productivity that would otherwise be attributable to technical change or increasing returns to scale. Other implications relate to the letting of special job contracts and quantity discounts, and to externalities that arise if this type of knowledge has spillover effects and full property rights in it cannot be established.

Sherwin Rosen

Law and Economics

Participation in Illegitimate Activities: An Economic Approach

While considerable public and private resources are spent in order to insure enforcement of existing laws, and while new laws are being contemplated, very little quantitative information is available about the deterrent effect of the various measures of combatting crime, or about the extent to which crimes of various kinds could be deterred. A study of these questions seems necessary to establish the effectiveness of legislation in general as well as to determine optimal social policy regarding regulations and law enforcement.

Following Gary Becker's work on crime, an attempt is made in this research to investigate the effectiveness of law enforcement and other related issues by setting up an economic model of participation in illegitimate activities and testing it against the empirical evidence. The study takes as its point of departure the view that those who violate specific laws do not differ fundamentally in basic motivation from those who abide by the same laws, though they do, of course, differ in the degree of their responses. It is proposed that illegitimate behavior is a result of choice under conditions of uncertainty, and that those pursuing illegal activities respond to the relative opportunities (costs and gains) available to them in legitimate and illegitimate endeavors. This framework is

used (a) to identify some measurable factors which determine individuals' decisions to participate in a criminal activity, and the extent of such participation at any given period; (b) to predict the effect of changes in these variables on the actual amount of crime in the community; (c) to measure via regression analysis the response of specific crimes and specific population groups to changes in variables reflecting deterrents and gains to offenders; and (d) to offer an "economic" approach for analyzing those who engage in illegitimate activities under various circumstances; in particular to discuss the effect of attitudes toward risk, income, age, and other "personal" characteristics on the incentive to commit offenses.

In spite of the diversity of activities defined as illegal, all such activities share some common properties which form the subject matter of our analytical and empirical investigations. For example, any violation of the law could be conceived of as yielding an increase in the offender's material wealth, the money equivalent of his psychic wealth, or both. On the other hand, conviction on a violation results in a reduction in the offender's wealth due to the penalty imposed on him by law enforcement agencies and to his acquired "criminal record." Since only apprehended and convicted offenders are subject to a loss of wealth, while other offenders are not, there is uncertainty concerning the final gain. A central hypothesis of this model is that individuals choose to commit a violation rather than engage in an alternative legitimate activity according to whether their expected utility from the violation exceeds that from the legal alternative.

The problem may be presented in a more general context, since the analytical question of interest in the case of most offenses is not only whether or not individuals choose to engage in "crime," but also "how much crime" they choose to commit in any given period. Put differently, what is their optimal allocation of time and other resources to competing legal and illegal ("safe" and "unsafe") activities during any period throughout their "working career." It is shown, under certain conditions, that offenders who are risk-averse have an incentive to combine legal and illegal activities, i.e., spend part of their "working time" in a legal activity as "self-insurance" or hedge against the risk involved in a full-time pursuit of a criminal activity. On the other hand, it is suggested that offenders who are risk-preferring tend to specialize in crime. A general analysis of this argument is included in my "The Economics of Insurance — A Suggested Approach" (unpublished draft, January 1969). This analysis also provides a framework for investigating the effects of the likelihood of apprehension and conviction, the size and form of punishment if convicted, the wealth level of the community, and the discounted value of future earnings, or property wealth, of the individual on his incentive to engage in crime. It is shown, for example, that an increase in the probability of apprehension and punishment, in the "fine," or in the return on the alternative legal activity would reduce the amount of offenses committed in any given period, while an increase in the illegal "payoff" would increase it. It is also shown that the magnitude of response to a 1 per cent change in the probability of punishment exceeds, is equal to, or falls short of the magnitude of response to a 1 per cent change in the "fine" according as offenders are risk-preferring, risk-neutral, or risk-averse, respectively. The analysis of optimal behavior under uncertainty is currently pursued to deal with other forms of "self-protection" (e.g., reducing the probability of apprehension and conviction) that some offenders undertake to reduce the risk involved in participating in illegal activities.

The empirical investigation employs a cross-state regression analysis on state averages of variables related to specific offenses and to specific racial groups in the U.S. in the years 1960, 1950, and 1940. Due to statistical exigencies, only the seven felonies reported by the F.B.I.'s Uniform Crime Reports are investigated. Other sources of data employed are the National Prisoner Statistics issued by the U.S. Department of Justice and the U.S. Census of Population.

The results of the empirical analysis, despite many shortcomings of the data, lend credibility

TABLE II-3
Total Felonies, Crimes Against Persons, and Crimes
Against Property in 1960 Regressed on Selected Variables[a]

Crime Rate of Offense Category (i)	Intercept	ln P_i	ln T_i	ln W	ln X	ln NW	Adjusted R^2 (41 d.f.)
1. All felonies	-4.1344	-0.4350	-0.5177	1.5642	1.0193	0.1859	0.58
t values	(-1.2878)	(-3.4781)	(-2.4418)	(3.6423)	(2.2845)	(4.2977)	
2. Crimes against persons	-0.2936	-0.5604	-0.4304	0.5088	0.5001	0.3835	0.83
t values	(-0.0657)	(-4.0387)	(-2.1161)	(0.8565)	(0.8419)	(4.9356)	
3. Crimes against property	-8.1958	-0.4009	-0.5566	2.0060	1.3751	0.1880	0.62
t values	(-2.8994)	(-4.0507)	(-3.0122)	(4.9538)	(3.1528)	(4.4469)	

[a]See text for description of variables

to the basic hypotheses of the model. The major consistent findings are that crime rates across states vary inversely with the probabilities of apprehension and of punishment by imprisonment [P], and the actual time served in state prisons by convicted offenders [T]. Crimes against property (robbery, burglary, larceny, and auto theft) are also found to vary positively with median family income [W], and with income inequality in the lower tail of the income distribution [X] (measured by the concentration of families below one half of the median family income). It is suggested that the relative variations in these latter two variables may approximate variations in the relative gains associated with crimes against property. In contrast, these two variables are found to have relatively lower, and generally insignificant, effects on the incidence of crimes against the person (murder, rape, and aggravated assault). In all specific offenses, crime rates are positively related to the per cent of nonwhites in the population [NW]. As an illustration, the accompanying table gives a few regression equations estimated from the 1960 data. These results are consistent with the results obtained by a regression analysis employing data from 1950. Also the results of the ordinary least-squares regression dealing with total felonies in 1960 are confirmed by the results of a two-stage least-squares regression analysis, which treats as

endogeneous variables the crime rate, the probability of apprehension and punishment, and per capita expenditure on police across states in 1960.

Further issues dealt with in the empirical investigation are the effects of age distribution, unemployment, education, urbanization, and other variables on specific offenses and on the "criminal behavior" of whites and nonwhites, and the interrelationship among specific crimes against property. It is hoped that a complete draft of the study will soon be available.

Isaac Ehrlich

Law Enforcement and the Courts

A widely held belief about our legal system is that persons arrested for crimes will have their cases decided in a court trial. In reality, the outcome of a case rarely depends on a trial, as most cases (between 80 and 90 per cent) are disposed of before trial through negotiations between the prosecutor and suspect, resulting in either a guilty plea or a decision not to charge the suspect. In this study, a formal model is first developed to explain the conditions under which a pretrial settlement (PTS) or trial will take place and the determinants of the sentence, given a PTS. The model is then

used to analyze the effects on the demand for trials (or conversely PTS's) of the bail system, court delay, and the imposition of a money payment for the use of the courts. Finally, a number of the model's hypotheses are tested against available data from two main sources: (1) a survey conducted for the American Bar Foundation on the disposition of felony cases in state courts in 1962 and (2) yearly data on criminal and civil cases in Federal courts contained in the *Annual Report of the Director of the Administrative Office of the U.S. Courts*.

Some preliminary empirical findings derived from the first source are the following:

1. One would expect on average a higher propensity for trials among suspects released on bail than among those who do not make bail. This results from court queues that impose greater costs on going to trial, relative to a PTS, for the latter than for the former group of suspects. Regressions for regions and counties of varying population sizes were estimated, with the fraction of cases disposed of by trial as the dependent variable and the fraction of suspects who make bail as one of the independent variables. The regression coefficients of the bail variable were generally positive and highly significant. Moreover, it can be shown that the latter coefficient is equal to the difference in propensity to go to trial between those who make and those who do not make bail. Note that, although no direct data on court queues are available, the fact that the bail variable has the predicted sign is indirect evidence of the existence of court queues.

2. The regression coefficients of the bail variable were systematically higher in counties with large populations than in those with small ones. Part of this may result from larger measurement errors in the bail variable as county size declines, but an additional interpretation predicted by our model is that the coefficient would rise as the queue rises. This finding is consistent with the belief that court congestion is most pronounced in the more urban highly populated areas.

3. Persons not making bail are relatively more concentrated in low-income groups than persons making bail. Since low-income suspects would generally use more time-intensive methods of reducing the probability of their conviction (e.g., locating witnesses), detention of these suspects would restrict their ability to substitute time for market goods, and in this way raise their probability of conviction compared to suspects out on bail. Preliminary findings based on regressions across counties indicate that both the likelihood of conviction and that of imprisonment are greater for persons who do not make bail.

Additional empirical work is planned using data from the federal courts on both criminal and civil cases. One feature of this data is the availability of direct measures of court delay. A summary of the theoretical model was published in the *Papers and Proceedings of the American Economic Association*, May 1969.

William M. Landes

5. BUSINESS CYCLES

Econometric Model of Business Cycles

This project has been undertaken in collaboration with Arthur F. Burns and Geoffrey H. Moore and has had the able assistance of Anloh-Lin. Since formulation of the model last year [1], we have obtained a set of estimates of the parameters of the structural equations by single-equation methods, using quarterly data

[1]Summarized in *Toward Improved Social and Economic Measurement*, 48th Annual Report, NBER, June 1968, p. 71.

on the postwar economy of the United States. The estimates are reasonable not only for the demand equations for goods and services but for the supply equations as well. We are in the process of applying simultaneous-equation methods of estimation.

Among the interesting results so far is an aggregate supply equation which, together with aggregate demand, can explain a large fraction of the variations in the general price level. The potential contribution of this project probably lies less, however, in the novelty of individual equations than in putting together a model based on, and capable of explaining, the observed regularities reported in Burns' summary article, "Business Cycles," in the *International Encyclopedia of the Social Sciences.*

A paper is being prepared for presentation in November this year at the Income and Wealth Conference on Econometric Models of Cyclical Behavior, organized jointly with the Social Science Research Council. An attempt is being made by Geoffrey Moore, Charlotte Boschan, and Victor Zarnowitz to provide simulation results for the purpose of cyclical analysis. They report below on this work and will also give a paper on it at the conference in November.

Gregory C. Chow

Business Cycle Turning Points

The purpose of this project is to establish business cycle chronologies for foreign countries of the type provided for the United States by the National Bureau.

An Occasional Paper on German business cycles over the period 1950 to 1967 has been approved by the Board of Directors and is now in press. The analysis of German indicators, adjusted for their long-run trends, and of the growth rates of these indicators establishes three and one-half clear-cut cycles in the German economy over the period studied. Relative to trends, there were downturns in April 1951, January 1956, January 1961 and December 1965, and upturns in January 1954, March 1959, February 1963, and June 1967. The aver-

age duration of the speedup periods was fifty-four months, that of the slowdowns fifty-nine months.[1]

In addition, we have investigated the occurrence of business cycles of the classical type in Germany over the same period. Two procedures have been used for this purpose. One consists in determining turns in the indicators unadjusted for trend and combining the resulting indicator cycles into a diffusion index. The second method is to standardize the indicator series and to combine them into a composite index.

Both methods reveal that there was not a single recession of the classical type in Germany during the period until 1966. The only recession found by these tests started in March or May of that year (depending on the method of measurement) and lasted until May 1967. As expected, the peak is later and the trough earlier than in the trend-adjusted chronology. The absence of recessions prior to 1966 confirms our view that the classical methods of measurement are not appropriate for judging developments in economies such as the German one of recent years.

The next step of the investigation is the application of the procedure developed in the German study to the United States economy. More than eight years have passed since the last classical business cycle turning point in the United States. Will the new procedures bring turns to light which the National Bureau's present method leaves submerged? If they do, should these procedures replace the classical ones, or should both be used side by side? These are some of the questions this study is designed to answer.

Following the analysis of U.S. business cycles, I plan to resume the dating of British and, thereafter, French cycles. Part of the the British data have already been processed.

Ilse Mintz

Determinants of Investment

Major investment of time and resources has been directed to the questionnaire responses of the McGraw-Hill Capital Expenditure Surveys and related data. These have been collected, checked, processed, committed to tape, and subjected to substantial analysis for the years through 1966. Addition of data for 1967 and 1968 is now under way. Continuing research has involved application of a "permanent income theory" to investment, suggesting that the acceleration principle is operative to the extent that firms consider past changes in demand, output, or sales as permanent rather than transitory. The McGraw-Hill microeconomic data substantiate the hypothesis that there is a larger permanent element in the variance in demand changes given by cross-sectional data than in the variance in demand changes given by time series.

Current work is directed toward investigating further differences to be found among industries and time periods. Evidence is accumulating that accelerator coefficients were lower in the 1961-66 period than in the years 1955-60. A great deal of computer analysis is currently under way involving a vast amount of data bearing on plant and equipment investment, inventory investment, actual and anticipated capital expenditures, and the roles of profits, sales, expectations, utilization of capacity, and many other factors.

Some further analysis is also proceeding with bodies of quarterly data appropriate for estimating the role of demand factors versus that of "relative price" factors and their possibly separate lag structures. Recent publications include: "A Permanent Income Theory for Investment: Some Empirical Explorations," *American Economic Review,* June 1967; (with M.I. Nadiri) "Investment Behavior and Neo-Classical Theory," *Review of Economics and Statistics,* August 1968; "Investment and the Frustrations of Econometricians," *American Economic Review,* May 1969; "Tax Policy and Investment Behavior: Comment," *American Economic Review,* June 1969. A paper on the capital expenditure realizations function is scheduled for delivery at the CIRET Conference in Madrid in September 1969. A comprehensive monograph on all these topics is also to be prepared.

Robert Eisner

Money

A monograph on "Monetary Statistics of the United States: Estimates, Sources, and Methods" was sent to press in May 1969 and will soon be in print. It is the first of three projected sequels to *A Monetary History of the United States.*

Part I of this volume contains an extensive discussion of the problem of defining the quantity of money, which should prove to be of general interest. Recent contributions to the literature on the subject are examined. Particular attention is given to a number of attempts to settle the proper definition of money by theoretical considerations. Prominent among these considerations are: (1) whether an asset is net wealth; (2) whether a payment is "neutral" in its effect on the asset and interest rate structure; (3) whether an asset possesses "liquidity." We reject these a priori approaches to the definition of money as unsatisfactory. We conclude that the definition of money is an issue to be decided not on grounds of principle, as in the a priori approaches, but on grounds of usefulness in organizing our knowledge of economic relationships.

The new volume provides a comprehensive survey of the construction of quantity of money estimates for the United States. As such, its main appeal will be to the monetary historian and the monetary statistician. The monetary historian will find (Part II) a comparison of alternative estimates of the quantity of money from the earliest years of the Republic to the Civil War and a critical review of the development of monetary statistics in the

period since 1867, when our own estimates begin. The monetary statistician will find (Part III) a detailed explanation of our methods of estimating the quantity of money, semiannually or annually from 1867 to 1907, and monthly thereafter until the 1940's, when we shift to Federal Reserve estimates.

In addition to the preparation of the monetary statistics volume for publication, we have begun to revise and extend our existing manuscript on trends in money, income, and prices. The main analytic use of our monetary statistics will be made in this volume on trends, which we hope to complete in 1969, and in a companion volume on cyclical movements that we shall turn to in 1970.

<div align="right">

Milton Friedman
Anna J. Schwartz

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Study of Short-Term Economic Forecasting

Three reports of the study were published in 1967-68: Moore and Shiskin's *Indicators of Business Expansions and Contractions*, Zarnowitz' *An Appraisal of Short-Term Economic Forecasts*, and Fels and Hinshaw's *Forecasting and Recognizing Business Cycle Turning Points*. A collection of essays edited by Jacob Mincer, *Economic Forecasts and Expectations*, is in press and books are expected in the Fall of this year.[1] Another completed manuscript is Cole's "Errors in Estimates of Gross National Product."

Financial support of this project has been provided by the Relm Foundation, several industrial companies, and general funds of the National Bureau. In addition, many individuals and institutions provided forecast data and helped to interpret them.

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[1] The essays include "The Evaluation of Economic Forecasts," by Jacob Mincer and Victor Zarnowitz; "Data Errors and Forecasting Accuracy," by Rosanne Cole; "Models of Adaptive Forecasting," by Jacob Mincer; "Expectations in the Term Structure of Interest Rates," by Stanley Diller; and "Anticipations of Purchases of Consumer Durables," by F. Thomas Juster.

In the section that follows, I discuss the new and continuing studies of general economic forecasts. Only brief references are made to work on related subjects, since a number of separate reports are presented below.

Forecasts of Aggregate Economic Activity

In his 1968 presidential address to the American Statistical Association, Geoffrey H. Moore compared the accuracy of several sources of general economic forecasts, drawing upon the results of the Bureau's studies (see his "Forecasting Short-Term Economic Change" in the March 1969 issue of the *Journal of the American Statistical Association*). Moore also has drafted a manuscript on "A Standard for Forecast Accuracy Based on Leading Indicators," in which a technique is developed for generating and evaluating short-term forecasts of cyclically coincident and lagging variables.

I have prepared a report on "The Quality and Significance of Price-Level Forecasts." It shows that recent forecasts of the Consumer Price Index were on the average more accurate than naive model predictions and also frequently, but not always, better than simple trend projections. Forecasts of the Wholesale Price Index were on the whole much worse: at times seriously biased and often inferior to extrapolations of recent values. Moderate price increases were expected most of the time, while the actual changes were apt to be either sizeable or minimal. Thus, when price changes were large (small), forecasters tended to understate (overstate) them, which implies rather stereotyped reactions. Nevertheless, predicted price changes definitely show a positive correlation with actual changes.

Where gross national product and price levels are predicted by the same source, the GNP forecasts can be decomposed into their implicit quantity and price components. The errors of the two components were negatively correlated in several of the forecast sets. Thus, the effects of price errors on GNP forecasts have not always been adverse. For example, most of the private economists in my sample

predicted GNP more accurately in current than in constant prices for the years 1953-64. The opposite result, however, is indicated by the error statistics for the recent (1962-67) forecasts by the President's Council of Economic Advisors.

A short version of this report was presented at the Annual Meeting of the American Statistical Association in August 1968 and published as "An Evaluation of Price-Level Forecasts" in the *Proceedings of the Business and Economic Statistics Section,* A.S.A., 1968. The full version will bring the forecasts up to date and include additional sections on econometric price-level predictions and the forecasting value of price diffusion indexes.

In another draft manuscript, "The Record of Turning Point Forecasts of GNP and Other Major Aggregates," which concentrates on the directional aspects of quantitative forecasts, it appears that the relative frequencies of turning-point errors are much lower for variables dominated by fairly stable growth tendencies than for variables subject to strong cyclical and irregular fluctuations. Among forecasts of the former (GNP, personal consumption) "missed turns" are much more numerous than "false signals"; among those of the latter (different types of private investment expenditures), both kinds of turning-point errors are relatively frequent. As might be anticipated, forecasters apparently make greater use of extrapolative techniques in predicting trend-dominated series than in predicting more volatile series. The record of directional forecasts also seems to be better for variables that lag at business recessions and revivals (e.g., outlays on plant and equipment, wholesale prices) than for those that lead or reach their turns earlier (e.g., inventory investment, consumer prices). Finally, the record for the postwar forecasts was better at troughs than at peaks. Business contractions and retardations have been relatively mild and brief in this period, and they were widely expected to be so. Quarterly and semiannual forecasts indicate that turning points, though often recognized fairly promptly, have seldom been correctly dated in advance.

An abbreviated version of this paper was presented to the Conference on Forecasting and Recognizing Turns in the Business Cycle, sponsored jointly by the National Bureau and the National Association of Business Economists and held in March 1968 at Long Island University.

At the request of the American Statistical Association, the National Bureau assisted in redesigning the periodic A.S.A. survey of aggregate economic forecasts and in evaluating results. The new A.S.A. business outlook questionnaire covers more variables and provides more information on the composition of the sample, the assumptions and methods of the forecasters, and the probabilities they attach to different expected outcomes. First used in the annual survey of July 1968, the questionnaire has since been revised to serve as a basis for a continuing quarterly survey of a fairly large and representative group of economists who regularly devote much of their professional effort to forecasting key economic indicators. As these data accumulate and can be compared with actual values, the forecast survey should contribute some answers to the many interesting scientific questions relating to forecasting accuracy and methodology: the evaluation of different techniques, the degree of consensus among forecasters, the structure and internal consistency of forecasts, and so on. I have summarized the first results of the new questionnaire in "The New ASA-NBER Survey of Forecasts by Economic Statisticians," *The American Statistician,* February 1969. This was reprinted as a supplement to National Bureau Report 4.

Some preliminary tests of short-term econometric forecasts have been carried out by Yoel Haitovsky, Michael K. Evans and George I. Treyz, as described below. They will present a progress report in November at the conference on Econometric Models of Cyclical Behavior.

Rosanne Cole has done some further work on the effects of data errors and structural errors on forecast accuracy; the structural errors are estimated by comparing the relationships among predicted values with those among the corresponding actual values. A paper on the

preliminary results of this study was presented at the 1968 Annual Meeting of the American Statistical Association, and a summary has been published in the *Proceedings*.

A suggested new subject for research which I have begun to explore is a comparative study of aggregative economic forecasts in several foreign countries. Materials for and interest in a research undertaking of this sort appear to exist in several countries, including England, Sweden, West Germany, and Canada.

<div align="right">Victor Zarnowitz</div>

Evaluation of Forecasting Performance of Short-Term Econometric Models of the U.S.

A comprehensive analysis of the unconditional *ex ante* and the conditional *ex post* prediction performance of the Wharton School-Michael Evans model is near completion. Detailed analyses are made of *ex ante* and *ex post* predictions for gross national product and its aggregate demand components, the price level, corporate profits (before taxes), disposable income, and unemployment.

The period to be analyzed, for which actual *ex ante* forecasts and the associated assumptions are available, covers 1964.1-1965.2 (the Evans model) and 1966.1-1968.4 (the Wharton School model). However, the materials for 1964.1-1964.3, 1966.1-1966.2, and 1968 are not yet completed.

In the *ex ante* forecasts, "guessed" exogenous and preliminary lagged endogenous values are used, while the *ex post* forecasts use actual values — known now but not at the time the forecasts were made. Two types of constant adjustments, designed to take account of a systematic bias in equation residuals, were used in the analysis of *ex ante* forecasts: (1) the constant adjustments actually used in the forecasts at the time the forecasts were made; (2) a mechanical (computerized) adjustment based on the average residuals for the two latest quarters available at the time the forecasts were made. *Ex post* forecasts were computed both without any constant adjustment and with the

mechanical adjustment only. In addition, *ex post* forecasts were computed using the actual values of all exogenous variables, with constant adjustments and lagged values left unchanged. This version is termed *ex post* forecasts with preliminary lags.

The GNP forecast errors using four of these procedures are shown graphically in Chart II-2 and the average absolute forecasting errors, as a measure of forecasting inaccuracy, are given in Table II-4.[1] In addition to these tests, two naive model techniques were applied to all variables under consideration; one is the "no change" model; the other is the "last-change" model.

In order to compare forecast-period prediction errors with sample-period errors, *ex post* "predictions," with and without constant adjustments, and naive model "predictions" were calculated for the post-Korean war span 1953.1-1964.4.

Finally, we experimented with forecasts based on an alternative two-stage estimation procedure. First, sample-period values of all endogenous variables were "predicted" using the Wharton School equations. Second, all parameters were re-estimated using the "predicted" endogenous variables. This procedure substantially reduced one-quarter-ahead forecasting errors.

The preliminary results suggest:
1. The actual *ex ante* forecasts are superior to the *ex post* forecasts with preliminary lags. The Wharton forecasts were better when they guessed the exogenous values than when the correct values were inserted. This surprising result has also been found by other analyses of econometric forecasts.

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[1]It should be noted that the definition of "realization" is different when preliminary data are used in forecasting than when revised data are used. In the former "realization" is defined as last period *preliminary* values plus *actual* change (Parts A,C,D of Chart II-2); in the latter it is the actual values (Part B of the Chart). This was done in order to keep all forecasts on a comparable basis and to facilitate comparisons.
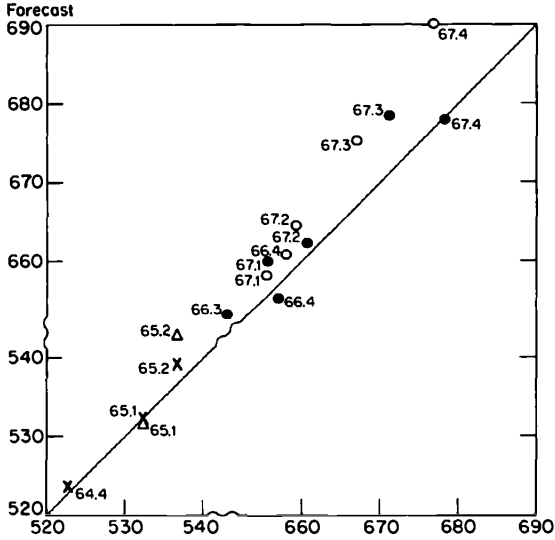
Chart II-2

U.S. Gross National Product, Forecast vs. Realization
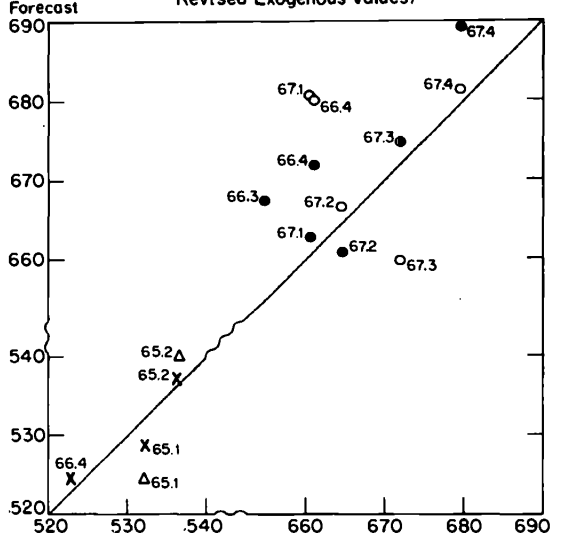### with Evans and Wharton School Models

Evans. Model (1954 dollars)
X 1 quarter ahead
△ 2 quarters ahead

Wharton School Model (1958 dollars)
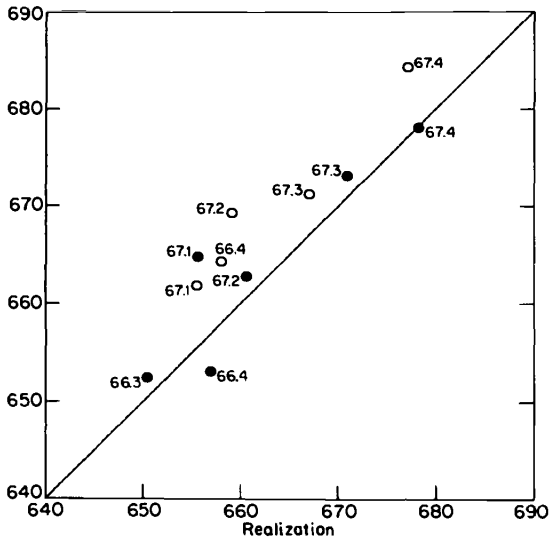● 1 quarter ahead
○ 2 quarters ahead

A. Ex Ante Actual Forecasts

B. Ex Post (Mechanical Constant Adjustment, Revised Exogenous Values)

C. Ex Post (Actual Adjustments, Preliminary Lags)

D. Ex Ante (Mechanical Constant Adjustment, Preliminary Exogenous Values)
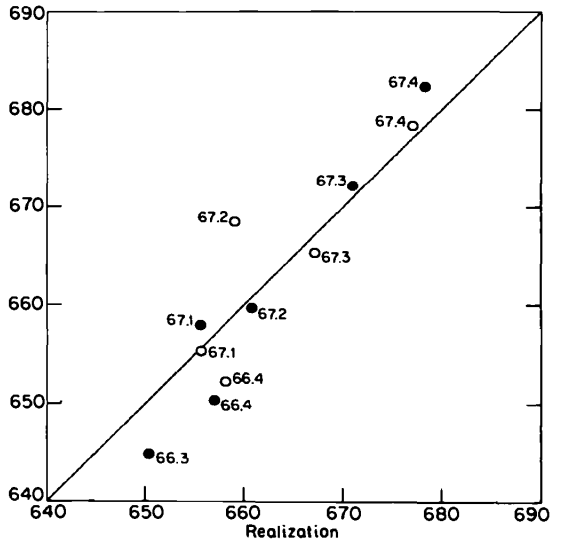

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TABLE II-4
U.S. Gross National Product, Average Absolute Errors of
Forecasts Made by Wharton School and Evans Models[a]

	Ex Ante Actual Forecasts	Ex Post Mechanical Constant Adjustment, Revised Exogenous Values	Ex Post Actual Adjustments, Preliminary Lags	Ex Ante Mechanical Constant Adjustment, Preliminary Exogeneous Values
	(A)	(B)	(C)	(D)
Wharton School Model (Billions of 1958 dollars)				
One quarter ahead	3.0	6.7	3.2	3.4
Two quarters ahead	6.5	13.7	6.9	3.7
Three quarters ahead	5.8	16.7	10.8	4.3
Four quarters ahead	5.5	17.4	13.1	5.3
Five quarters ahead	7.7	24.2	20.0	5.8
Evans Model (Billions of 1954 dollars)				
One quarter ahead	1.0	1.9	–	–
Two quarters ahead	3.3	5.7	–	–
Three quarters ahead	1.5	4.0	–	–

[a]See text for indication of limited number of observations available at present stage of the research, particulary for the longer forecasting spans.

2. The *ex ante* forecasts with mechanical constant adjustments are likewise better than the *ex post* forecasts with the same mechanical adjustments.

3. The actual *ex ante* forecasts and the *ex ante* forecasts with the mechanical constant adjustments give just about the same result. If anything, the mechanical *ex ante* forecasts are slightly superior. However, the difference in the average absolute error is only $1.0 billion, and it is not possible to draw any firm conclusions at this stage of the analysis when only half of the forecasts have been tabulated.

4. Mechanical constant adjustments of the type used in the Wharton School model tend to improve the forecasts for one and two quarters into the future but tend to worsen it thereafter. This may mean that one should use a "decaying" adjustment of the type suggested by Goldberger, or possibly that no adjustment at all is needed after two quarters.

5. *Ex ante* GNP forecasts with mechanical constant adjustments outperformed the actual *ex ante* forecasts when predictions went beyond one quarter ahead. Moreover, the former seem to have a smaller bias. Since mechanical constant adjustment is simpler, the superiority of subjective adjustments is questionable.

6. The *ex ante* forecasts seem to outperform the naive model forecasts, which in turn outperform the *ex post* forecasts.

7. Substitution of the correct values for nonpolicy exogenous variables made no significant difference in forecast accuracy compared with predictions that used the guessed values of these variables.

8. The algebraic sum of the mean square forecasting errors for component variables tends to be smaller than the mean square forecasting error of the aggregative variable. This finding suggests that the high degree of simultaneity of the model causes errors to reverberate throughout the model and, on balance,

to reinforce each other. This is contrary to the hope that simultaneity will cancel errors.

An analysis similar to the one just described is being performed on the Department of Commerce-OBE model. The Wharton School-EFU and the Department of Commerce-OBE are at present the only econometric forecasting models in the United States with reasonably long records of quarterly forecasts, with respect to which (1) the forecasts — and the assumptions associated with them — can be traced and reproduced and (2) the responsible parties have agreed to cooperate with the National Bureau in conducting the present study.

Michael K. Evans
Yoel Haitovsky
George I. Treyz

Business Cycle Analysis of Econometric Model Simulations

Plans have been drawn and some materials have been collected and analyzed for a new research project on "Business Cycle Analysis of Econometric Model Simulations." The results of the study are to be presented at the Conference on Econometric Models of Cyclical Behavior, sponsored by the Social Science Research Council and the Conference on Research in Income and Wealth, to be held in November 1969 at Harvard University. Model-builders' simulations of several major quarterly models of the U.S. economy will be analyzed with respect to how well they correspond to historical records of behavior. Timing relationships, amplitudes, conformity to business cycles, diffusion, and patterns of cyclical movements will be analyzed for about twenty-five selected variables. The simulations will include single-equation and complete model predictions during the sample period, *ex post* forecasts for a few years beyond the sample period, and long-run projections with assumed trends in the exogenous factors. Nonstochastic and stochastic simultions will be examined, with different selections of initial conditions and predictive

spans as well as alternative treatments of predetermined variables.

Victor Zarnowitz
Charlotte Boschan
Geoffrey H. Moore

Cyclical Timing of Consumer Credit, 1920-1967

The impact of consumer credit on the economy has long been a subject of concern to economists, partly because of the spectacular growth in all kinds of credit to consumers. From less than $5 billion before World War II, instalment credit outstanding today stands at just under $90 billion, and this growth typifies all parts of consumer indebtedness.

Although this study focuses primarily on a detailed examination of the behavior of instalment credit at business cycle peaks and troughs, we have also attempted to assess the quantitative impact of credit over the cycle. Table II-5 suggests that, despite the great growth in the stock of credit outstanding, there has been little change in the impact of credit flows on disposable income. The table relates the change in instalment credit outstanding during cycle phases to the level of disposable income at cycle turning points. Column 5 indicates that, despite the growth in credit outstanding, changes in this variable during business cycle expansions and contractions are no greater in recent years — relative to disposable income as peaks and troughs — than was the case before World War II. The direction of change in the ratio (column 6) indicates a fairly high degree of cyclical conformity. Thus the role of credit in economic instability appears to be essentially unchanged despite the great growth in instalment credit.

Examination of the cyclical behavior of consumer instalment credit (the greater part of total consumer credit) indicates a high degree of cyclical conformity since the 1920's. The automobile instalment credit component is generally more sensitive to changes in aggregate economic activity than the other components.

TABLE II-5

Relation between Disposable Personal Income and
Net Change in Instalment Credit
at Business Cycle Peaks and Troughs, 1929-61

Year (1)	Business Cycle Peak or Trough (2)	Disposable Personal Income (Mil. $) (3)	Net Change in Instalment Credit (Mil. $) (4)	Percentage Ratio, $\frac{(4)}{(3)} \times 100$ (5)	Change in Percentage Ratio (6)
1929	P	83,262	+467	+0.56	—
1932	T	48,695	-658	-1.35	-1.91
1937	P	71,197	+385	+0.54	+1.89
1938	T	65,484	-264	-0.40	-0.94
1944	P	146,341	+38	+0.03	+0.43
1946	T	160,021	+1,645	+1.03	+1.00
1948	P	189,138	+2,367	+1.25	+0.22
1949	T	188,585	+2,541	+1.35	+0.10
1953	P	252,564	+3,528	+1.40	+0.05
1954	T	257,445	+551	+0.21	-1.19
1957	P	308,524	+2,113	+0.68	+0.47
1958	T	318,826	-300	-0.09	-0.77
1960	P	350,044	+3,561	+1.02	+1.11
1961	T	364,424	+635	+0.17	-0.85

Source: Disposable Personal Income: *The National Income and Product Accounts of the U.S., 1929-65,* Statistical Tables, pp. 32-33; Net Change in Consumer Instalment Credit: BC #10,45.

TABLE II-6

Average Timing of Changes in Four Monthly Series on
Automobile Instalment Credit in Relation to the NBER Reference
Chronology, 1929-67[a]

(months)

	Peaks			Troughs		
	8/29 to 5/37 Prewar	11/48 to 5/60 Postwar	Entire Period	3/33 to 6/38 Prewar	40/45 to 2/61 Postwar	Entire Period
Net change in total outstanding	- 9.0 (2)	- 13.0 (4)	- 11.7 (6)	- 18.0 (2)	- 3.2 (4)	- 8.2 (6)
Extensions	- 2.5 (2)	- 3.7 (3)	- 3.2 (5)	- 1.5 (2)	- 2.8 (2)	- 2.3 (6)
Total outstanding[b]	+4.5 (2)	+ 5.5 (3)	+ 5.1 (5)	+ 3.0 (2)	+4.2 (3)	+3.7 (5)
Repayments	+5.5 (2)	+ 5.0 (1)	+ 5.3 (3)	+ 3.5 (2)	+9.0 (1)	+5.3 (3)

[a]Average number of months by which changes in the series specified precede (-) or follow (+) peaks and troughs. Numbers in parentheses show the number of reference cycle comparisons included in each average. Prewar averages, for all series, cover the same reference cycle turns and, therefore, are comparable. Postwar averages do not refer to the same reference turns and are not comparable.

[b]End of month.

Table II-6 shows the timing at peaks and troughs of four measures of automobile instalment credit. Net change in automobile credit outstanding turns first, and with a long lead at both peaks and troughs. Extensions in credit turn next, and at about the same time as business cycle peaks and troughs generally. Repayments and outstandings turn last, and lag business cycle peaks and troughs by three to five months.

Another part of the analysis relates changes in automobile credit to changes in new passenger car registrations. In general, changes in credit outstanding precede changes in registrations. Personal income turns after both series at cyclical peaks, but has the same timing as passenger car registrations at troughs. Thus the impact of credit on the automobile industry is more ambiguous at troughs than at peaks. Some of this evidence is consistent with the hypothesis that credit changes play a role in precipitating declines in automobile sales, and ultimately in aggregate output, at cyclical peaks. The independent role of credit is less clear at troughs.

The study has been revised and is now being edited. It will shortly be ready for distribution to the Board of Directors.

Philip A. Klein

6. FINANCIAL INSTITUTIONS AND PROCESSES

Interest Rates

This study, undertaken with the aid of grants from the Life Insurance Association of America, is concerned with the behavior, determinants, and effects of interest rates. All the shorter studies are to be published in a two-volume collection, *Essays on Interest Rates.* Volume I, now in press, has the following papers:

Jack Guttentag
Introduction and Summary
Phillip Cagan
The Influence of Interest Rates on the Duration of Business Cycles
Jack Guttentag
The Behavior of Residential Mortgage Yields Since 1951
Royal Shipp
The Structure of the Mortgage Market for Income Property
Phillip Cagan
A Study of Liquidity Premiums on Federal and Municipal Government Securities

Joseph Conrad and Mark Frankena
The Yield Spread Between New and Seasoned Corporate Bonds, 1952-67
Phillip Cagan
Interest Rates and Bank Reserves — A Reinterpretation of the Statistical Association

Volume II, which is being edited, contains the following papers:

Jack Guttentag
Introduction
Phillip Cagan
Changes in the Cyclical Behavior of Interest Rates (reprint of Parts I and II of O.P. 100)
Stanley Diller
The Seasonal Variation of Interest Rates (now in press as an Occasional Paper)
Mark Frankena
The Influence of Call Provisions and Coupon Rate on the Yields of Corporate Bonds
E. Bruce Fredrikson
The Georgraphic Structure of Residential Mortgage Yields

Avery Cohan
   The Ex-Ante Quality of Direct Place-
   ments, 1951-61
Reuben Kessel
   The Term Structure of Interest Rates
   (reprint of Chapters 1 and 4 of O.P. 91)
Thomas Sargent
   Expectations at the Short End of the
   Yield Curve: An Application of Macau-
   lay's Test

In addition, two other book-length studies
will soon be ready for publication. They are
Residential Mortgage Yields Since 1951 by Jack
Guttentag and Morris Beck, now under Board
review, and *A Theory of Monetary Effects on
Interest Rates* by Philip Cagan, under revision.
A final study still under way is *Nonresidential
Mortgage Yields Since 1951* by Shipp and
Robert Fisher.

The study has benefited from the advice and
assistance of an advisory committee whose
members are W. Braddock Hickman (chairman),
Federal Reserve Bank of Cleveland; Julian D.
Anthony, Hartford Life Insurance Company;
Daniel H. Brill, Board of Governors of the
Federal Reserve System; Lester V. Chandler,
Princeton University; George T. Conklin, Jr.,
The Guardian Life Insurance Company of
America; Milton Friedman, University of
Chicago; Raymond W. Goldsmith, Yale Univer-
sity; Sidney Homer, Salomon Brothers &
Hutzler; Norris Johnson, formerly of First
National City Bank of New York; Robert G.
Link, Federal Reserve Bank of New York;
Roger F. Murray, Teachers Insurance and
Annuity Association; James J. O'Leary, United
States Trust Company of New York; Roy L.
Reierson, Bankers Trust Company; Eli Shapiro,
Harvard University; Henry C. Wallich, Yale
University; Kenneth M. Wright, Life Insurance
Association of America; and C. Richard
Youngdahl, Aubrey G. Lanston and Company.

A detailed report by Thomas J. Sargent,
who is continuing his work in this area, follows.

Jack M. Guttentag

Interest Rates: Term Structure, and Price Expectations

Macaulay[1] was one of the only economists to
attempt to test the expectations theory of the
term structure by investigating the accuracy of
the forecasts which, by hypothesis, are im-
pounded in the yield curve at any moment.
Macaulay's approach was to decompose time
series of time rates and shorter-maturity call
rates by frequency. He reasoned that accurate
forecasting is to be expected at frequencies
where oscillations occurred with a high degreee
of regularity. For example, the data for the
period 1890-1913 which Macaulay examined
exhibited a pronounced seasonal component.
Macaulay argued that this should have been
incorporated into investors' expectations and
that this would cause time rates to lead call
rates, at least at the seasonal component. This
was because, on the expectations hypothesis,
time rates have forecasts of subsequent call
rates impounded within them. Since these fore-
casts should be accurate, time rates should lead
call rates. Macaulay found that, in fact, time
rates did lead call rates at the seasonal.

This study attempts to illustrate how cross-
spectral techniques might be used to carry out
tests like Macaulay's. Cross-spectral analysis
permits us to decompose time series by fre-
quency and to study the relationship between
time series at particular frequencies. In this case
the technique has the advantage that it permits
a precise statement of Macaulay's hypothesis.
In addition, by using the phase statistic,
Macaulay's test can be carried out fairly simply.

After illustrating these tools by using the
same data used by Macaulay, we applied them
to data on U.S. Treasury bill rates in the
1950's, a period characterized by a seasonal. A
paper which summarizes the results is available.

In a related project, the connection between
commodity price appreciation and interest rates

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[1]F. Macaulay, *Some Theoretical Problems Sug-
gested by the Movements of Interest Rates, Bond
Yields, and Stock Prices in the United States Since
1856,* New York, NBER, 1938.

is being studied. Irving Fisher[2] argued that an increase in the anticipated rate of inflation would drive nominal interest rates upward by the full amount of the increase. Fisher used this proposition, together with his hypothesis that anticipated rates of inflation are a distributed lag of actual rates of inflation, to provide an explanation of the Gibson paradox. Keynes, on the other hand, denied that nominal rates would rise to offset the entire increase in anticipated inflation.[3] He maintained that increases in anticipated inflation would stimulate output and employment and, in Fisher's language, drive down the real rate of interest.

The differences between the views of Fisher and Keynes on this matter are of concern, in addition to other reasons, because of their implications for broader questions of macroeconomics. For example, in the context of an underemployment model of the kind Keynes was discussing, Keynes's proposition about anticipated inflation and interest rates will be true, if and only if it is also true that fiscal policy is all-important. On the other hand, Fisher's proposition is valid only under conditions in which monetary policy is all-important. Thus, studies of Fisher's proposition involve some of the key issues of macroeconomics.

In this study, an econometric model incorporating a role for the Fisher effect is being estimated from data for several countries. In addition to the distributed lag inflation variable included by Fisher, several other variables, most notably the change in the real money supply, are assumed to affect nominal interest rates. The distributed lag variable itself is allowed to assume a more flexible form than it was in Fisher's study, since we have used rational and Almon lag functions which do not require that the distributed lag weights diminish monotonically with increasing lags. In addition, we are attempting to formulate and test a richer dis-

tributed lag formulation which permits variable lags.

A report on some work along these lines appeared in the February 1969 issue of the *Quarterly Journal of Economics.*

Thomas J. Sargent

The Quality of Credit in Booms and Depressions

Several studies in this program have already been published,[1] and several others are at various stages of completion. The study "Home Mortgage Delinquency and Foreclosure" that John Herzog and I are making has been extended in time at the suggestion of some of the Directors. The original manuscript extended only through 1963, the year from which our sample data on loan status came. In the revision, later nationwide data on characteristics and performance of residential mortgages were incorporated. Using the original regression coefficients found for these characteristics, we computed extended indexes of delinquency and foreclosure risks for the years 1964-67. Since the trend towards longer maturities and higher loan-to-value ratios that prevailed throughout most of the postwar years was arrested beginning about 1964, some of the study's indexes of mortgage risks ceased to rise over these more recent years. At the same time, continuance of high levels of economic activity, accompanied by generally rising values of residential properties, arrested and even reversed the weakening of actual mortgage performance that had characterized the later 1950's and the early 1960's. In general, the more recent experience tends to confirm the hypothesis that mortgage risk and

[2]Irving Fisher, *The Theory of Interest,* New York, 1930, pp. 399-451.

[3]J. M. Keynes, *The General Theory of Employment, Interest and Money,* London, 1936, pp. 141-144.

[1]Albert M. Wojnilower, *The Quality of Bank Loans: A Study of Bank Examination Records,* 1962; Martin H. Seiden, *The Quality of Trade Credit,* 1964; Thomas Atkinson, *Trends in Corporate Bond Quality,* 1967; Geoffrey H. Moore and Philip A. Klein, *The Quality of Consumer Instalment Credit,* 1967; George K. Brinegar and Lyle P. Fettig, *Some Measures of the Quality of Agricultural Credit,* 1968.

performance are very sensitive to economic activity, probably more sensitive than to mortgage terms.

George Hempel's manuscript on "The Postwar Quality of State and Local Debt" has been reviewed by a staff reading committee, and the author is now completing revisions preparatory to submission to the Board of Directors.

Over the past year Edgar Fiedler, assisted by Maude Pech, has virtually completed revision of the study, *Measures of Credit Risk and Experience,* an annotated compendium of time series statistics relating to credit quality and performance. A report on this work follows. I hope soon to complete revision of my synthesis of the National Bureau's numerous studies related to credit quality. This will be under the title, "The Quality of Postwar Credit: A Summary Volume."

Financial support for the quality of credit studies has come over the years from a large number of sources. Support for those still in progress has come especially from the Federal Reserve Board, the Bankers Trust Company of New York, the U.S. Savings and Loan League, the Mortgage Bankers Association, and the National Association of Mutual Savings Banks. General funds of the National Bureau are now supporting completion of these studies.

James S. Earley

Measures of Credit Risk and Experience

A volume presenting the results of this investigation is entering the final stages of preparation. The text and source notes are being edited prior to submission to the Directors. Historical data for the 188 series to be included in the book are being prepared for publication, and charts of these series are being designed.

A new feature of the revised manuscript is a "short list" of thirty-four key series, designed for business and financial analysts who want to maintain surveillance of the quality of the nation's credit. These series do not provide a broad and conclusive body of information on credit risk and experience — indeed, even the

599 series in the comprehensive list fall short of that — but they do comprise a representative cross section of the data available on a current and continuing basis.

The Board of Governors of the Federal Reserve System and the Bankers Trust Company have contributed substantially to the support of this study.

Edgar R. Fiedler

Performance of Banking Markets

The two parts of this project are designed to clarify the relation between structure and performance of banking markets. The studies are supported by a grant from the American Bankers Association, and both have greatly benefited from the Association's aid in gathering necessary data from a large number of cooperating banks.

Performance of Banking Markets in the Provision of Services to Business

The purpose of this study is to determine whether the prices paid by businesses for bank services are related to the structure of banking markets. A model of bank pricing of business services is developed. The relationship between market structure and prices is estimated from the pricing model with the addition of variables which describe market structure. The size and sign of the structure variables are then analyzed.

The pricing model implies that, because of regulatory constraints and long-run profit-maximizing criteria, banks attempt to earn a profit on the whole package of services supplied to a customer rather than by pricing services independently. Observed prices of individual services to a customer are therefore influenced by the components of the package of services purchased. Thus, interest rates on loans, which have been used in all previous attempts at empirical estimation of the relationship between prices and bank market structure, are not

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adequate for this purpose. Data which describe all sides of the bank-customer relationship are required.

To compile data on customers, a questionnaire was constructed and sent to a sample of banks. The sample was chosen from the population of banks with assets between $40 million and $400 million. Responses were received from 160 banks in 111 Standard Metropolitan Statistical Areas. The responses provided data on approximately 8,500 bank customers.

The customer profiles help us test the major hypothesis of the pricing model: that prices of individual bank services provided to business customers are influenced by the components and prices of the package of services purchased. These tests lend strong support to the use of the package-pricing concept to describe bank pricing practices. The tests also suggest that compensating balance provisions and the profitability of other services provided to customers may be a better indicator of bank credit rationing during changing monetary conditions than are movements in loan rates.

The completed report will consist of three major sections. The first section presents the bank pricing model and explores the implications of the model on some controversial issues in bank pricing practices. The second section contains the results of statistical tests of the implications of the pricing model and the parameter estimates of the price-market structure relationship. The third section contains an analysis of the expected impact of increased computerization of banking operations on the parameters of the price-market structure relationship. The manuscript has been submitted for review by a staff reading committee.

Donald P. Jacobs

Banking Structure and Performance in Consumer Credit Markets

This study has been designed to compare the performance of commercial banks in their consumer credit activities under different types of branch banking laws. Information on lending policies and finance charges was obtained from a sample of commercial banks in 86 Standard Metropolitan Statistical Areas and 287 other markets in 24 states. The processing and tabulation of the sample data have been completed, and an extensive array of statistical tests have been conducted in a search for significant relationships between performance measures and relevant economic and market variables. A number of additional tests remain to be made, but it is anticipated that a revised version of the preliminary manuscript will be available by the end of the year.

Evidence from the results to date suggest that laws permitting branch banking are, in general, conducive to a wider range of service, to more liberal lending policies, and to more convenient facilities than laws prohibiting branching. The evidence on finance charges on consumer loans is not conclusive, and further tests are being made. States that permit local branching only reported the lowest charges; unit banking states reported the next lowest; and statewide branching states the highest. An over-all index of performance that combines the measures of price and services is being developed but has not been tested.

Paul F. Smith

Consumer Credit

The objective of this study is to assess the role of consumer credit in the United States economy. Three books and five Occasional Papers have been published since 1962, as well as a special progress report in the June 1965 Annual Report of the National Bureau.

Richard Selden has substantially completed his study of the behavior of finance companies; he gives a detailed report below. Further investigation of the rate structure in automobile financing from national samples of new and used automobile instalment credit contracts, which I conducted during the past year, did not yield additional insights into the rationale for observed variation in automobile finance rates. My previous findings from this work were that

elements of the credit contract, legal restraints, and institutional differences among credit sources are the main factors affecting automobile finance rates. These results will be incorporated into a summary report on the consumer credit project as a whole, which will relate the findings of the study to the current use and role of consumer credit in the economy.

Robert P. Shay

Financial Intermediaries and the Effectiveness of Monetary Policy: The Case of Finance Companies

Consumer instalment credit has excited the interest of students of business cycles and stabilization policies at least since the 1920's. More recently the attention of economists has been drawn, by Goldsmith and by Gurley and Shaw, among others, to a topic that partially overlaps the older "instalment credit and business cycles" issue — the implications of the development of nonbank financial intermediaries for the effectiveness of monetary policy. The focus of the study described in this report can be found at the intersection of these two problem areas. It examines the implications — for both the theory of business fluctuations and the effectiveness of general monetary policy as practiced in the United States — of a particular type of nonbank intermediary that specializes in the instalment credit field. The intermediary selected for analysis is the finance company, including both the sales finance and consumer finance varieties.

Since these topics have already been studied fairly intensively, perhaps a word is needed to explain the present undertaking. First, substantial time has elapsed since most of the earlier studies of instalment credit and business cycles were made. This obviously is true of the National Bureau's pioneering nine-volume effort in the late 1930's and early 1940's, which culminated in Haberler's still valuable summary of the issues.[1] The massive Federal Reserve

study, published in 1957, antedated the recessions of 1957-58 and 1960-61.[2] The present study carries the analysis through 1961. Second, much of the earlier work was built on an inadequate data base or, it seems to me, was not directed toward the relevant issues. The present study enjoys real advantages, in terms of data, over earlier investigations, mainly because of the availability of monthly and quarterly time series for the period 1952-61 on finance company debt, lines of credit, and a few other variables. A very large proportion of the effort expended on this study has gone into the tedious process of obtaining raw data from a number of finance companies and putting them into usable form. Finally, with relatively few exceptions the work previously done on the financial intermediary problem has been very general in nature. No one, as far as I am aware, has made a detailed study of finance companies within the context of the specific issues raised by Gurley and Shaw. While it is true that finance companies make up a relatively minor part of our financial system, the present study is based on the premise that conclusions of broad applicability can be derived from analysis of their behavior.

All of the underlying statistical work for the study has been completed. In addition to the construction of monthly and quarterly time series from data furnished by individual finance companies, this has involved seasonal adjustment and other transformations of instalment credit figures published regularly by the Federal Reserve Board, and the preparation of a large number of working charts. Drafts have been prepared of the first four of seven planned chapters, and a fifth is nearing completion. I expect to finish drafts of the other two and to revise the earlier drafts by September 1969.

Although much work remains to be done, it may nevertheless be appropriate to indicate a few tentative conclusions that have emerged from this study. Perhaps the most interesting finding has been the striking similarity among sales finance companies, consumer finance

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[1] Gottfried Haberler, *Consumer Instalment Credit and Economic Fluctuations*, New York, NBER, 1942.

[2] *Consumer Instalment Credit*, six volumes, Board of Governors of the Federal Reserve System, 1957.

companies, banks, and credit unions in the cyclical behavior of their instalment credit operations. For a given type of instalment credit (e.g., auto paper) it turned out that all lenders had broadly similar cyclical timing and amplitudes in monthly growth rates. This suggests that general monetary policies impinging on the supply of funds to particular types of lenders have exerted little or no differential effects upon institutions extending instalment credit.

Another interesting set of findings relates to differences in behavior between large and small finance companies. The sales finance industry in particular is characterized by high concentration. It has sometimes been suggested that the leading firms in the industry are less influenced by changes in monetary policy than the smaller firms are. The data assembled in this study do not support this view. Our somewhat fragmentary information suggests that small firms have been able to obtain additional credit lines from banks during periods of monetary restraint at least as easily as the largest firms in the industry. In terms of the behavior of total debt, small firms peaked several months ahead of large firms in 1953; however, during the

following two business cycles, small firms kept up with (or even exceeded) their large competitors in ability to borrow additional funds.

A final finding that can be noted here relates to the demand for money by finance companies. Both sales finance and consumer finance companies are substantial holders of cash. Evidence assembled in this study indicates clearly, however, that these cash holdings do not behave in a cyclically destabilizing manner. There is a very close relation between finance company cash holdings and the volume of their bank lines and bank loans. This reflects the fact that most of these holdings consist of compensating balances maintained at line-granting banks. During the period of this study, large sales finance companies were subject to balance requirements equal to 10 per cent of lines plus 10 per cent of loans. Obviously, during periods of rising demand for instalment credit, when finance companies were increasing their borrowings from banks, cash holdings of finance companies would be expected to rise rather than fall, and we have found this to be the case.

Richard T. Selden

7. STUDIES IN INDUSTRIAL ORGANIZATION

The Service Industries

The past year marked the publication of a summary volume, *The Service Economy*, which received considerable coverage in the general and financial press. A conference volume, *Production and Productivity in the Service Industries*, (ed. Victor R. Fuchs) also appeared. Reuben Gronau's manuscript "The Value of Time in Passenger Transportation: The Demand for Air Transport" has been sent to press, and David Schwartzman's manuscript "Retail Trade in the United States 1929-1963; An Analysis of the Growth of Sales Per Worker" is being revised. The publication of these volumes will

mark the end of the project that was begun in 1963 with the financial assistance of the Ford Foundation.

Victor R. Fuchs

Economics of Health

The NBER's program of research in the economics of health has been supported by grants from the Commonwealth Fund and the National Center for Health Services Research and Development. The objectives of the research program are to gain a better understanding of the factors affecting the demand for

health and for medical care, the productivity of medical care and the socioeconomic determinants of health.

The program benefits from the advice of an advisory committee chaired by Dr. George James, Dean of the Mt. Sinai School of Medicine, and including the following members: Gary S. Becker, Columbia University and NBER; James Brindle, Health Insurance Plan of Greater New York; Norton Brown, M.D.; Eveline Burns, New York University Graduate School of Social Work; Philip E. Enterline, University of Pittsburgh; Marion B. Folsom; Eli Ginzberg, Columbia University; William Gorham, Urban Institute; David Lyall, M.D.; Melvin Reder, Stanford University; Peter Rogatz, M.D., State University of New York; Gus Tyler, I.L.G.W.U.

Since the last Annual Report, I have published the following papers:

"The Growing Demand for Medical Care," *New England Journal of Medicine,* July 25, 1968; "What Kind of System for Health Care?," *Bulletin of the New York Academy of Medicine,* March 1969; "Improving the Delivery of Health Services," *Journal of Bone & Joint Surgery,* March 1969.

"The Production of Health, An Exploratory Study," by Richard Auster, Irving Leveson, and Deborah Sarachek, has been accepted for publication by the *Journal of Human Resources.* Other publications, past and prospective, are reported on below by the directors of individual studies.

Victor R. Fuchs

The Demand for Health: A Theoretical and Empirical Analysis

Most students of medical economics have long realized that what consumers demand when they purchase medical services are not these services per se but rather good health. Existing models of the demand for medical care often proceed, however, on the general assumption that this topic can be studied independently of the demand for good health. The aim of this project is to correct this imbalance by constructing a model of the demand for health itself. Since "health capital" comprises one component of the stock of human capital, the study takes as its point of departure the view that consumers inherit an initial stock of health which depreciates over time and can be increased by gross investment. Death may be said to occur when the stock falls below a certain level, and one of the novel features of the model is that it can show under what conditions an individual would choose to live a finite life. Following ideas developed by Gary Becker, gross investments in human capital, as well as commodities that enter consumers' utility functions, are said to be produced by household production functions whose direct inputs include market goods and the time of the consumer. Thus, gross investments in the stock of health are produced by medical care, own time, diet, exercise, recreation, and other factors. Household production functions also depend on certain "environmental variables" that influence the efficiency of the production process.

In this model, health is demanded by consumers for two reasons. As a consumption commodity it directly enters their preference functions, or, put differently, sick days are a source of disutility. As an investment commodity it determines the total amount of time available for market and nonmarket activities. In other words, an increase in the stock of health reduces the time lost from these activities, and the monetary value of this reduction is an index of the return to an investment in health. The demand for health is a function of wealth, its relative "shadow price," and the monetary internal rate of return to an investment in health. Forces that influence these variables alter the demand for health and also the derived demand for gross investment, measured, say, by medical expenditures.

As illustrations of two important theoretical issues that can be analyzed within the context of the above framework, consider the following questions. First, how would the desired lifetime patterns of health and gross investment be influenced if the rate of depreciation on the

stock of health were an increasing function of age, at least after some point in the life cycle? If health were mainly a consumption commodity, a rise in the rate of depreciation with age could be shown to increase the price of health in the future relative to its price in the present. Therefore, the stock of health would fall over the life cycle but, at the same time, the demand for gross investment would rise unless the elasticity of substitution between present and future health was greater than unity.

Second, if education were an environmental variable that improved the efficiency of household production, what would be its role in the demand curve for health and in the derived demand curve for medical care? If upward shifts in education raised productivity by increasing the marginal products of the direct inputs in household production functions, such shifts would reduce the absolute prices of health and the other commodities produced by the household. Holding the appropriate money wealth constraint fixed, a higher level of education would expand the opportunity space of the household and might also alter the terms of trade between commodities, if productivity were augmented more in some activities than in others. Consequently, the model predicts a positive education effect in the demand curve for health which is directly related to the wealth elasticity of demand for health and, assuming the relative price of health falls, to the price elasticity. On the other hand, an increase in education would tend to reduce the demand for gross investment unless both the wealth and price elasticities of health exceeded unity.

The empirical portion of the study employs multiple regression analysis to estimate demand curves for health and derived demand curves for medical care. Theoretical considerations suggest that both the number of healthy days enjoyed by an individual in a given year and his total length of life can be used as alternative indexes of health. Two variants of healthy days are available from the 1963 health interview survey conducted by the National Opinion Research Center for the Center for Health Administration Studies of the University of Chicago. These are 365 days minus restricted activity days and 260 days minus work-loss days for members of the labor force. The total sample size is 7,803. Length of life has been approximated by a survival probability index (one minus the death rate) for states of the United States.

Two of the more interesting empirical results are: First, whether health is measured by length of life or by healthy days, education has a positive and significant regression coefficient in the health demand curve. Moreover, the magnitude of the effect of education on these two measures is approximately the same. Second, an increase in age simultaneously reduces health and increases medical expenditures. Calculations suggest that the continuously compounded rate of growth of the depreciation rate is 2.0 per cent per year over the life cycle and that the elasticity of substitution between present and future health is small but positive.

It is hoped that a complete draft of a manuscript will be available in a few months.

Michael Grossman

Spatial Variations In Health

A paper entitled "An Economic Analysis of Variations in Medical Expenses and Work Loss Rates" was presented at the Second Conference on the Economics of Health in December and will be published in the Proceedings of the Conference. Utilizing unpublished data on medical expenses and work-loss days due to illness or injury of currently employed persons, the analysis yielded the following principal findings: (1) the income elasticity of demand for medical care as a whole (using expected values) is 1.2, while the elasticities for its components range from .85 for doctor expense to 3.2 for dentist expense; (2) the elasticity of total expenses with respect to the earnings rate is 2.1; (3) work-loss days are usually positively related to family income and inversely related to the earnings rate. This last result suggests the tentative conclusion that differences in unadjusted work-loss days may be an unreliable measure of variations in health status.

Work has progressed on my "Econometric Analysis of Spatial Variations in Mortality by Race and Sex." The primary objectives of this study are: (1) to isolate the factors responsible for the well-known discrepancy in the health status of U.S. whites and Negroes; (2) to gauge how strongly differences in economic factors affect the level of health and the way it is produced; and (3) to study the health implications of factors such as climate, air pollution, and the occupational structure and psychological pressures associated with modern economic life. To these ends the mortality rate is now being regressed for states and Standard Metropolitan Statistical Area's on a number of independent variables, including income, the earnings rate, marital status, nativity, urbanization, occupation, labor force participation of married women, the death rate from ulcers (as a measure of psychological pressures), and measures of climate and air pollution. It will take some time to interpret all the findings, but I hope to have a first draft shortly.

Morris Silver

Socioeconomic Determinants of Hospital Use

This study is now entering its final stage. All important analyses have been completed, and most of the text is in first draft. The objective of the study is to examine how extramedical conditions of a hospitalized patient and institutional characteristics of the hospital where he is treated affect the amount and type of services the patient receives. The population studied consists of 9,000 patients discharged from twenty-two short-term general hospitals in the Pittsburgh area during 1963. This is a one-in-nine random sample.

Some of the main findings are as follows:

1. There are significant differences in hospital use, adjusted for diagnoses, depending upon who pays the major portion of the hospital bill. These differences become crystallized when the patient is treated at hospitals where the occupancy rate is high and an outpatient clinic is available. When ranked from the great-

est amount of use of hospital care to the least, the four major categories of patients by source of payment can be listed as follows: government, free services, insurance, and the patients themselves.

2. Patients from high-income families seek and enter hospitals with high-staffing ratios and receive a service-intensive type of care as opposed to a time-consuming type. This appears to be attributable to the fact that, the higher the income, the greater the opportunity cost of time spent in the hospital. Also, service-intensive types of care are often regarded as quality care.

3. There is additional evidence that the cost of time is a choice-conditioning factor in the consumption of hospital services. When a patient is currently employed and lives with a relative, he has an inducement to shorten the length of stay in the hospital by receiving a service-intensive type of care and by substituting at-home for inpatient care.

4. Substitution between inpatient care and at-home (or outpatient) care depends on the relative scarcity of empty beds and the relative ease of access to outpatient care.

5. Patients with hospital insurance coverage of one kind or another enter hospitals with less serious illnesses and stay a shorter period than those without insurance. But, for a given illness, insured patients stay longer, receive a greater number of services, and incur higher hospital bills.

6. The availability of empty beds will, *ceteris paribus,* increase hospital use.

7. Patients in hospitals which have approved graduate medical-training programs stay longer, receive a greater number of special services, and are billed more than those in hospitals without these programs.

Excerpts from Chapters 3 and 4 of the study were presented at the 96th annual meeting of the American Public Health Association, and the paper has been accepted for publication in the July-August 1969 issue of *Medical Care.* Another paper, "An Output Approach for Efficiency in Hospitals," co-authored with Richard Auster, has been accepted for publica-

tion in the summer issue of *Health Services Research.*

Kong Kyun Ro

Economics of Accidents

Accidents are exceeded only by cardiovascular diseases and cancer as a cause of death in the United States. Until the age of 35, accidents are the leading cause of death. What is further striking is the growth in relative importance since 1900 of deaths resulting from accidents. Today, accidents account for more than 30 per cent of deaths in the 1-4 and 25-34 age groups, 45 per cent in the 5-14 age group, and nearly 60 per cent in the 15-24 age group. In 1900 for each of the above age groups, accidents accounted for less than 10 per cent of the deaths. For males age 15-24, motor vehicle accidents cause over 40 per cent of deaths. Accidents also result in disabilities that reduce an individual's productivity over his life.

In spite of significant economic losses imposed by accidents there has been little systematic economic analysis of the subject. Yet accidents are an economic problem in the sense that inputs of scarce resources can reduce both the probability and the severity of accidents. In this study, a formal model is first developed that identifies the factors affecting the incentives to invest resources in accident prevention or safety. This is related to the productivity and costs of safety devices, and the choice of liability rules with respect to who bears accident losses.

An empirical analysis is planned which will concentrate on automobile accidents. Both cross-section and time series data will be analyzed. It is further hoped that this study will shed light on the current controversy in the automobile accident field between proponents of the fault system and advocates of replacing it with self-insurance schemes that approximate a system of absolute liability.

William Landes

Diversification in American Industry

There are three principal components of this study. One involves an extension and analysis of some of the data on trends in diversification developed in my book *Diversification and Integration in American Industry* (NBER,1962). This information will help answer such questions as how strong the trends have been since 1954 and if they are still largely localized in particular industrial sectors. At the aggregate level, the relevant information has now been developed to 1963 based on Census data. At the individual firm level, we are still preparing a comparison, for about a hundred companies, of the rankings based on a previously computed measure of diversification for 1954, with rankings based on similar data for 1968 derived from Dun and Bradstreet establishment records. In addition to showing if relative diversification among firms in various industries has changed markedly since 1954, this information will permit us to relate the changes in diversification ranks to estimates of rates of return to investors over the 1954-68 period.

A second component of the study involves an analysis of the record for roughly twenty innovations in the period 1920 to 1968. The twenty innovations consist of new products in a broad spectrum of manufacturing industries. We have now developed data, mainly from the *Thomas Register of American Manufacturers,* which identify the first producers and the subsequent entrants into the relevant markets at successive points in time. This will enable us to determine the characteristics of innovators and followers — for example, if they are large or small firms, new or existing firms, diversified or homogeneous firms, etc. In addition, we shall try to explain the diffusion rate for innovations, with diffusion measured by the ratio of producers in existence at various intervals following the innovation to the number in existence twenty years after the innovation. The principal explanatory variables in the model will be the growth rate of the market and certain barriers to entry.

A final section of our work will be an attempt to formulate and test a model that

explains, for a given market, the relative importance of new firms, of old firms primarily based in the industry, and of old firms primarily based outside the industry.

Funds for the project have come from the National Bureau of Economic Research, supplemented by a small grant from the General Electric Foundation to the State University of New York at Buffalo. Mr. Robert McGuckin, a graduate student at Buffalo, is assisting me in this project.

Michael Gort

Managerial Incomes and Stockholder Returns

The consistency between the personal economic objectives of the senior corporate executive and the pecuniary interests of his firm's common stockholders has been at issue ever since it became apparent that the large aggregations of scarce resources demanded by industrialization would require a professionalized managerial group for their successful administration. The consequent separation of the capital-supply and capital-management functions raised the possibility that the decision-making process within the firm would take on a different character, and be directed toward different goals, than was true in a simpler commercial environment where the two functions resided in the same individuals. The usual conclusion in the literature of business and economics over the last several decades has been that this possibility had become a reality.

The study I have now completed raises questions about the appropriateness of that conclusion. Our tax laws encourage corporations to reward their employees through devices which depend for their value on the market price behavior of the company's shares, and even a casual inspection of annual proxy statements suggests that many top executives maintain significant direct equity investments in their own firms. It therefore seemed useful to examine the possibility that the link between the personal income of these men and the re-

turns to shareholders is stronger than has been generally recognized. The evidence gathered for the study appears to support that hypothesis. During the last quarter century, executive incomes have depended heavily, directly, and persistently on the dividends received and capital gains experienced by the men in question, in their role both as stockholders of their employer companies and as beneficiaries of stock-related compensation arrangements. In particular, the annual increments to executive wealth arising from these sources have substantially exceeded those attributable to the concurrent "fixed-dollar" elements of remuneration, such as cash salaries and bonuses.

The senior officers of three categories of firms were chosen as the sample to which the analysis was addressed. The main focus was on the group of fifty large manufacturing corporations which formed the basis for my recent study of the components of managerial pay (*Executive Compensation in Large Industrial Corporations,* National Bureau of Economic Research, 1968). In addition, data from fifteen small manufacturers and from fifteen chain-store retailing organizations were compiled to supplement and test the broader applicability of the findings. The investigation, covering the period from 1940 to 1963, includes data on stockholdings and compensation for some 950 individual executives and encompasses approximately 11,500 man-years of managerial experience — in all cases relating to the men who occupied the five highest-paid executive positions every year in each of the firms studied. As a sampling of the results, it was found that the average *per capita* stockholdings of these top five men in their own companies have run in the neighborhood of $2.5 million since 1960. The attendant annual after-tax capital gains and dividends have amounted to an average of $400,000, as compared with total annual after-tax employee remuneration in the order of $200,000 per capita. Since nearly $100,000 of this latter figure is itself traceable to stock-related pay schemes, the over-all picture is one of a man who enjoys a $600,000 aggregate annual income, $500,000 of which originates from equity or equity-like sources. This does

not, on its face, seem to be a situation leading executives to neglect the interests of shareholders in formulating operating policies.

The manuscript has been reviewed by a staff reading committee and is now being revised. A preliminary discussion of the findings appeared as an article in the May 1969 issue of the *Journal of Finance*. Work on several related investigations, not directly under Bureau auspices but with acknowledgment of the Bureau's original support, is also in progress. These will be prepared for subsequent publication in scholarly journals.

Wilbur G. Lewellen

8. INTERNATIONAL STUDIES

Relation of U.S. Manufacturing Abroad to U.S. Exports

This study is concerned with the effect of U.S. direct investment in foreign manufacturing on the export trade of the United States. The work done thus far has included assistance to government agencies in the improvement of data on direct investment which these agencies have collected; the processing of new data arising from the government's controls on direct investment; and the assembling, from nongovernmental sources, of related data on the domestic or worldwide operations of U.S. parent companies, on foreign trade flows, and on the existence, location, and other characteristics of foreign affiliates of U.S. companies. Aside from the data collection our work has concentrated on two aspects of the project: the preparation of a paper analyzing the nature of the relation between overseas production and trade and outlining the plan of research; and an analysis of transport costs, one of the variables expected to play an important role in explaining the location of affiliates and the flow of trade. The objective has been to relate transport cost in two large samples of transactions to various characteristics of the transaction and of the commodity in order to permit the estimation of transport cost for each commodity between the United States and its customers and between other pairs of countries.

The strong interest of the United States government in the direct investment study has been reflected in the cooperation received from several government agencies whose help has been a prerequisite for our work. The Office of Business Economics, with assistance from the National Bureau, has re-edited and put on tape data from several years' questionnaires relating to trade between U.S. companies and their foreign affiliates.[1] The Office of Foreign Direct Investments is making up a tape from its questionnaires covering the export sales of U.S. firms with foreign affiliates and the location of the affiliates. These will be combined with OBE data on the sales, plant and equipment expenditures, and other activities of foreign affiliates, and with other data supplied by the National Bureau, for processing by the Bureau of the Census in such a way as to insure the confidentiality of government records. The information from the National Bureau will include detailed data on exports to each country by the United States and its main foreign competitors, and data on the operations of U.S. parent companies, including industry classification, sales, and employment.

By the end of this year there should be, in addition, estimates of domestic output by industry in at least a large number of host countries, and a tape containing the location of foreign affiliates of each U.S. parent company, a classification of each affiliate as manufacturing or not, and, for most countries, the SIC

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[1]See Marie T. Bradshaw, "U.S. Exports to Foreign Affiliates of U.S. Firms," *Survey of Current Business,* May 1969, Part 1.

classification of the foreign affiliate and the SITC classification of its main products. We will also have measures of the size of operations for affiliates in some countries.

Information from the National Bureau and the government will be combined to produce one set of records on each company, containing data from all of these sources. This will be, we believe, a unique collection of individual company data for the study of direct investment activities and their relation to international trade.

The analysis of the data will involve an examination of the relation between U.S. affiliate production in a country, as far as we can measure it, and U.S. exports of the same products to that country. The dependent variables we shall attempt to explain will fall into two classes. The first will contain measures of total U.S. exports of a product group to a particular country, the U.S. share in that country's imports and consumption, and changes in these amounts or shares. The second will be measures of exports by particular parent firms, their shares of imports and consumption, and changes in exports and export shares.

In the analysis of the exports of the U.S. as a whole, the explanatory variables will include data on the characteristics of the host country, such as its population, income, and related variables; transport costs; and measures of the existence, characteristics, and size of U.S. affiliates in each industry. Where possible, information on host-country domestic production and on tariff or other trade barriers will be incorporated; it may also prove desirable to add data on U.S. affiliates in nearby or related countries. For some products, including most metals, metal products, machinery, and transport equipment, we will also make use of data on the relative price levels of the main exporting countries available from the National Bureau's study of comparative price (see p. 102).

We hope to find that, after factors other than those relating to the affiliate are taken into account, the addition of information on the presence and activities of U.S. affiliates will improve the explanation of the value or share of U.S. exports. It is not expected that the explanations will be identical for all industries or countries. In some instances the presence of a U.S. manufacturing affiliate is probably associated with higher export sales from the United States, if the affiliate provides engineering and repair services, parts, supplies, and adaptation to local requirements. In other instances the presence of an American affiliate may be associated with smaller U.S. export sales, if affiliate output serves as a substitute for imports from the United States. In most cases, of course, both influences will be operating, but the magnitude of these effects may differ among industries and countries. In particular, we would expect to find differences between developed and less developed countries with respect to the characteristics of affiliates and their impact on trade, and we may wish to examine these relationships separately for the two or more groups of countries.

The relationships for U.S. exports as a whole inevitably leave some uncertainty as to what would have happened if the investment had not taken place. Investments must often have been made in response to import-saving or other restrictive legislation on the part of the host country which would, in any case, have reduced imports from the United States. The company data will provide one way of testing this possibility, since the restrictions will, in many cases, apply equally to different U.S. companies. If, for example, a negative relationship between affiliate production and U.S. exports is found among U.S. firms within individual countries as well as among countries, it would suggest that the effect stems at least partly from the affiliate production rather than solely from tariffs or other restrictions.

Robert E. Lipsey
Merle Yahr Weiss

New Technology Project

The original object of the six institutes participating in the New Technology Project has been to throw light upon the rate of diffusion of new technologies in different countries. In the past year, the first in which the National Bureau has been involved, the aims have been classified and the research design has been made more explicit. The aim is still to explain why major innovations have disseminated more rapidly in some countries than in others, but the richness of the international data suggested that we carry forward two related endeavors concurrently. In one inquiry we are trying to explain the international differences — this is based upon a new, operational definition of the "technological gap." In the other, we are organizing the six national data sets to be pooled, first, over the six (or more) processes in the investigation and, secondly, over the six countries as well, to try to estimate the parameters in a general model to explain intracountry diffusion rates.

A detailed investigation of the basic oxygen process in steelmaking was the first study to get under way, under the direction of the National Bureau. Since then, the group has begun a study of special presses in paper manufacture, directed by Industriens Utredningsinstitut (Stockholm). Work is beginning on the use of numerically controlled machine tools, with a questionnaire prepared by Institut fur Wirtschaftsforschung (Munich), and on continuous-casting lines in steel, with a questionnaire by Osterreichisches Institut fur Wirtschaftsforschung (Vienna). During the current year, research plans for two additional processes will be prepared by the National Institute for Economic and Social Research in London and by Instituto Nazionale per lo Studio Della Congiuntura in Rome.

In each case, the investigation starts with the characteristics of the innovation and, especially, the technological structure or profile into which it must be fitted within each country. The second line of explanation will come out of the economic, or market, structures of the several national industries. Starting from the premise that the rate of adoption of new tech-

niques will be positively related to the profit ability of the innovations compared with existing techniques, and negatively related to the size of investment that is required in order to introduce them into the firm, we have designed our first-stage questionnaires to get behind the profitability variable, in order to examine the factors that determine the relative advantage of the new process. We start by defining the elasticity of relative profitability with respect to capital savings, labor savings, improved material flows, increased utilization of low-cost indigenous materials, etc. The list varies from process to process. The object of this stage of the work is to identify the conditions under which the new process will be relatively more or less attractive. Then, by comparing the technical conditions in several countries within the industry in question, we can infer whether, on the basis of technical attributes, we should expect the rate of adoption to be more rapid in one place or another.

I will illustrate the first stage by listing some of the variables in the oxygen-steel questionnaire, which has now been largely completed by most of the institutes. In addition to a number of questions about the growth and composition of production, and the changing age-profile of steelmaking capacity, we have asked for information on the following technical characteristics in each country:

1.   The supply of scrap — since the basic oxygen process can absorb relatively little scrap, compared with open hearth.

2.   The availability of hot metal.

3.   The size and degree of integration of existing plant — since the charge requirements and the relatively short delivery time of the oxygen converter makes it relatively more profitable where closely integrated facilities are available.

4.   The phosphorus content of the metal entering the steelmaking process — since the basic oxygen technique has a distinct advantage where there is low phosphorus ore, while the Thomas process is more efficient in the presence of high-phosphorus metal.

5. The proportion of special alloys in the product mix — since the oxygen converter is less advantageous in the production of special steels.

There is evidence to suggest that in the steel industry, as elsewhere, many firms will not introduce new equipment until old capacity has been written off, whatever orthodox application of the marginal cost rules of thumb might suggest. We have, therefore, included a variable to reflect the age or vintage of facilities already in place in the first years after the introduction of the basic oxygen technique.

The rate of diffusion of a new process, represented by its proportion of total capacity, depends not simply upon the replacement of existing equipment but also upon the rate of growth of demand for the product relative to the existing capacity. Hence, the inclusion of a variable to reflect the influence of increments of *needed* capacity — the induced investment variable of the acceleration principle.

Finally, for an industry as capital-intensive as steel, especially where an innovation can only be introduced in the form of a major piece of equipment, the capital market conditions are extremely important. The significance of this variable is increased by item 3 in the list above; first, the advantage of the basic oxygen process depends in part on the ability of the plant to use the converter's relatively small-heat, short-period output; second, since the utilization of scrap is relatively low and the hot-metal requirement is rigid, investment costs for pig-iron are correspondingly higher, unless the converters can be introduced into integrated plants.

This list, then, summarizes the "orthodox" economic and technological variables that will determine, in part, the probability that a given firm or steel industry should have adopted one of the basic oxygen processes soon after their introduction. The potential variance in the profitability of a given process suggests a more operational approach to the definition of the technological gap, and provides the dependent variable for the second stage of the analysis. The gap, measured against the optimum defined by the technical conditions, will be regressed upon indexes of corporate structure, apparent management goals, and market patterns, in order to evaluate the influence of the company, or market, factors upon the rate of diffusion.

We have prepared and distributed a second questionnaire to gather information about financial variables, organizational structure, and research and development activities, all at the company level. Similar questionnaires are being prepared for the special paper presses and the numerically-controlled machine tools.

The project is being financed in part by an international grant from the Ford Foundation. The project staff includes NBER research assistants Guy Herregat and Mansing Lee, and has had the cooperation of Donald Shoup through this year.

Alfred H. Conrad

International Price Comparison Study

The study of comparative prices and price trends in the international trade of the United States and its main foreign competitors has been completed. A manuscript, tentatively entitled "Price Competitiveness in World Trade," was reviewed by a staff reading committee and is being revised for submission to the Board. The report will contain eight general chapters describing the study's methods and giving the main conclusions about changes in the price competitiveness of the United States between 1953 and 1964 and about techniques of measuring international prices. Seven chapters discuss particular groups of products, two of these are revisions of earlier occasional papers on iron and steel and nonferrous metals[1] and the other five cover machinery and transport equipment. Seven appendixes set out the indexes of international prices, price competitiveness and price levels, the trade flows that correspond to the price data, and indexes

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[1] *Measuring International Price Competitiveness: A Preliminary Report,* Occasional Paper 94, 1965, and *Comparative Prices of Nonferrous Metals In International Trade, 1953-64,* Occasional Paper 98, 1966.

derived from wholesale price and unit value data.

Another publication stemming from the project is an article on "International Price Comparisons by Regression Methods," in the June 1969 issue of the *International Economic Review*. As an outgrowth of the study we are planning a further examination of the role of prices in trade flows, as reported below.

The study was financed from two grants by the National Science Foundation and from the general funds of the National Bureau. Jill Adler, Marianne Lloris, Christine Mortensen, and Doris Preston assisted in various phases of the data processing and analysis during the past year, and Beatrice Grabiner was the project secretary.

Irving B. Kravis
Robert E. Lipsey

The Role of Prices in International Trade

The report on Price Competitiveness in World Trade, now in manuscript form, includes one chapter which uses the data on relative price movements and relative price levels, developed in the international price comparison study, to explain the composition of trade and shifts in the direction of trade. Since these questions were not the main focus of the study, that chapter was only an experiment, based mainly on large commodity aggregates and treating the world as a single market. However, since the study produced a unique set of detailed international price data, we wish to extend this examination of the relation of prices to trade flows to exploit the data more fully and to eliminate some of the biases that may be present in our results so far. We expect to report the first results of this work at the Spring 1970 meeting of the Conference on Research in Income and Wealth.

One part of this study will involve an examination of relationships between prices and trade for large commodity aggregates in individual country or area markets, extending the work reported earlier and reducing the possible influence of income changes on the

price elasticity measures. We hope then to go to finer levels of commodity detail, to the extent permitted by the trade data, in order to remove some of the effects of aggregation of dissimilar commodities.

Other aspects of the work will involve further analysis of the price level data. We wish to examine the relation of price levels in individual products to the characteristics of the producing industries, using data of the type reported in Censuses of Manufactures, such as that on value added per worker or other measures of capital or labor intensity. These variables have been used in a number of studies to explain the flow of trade, by-passing the price relationships, which are presumably an intermediate link in the chain of causation. For this purpose we have constructed a concordance between the SITC and SIC on a more detailed commodity and industry level than that used in earlier studies.

An additional use of the price level data will be an extension of our earlier attempt to relate price levels to market shares, by country and product. The new work in this case will involve adding trade data in this detail for years other than 1963 and calculating the relationships of price levels to trade in individual country and area markets.

Irving B. Kravis
Robert E. Lipsey

Balance-of-Payments Adjustment Policies

This project studies the postwar pattern of response of policy measures affecting demand to imbalances in international payments. Nine countries have been analyzed: Belgium, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom, and the United States. Patterns of policy reaction in each country are demarcated by a statistical investigation aimed at discovering the causal dependence of major monetary and fiscal instruments on the country's external position. On this basis, a synthesis of the individual

studies is undertaken to search for general patterns in the international monetary system as a whole. Questions are then studied, such as whether the policies employed to adjust deficits and surpluses in the balance of payments are symmetrical with each other, or whether deficits and surpluses provoke different kinds of reactions; whether or not countries seem to assign certain policy instruments to balance-of-payments adjustments while reserving others for domestic targets; whether any general change in the policy pattern is discernible over the period under consideration; or whether variables such as the size of trade or the size of reserves could explain differences in policy patterns among countries.

It appears from the analysis that, in the responsiveness of monetary policy to the balance-of-payments position, the nine countries investigated may be divided into three groups.

a. In two countries, the United Kingdom and Japan, monetary policy appears to have been played consistently according to the classical "rules of the game"; that is, to have been guided by the fluctuations in the country's external position.

b. In four other countries — France, Belgium, the Netherlands and, probably, Italy — monetary policy seems again to have been directed by balance-of- payments movements, but not with the same consistency as in the two former countries.

c. In the three remaining countries — the United States, Germany, and Sweden — monetary policy does not appear to have been generally responsive to the balance of payments.

In those countries where compliance of monetary policy with the directives of the balance of payments tended to be the rule, the monetary tools used for the purpose appear to be primarily the traditional instruments; namely, the discount rate and the supply of money. The United Kingdom is the most important general exception; there, money supply is largely disregarded, and credit supply takes its place as a major instrument of monetary policy.

Budgetary policy, on which attention has been so largely focused in theoretical discussions since the 1930's, appears to have responded to the balance-of-payments position only infrequently, and definitely not as a rule, although this conclusion must be more heavily guarded than most others because of the qualifications attaching to observations of this variable. It does not appear, moreover, that the failure to use budgetary policy for balance-of-payments adjustments stems from the use of this instrument in the service of competing domestic targets. It seems more probable that, despite the heavy emphasis on this instrument in analytical discussions or even in statements of policy makers, fiscal policy is largely unresponsive to the needs of major policy targets — either because it is too inflexible or because the principle of a balanced budget is still adhered to by policy makers. Countries whose monetary policy generally responds to balance-of-payments fluctuations tend to make exceptions to this pattern mainly when they are in surplus. Similarly, compliance of monetary policy with balance-of-payments requirements in generally noncomplying countries tends to be found at times of deficits. It thus appears that makers of monetary policy tend to gear their conduct to the country's external position more in time of deficit than in time of surplus. It also appears that this tendency is not related to the level of external reserves: it is found when reserves are high as well as when they are low. It seems that countries tend to regard as their external target not so much the attainment of balance-of-payments equilibrium as the avoidance of deficits. The external target appears, that is, to be defined in a one-way manner. The loss of reserves is viewed with concern, but the accumulation of reserves — which might have been considered just as undesirable due to its interference with the operation of the international system and to the real loss to the economy of holding reserves — is viewed in fact with indifference or satisfaction.

The study has been completed during the last year, and revisions have been made following comments by the staff reading committee

and by members of the project's Advisory Committee. The draft is now being edited for submission to the Board of Directors. It is planned to appear as a book, which is tentatively titled "Demand- Policy Responsiveness to the Balance of Payments: The Postwar Pattern."

The project has benefited from the financial support of the Ford Foundation to the National Bureau's program of international economic studies.

<div align="right">Michael Michaely</div>

The Pattern of Export and Import Substitution in an Outward-Looking Economy: Korea

In his recent book *Imports of Manufactures from Less Developed Countries,* Lary shows that value added per employee can be used as a proxy for the capital/labor measure which incorporates the role of human capital. As such, it serves as a useful guide in identifying the comparative advantage of less developed countries in manufactured goods. I have applied this measure, along with capital (fixed assets) and wages per employee, in evaluating the patterns of Korea's trade.

The 3- to 6-digit levels of trade data for Korea, as published in the Standard International Trade Classification (SITC), are regrouped to correspond to the 4-digit Census of Manufactures classification, matching the average trade flows in 1962-63 and 1966-67 with the 1962 and 1966 Census data, respectively. The trade data used are for manufactured goods as listed in SITC groups 4 to 8. Noncompetitive imports, which comprised in 1966, for example, about 30 per cent of total manufactured imports, are exluded.

The explanatory value of Lary's measure is well substantiated in the case of Korea for both periods considered (although the industrial structure changed considerably and manufactured exports rose almost seven times from 1962-63 to 1966-67). It is found that Korea's exports, measured in terms of value added per employee, are about twice as labor-intensive as imports in both periods. Similar results are obtained when both capital and wages per employee are used (though this computation has been done only for 1966-67). Also, the correlation coefficients between pairs of log values of value added, capital, and wage per employee in different industries range from .71 to .66, all of which are significant at the 1 per cent level.

I am writing an article on this part of the research, investigating at the same time a number of related questions. For example, how representative is the average value added of a given sector which includes firms of different size with a considerable range of value added per employee? Also, how do government policy measures, such as taxes, subsidies, and tariffs, affect different industries and their trade flows? As a part of this inquiry, I have gathered various data to compute effective rates of protection (or protection on value added) of different industries. This information includes ratios of domestic to foreign prices (gross of tariff) for imports used in Korea to levy special customs duties. Considerable changes in the input coefficients are shown in the inter-industry tables (1960, 1963, and 1966) and the Census data. In measuring effective protection, the effect of input substitution will be incorporated.

I am also gathering data for other developing Asian countries to study their trade patterns and to permit comparisons with the findings for Korea.

In addition to the above, I have been completing research work started before my fellowship appointment. The results of this work appear in two articles: "Accuracy of International Trade Data: The Case of Southeast Asian Countries," *Journal of the American Statistical Association,* June 1969 (with T. Morgan), and "Substitution and Two Concepts of Effective Rate of Protection," *American Economic Review,* forthcoming (with J. Anderson).

<div align="right">Seiji Naya</div>

Other Studies

Walther P. Michael has completed a further revision of his study on "Measuring International Capital Movements," and the draft of a

proposed Occasional Paper will soon be presented to the Board of Directors. H. G. Georgiadis' work on "United States Performance in International Competition" is nearing completion; he expects to have ready within a few months a full draft including certain parts previously intended for separate publication as an Occasional Paper. J. Herbert Furth and Raymond F. Mikesell are collaborating on an analysis of foreign dollar balances in relation to the U.S. balance of payments.

Peter Temin has started research on international aspects of the 1929-31 crisis, focusing initially on formulating in a testable manner the familiar hypothesis that the withdrawal of American capital from Germany in 1928-29 set off a chain of events leading to the international exchange crisis of 1931.

9. ECONOMETRICS AND MEASUREMENT METHODS

Papers on Statistical and Econometric Methodology

In my capacity as a statistical consultant on econometric studies at the National Bureau, I have developed some estimation methods and written several papers which I hope the Bureau personnel will find helpful. All the completed papers were submitted for publication. The list of papers includes the following:

1. "A Note on the Maximization of $\bar{R}^2$," *The American Statistician,* February 1969.
2. "Estimation of Regression Equations When a Block of Observations is Missing," *Proceedings of the American Statistical Association,* Summer 1968.
3. "REGEN-Computer Program to Generate Multivariate Observations for Linear Regression Equations" (with Sidney Jacobs), to appear in *Applied Statistics* (Journal of the Royal Statistical Society, Series C).
4. "On Errors of Measurements in Regression Analysis."
5. "On the Bias of Regression Coefficients Estimated from Midpoints of Grouped Observations."
6. "On the Correlations Between Estimated Parameters in Linear Regression."
7. "Forecasting and the First Difference Transformation" (jointly with P.J. Verdoorn of the Central Planning Bureau, the Netherlands).

8. "On the Use of Auxiliary Information for Estimating Missing Observations in Regression" (jointly with Neil Wallace), in progress.

The manuscript entitled "Regression Estimates from Grouped Observations," which I completed at the Bureau the year before last, won the C. Oswald George Annual Award in Applied Statistics for 1968. The award is offered annually by the Institute of Statisticians, London, for papers submitted by younger authors. Plans are being made for publication of the manuscript by Griffin's Statistical Monographs and Courses and by the National Bureau of Economic Research.

Recently I have started extensive Monte Carlo experiments on the problem of Multicollinearity in Regression Analysis. These experiments clearly indicate that the constrained least squares procedure and the procedure for arriving at the constraints from the sample data are of considerable merit in solving multicollinear regression equations. The study on multicollinearity has heretofore produced three papers. One is the third item in the list given above. The other two are:

"On Multicollinearity in Regression Analysis: A Comment." *The Review of Economics and Statistics* (forthcoming)
"A Note on Regression on Principal Components and Constrained Least Squares."

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A final paper entitled "Multicollinearity in Regression Analysis" was presented at the joint statistical meetings of the American Statistical Association (Section on Physical and Engineering Sciences) and the Biometric Society in August.

Yoel Haitovsky

Regressions in the Context of Stable Disturbances

In this study, which is being conducted in a joint effort with Robert Blattberg of Carnegie-Mellon University, we consider alternative estimators of the regression parameter β in the model

$$(1)\ y_j = \beta x_j + u_j \quad j = 1,..., T$$

where y_j is the jth value of the dependent variable at j, the x's are a set of fixed numbers, and the u_j's are independent, identically distributed disturbances with mean zero. We assume that the u_j's follow a symmetric stable (Pareto-Levy) distribution. This distribution is defined by the log-characteristic function

$$(2)\ \log \phi_u\ (t) = i\delta t - |\sigma t|^\alpha$$

where δ is a location parameter, σ is a dispersion parameter, and α is the characteristic parameter. If $\alpha = 2$ the distribution is normal, while if $\alpha = 1$, it is Cauchy. As can be seen from the characteristic function, distributions of this class are stable, i.e., invariant under addiiton. In addition, a generalized central limit theorem holds for this class of distributions.

It can be demonstrated by successive differentiation of (2) that if $\alpha < 2$, only absolute moments of order less than α exist. Thus for $\alpha < 2$ the variance is infinite, although the mean exists as long as $\alpha > 1$. For $\alpha < 2$ the distributions are more peaked and denser in the extreme tails than is the normal distribution.

The minimum-variance property of the least squares estimator of β in (1) clearly depends on the existence of the variance of the u_j's. Thus if α

< 2, least squares (LS) is no longer the minimum dispersion linear estimator, although it remains unbiased as long as $\alpha > 1$. This should be a matter of some concern to economists since several studies by Mandelbrot and by Fama[1] have indicated that for various economic data $\alpha > 2$. This evidence suggests that economists' standard use of the central limit theorem to justify assuming that the u_j's follow a normal distribution may actually be used more appropriately to demonstrate only that the u_j's follow a stable distribution.

In addition to LS, we studied several estimators of β in (1) where the α characterizing the u_j's was assumed to be between one and two. These were:

(1) Members of the class of best linear unbiased estimators (BLUE), which are derived by minimizing the dispersion parameter characterizing the estimator. For $\alpha = 2$, the dispersion parameter is proportional to the variance of the disturbances, and so LS is the estimator in this case. A separate BLUE estimator is defined for each α. We studied several such estimators.

(2) The minimum sum of absolute errors (MSAE) estimator, which is derived by minimizing

$$\sum_{j=1}^{T} |\hat{u}_j| \qquad \text{in (1).[2] The}$$

estimator is maximum likelihood when the u_j's follow a two-tailed exponential distribution. Since it weights extreme observations less heavily than does LS, it is an attractive estimator in the context of the type of fat-tailed distribution under study.

[1]B. Mandelbrot, "The Variation of Certain Speculative Prices," *Journal of Business,* October 1963. E. F. Fama, "The Behavior of Stock Market Prices," *Journal of Business,* January 1965.

[2]For a discussion of the estimator see A. Charnes, W. W. Cooper, and R. O. Ferguson, "Optimal Estimation of Executive Compensation by Linear Programming," *Management Science,* January 1955.

Because of analytical difficulties involved in studying the properties of MSAE estimator, Monte Carlo experiments were performed for α's of 1.1, 1.3, 1.5, 1.7, 1.9, and 2. Sample sizes of ten and fifty were studied and one hundred replications were performed for each experiment. Two measures of the dispersion of the sample estimates around the true value were calculated. The central results were:

1. Of the linear estimators, the BLUE estimator for the α actually employed in an experiment generally out-performed those calculated on the assumption of some other value of α. The closer the value of α assumed in calculating an estimator to the α used in generating the u_j's, the better the estimator generally performed.

2. MSAE out-performed LS and BLUE estimators for $\alpha < 1.5$ while the two linear estimators were superior for $\alpha > 1.7$.

3. Over the range of α's studied, MSAE was more robust in its performance than was LS.

A preliminary report on this work was delivered at the December 1968 meeting of the Econometric Society.

Thomas J. Sargent

10. THE DEVELOPMENT OF COMPUTER USAGE

Introduction

Work on the use of the computer in the National Bureau's various operations, which was reported on briefly in the last Annual Report under the heading of a Computer Utility, has continued and become more diversified. More thorough analysis suggests that the problem to be met is not simply the proper use of the computer, but rather that of handling both the flow and the stock of research information from its origin to final dissemination in a number of possible ways.

The computer will inevitably play a very large role in the process, but other techniques for handling and storing information must be explored as well. Two examples which can be cited are microfilm and videotape, neither of which has been systematically explored within the Bureau in terms of the role it might play in storing, processing, and presenting research information. The Bureau currently uses MT/ST machines to transcribe manuscripts onto magnetic tape, where they can be corrected to produce perfect final copy. It is beginning to work with an electronic composer which takes a coded magnetic tape from the MT/ST machine and produces justified copy ready for offset photography, thereby eliminating type-setting entirely. Work is proceeding on exploration of the interfacing of magnetic tape containing manuscript with magnetic tape generated by computer.

In its first stages Project RIPP has concentrated on using the computer for research information processing, as noted by Richard and Nancy Ruggles immediately hereafter. At the same time, the Publications and Data Processing Departments are continuing to examine the wider implications set forth briefly above.

A closely related activity is that noted by M.I. Nadiri concerning an econometrics workshop. It is essential that a research information processing system be established in close coordination with potential users. The workshop has, as one of its objectives, the task of making sure that Project RIPP produces a system which is of maximum usefulness to the Bureau and to the profession as a whole.

Charlotte Boschan reports below on the evolving role of the Electronic Data Processing Unit, and the shift in emphasis in its work from general-purpose to special programs.

Donald S. Shoup

Progress on Project RIPP

The National Bureau of Economic Research is increasingly involved in using computers in its research programs. A number of computer facilities are being used, and many different sets of machine readable data are being acquired. The Research Information Processing Project is an attempt to provide a general system of information processing for research purposes which will (1) create a National Bureau of Economic Research Data Bank available both to National Bureau staff and to outside users; (2) develop techniques so that the computer can provide research output in a form suitable for publication or for direct use by anyone wishing to do further research in a given area; (3) permit the use of machine readable data sets obtained from a wide variety of sources; and (4) utilize already existing computer programs to create a library of useable programs.

In its initial stages, the Research Information Processing Project is concerned with developing computer techniques to handle three kinds of information. First, the time series which the National Bureau has on hand are being put into computer form to make them more readily available. Second, worksheets and data now in tabular form are being computerized so that the computer can be used for the manipulation of heterogeneous data (which is now done outside of the computer) and for the generation of tabular presentations suitable for publication as statistical appendixes in National Bureau publications. Finally, an attempt is being made to create systems of header documentation which can be attached to computer tapes and other files of machine readable data which the National Bureau has obtained from a variety of sources.

Richard and Nancy Ruggles

Workshop on the Computer and Applied Econometrics

An informal conference of econometricians from various universities was held on December 10, 1968, at the National Bureau to explore the possibilities and potentialities of a project dealing with the role of the computer in applied econometrics. The discussion involved considering ways of creating and maintaining an economic data bank, the development of new and better estimation techniques, and econometric model building. Among the issues considered were: (1) how to find and eliminate areas of duplication in the use of computers in econometrics research at various research institutions and universities, and (2) how the Bureau could help to improve the flow of information about the use of computers in economic research.

It was agreed that the National Bureau could serve a very useful role in this activity, and various steps were outlined. In particular, it was suggested that an interuniversity workshop should be set up to examine and design methods of collecting and disseminating information about new econometric techniques and new ways of using computers in econometric analysis. Means of financing this project are being explored.

M.I. Nadiri

Changing Functions of the Electronic Data Processing Unit

The E.D.P. Unit of the National Bureau started out as a small group which largely wrote new general-purpose programs in the fields of time series and business cycle analysis, promoted the use of these and other programs inside and outside the Bureau, and was suported by cash and machine-time grants. Conditions have changed: most basic statistical techniques have been programmed, and there is scarcely a research project in the National Bureau that does not generate its own demand and provide its own funds for computer time. The resulting massive use of electronic data processing imposes substantial tasks of consultation, program modification, operating control, and administration. Major programming efforts are now largely concerned with special-purpose tasks,

such as the processing of widely varying types of data collections. Major new challenges lie in the development of interactive systems of data banks and programmed analytical approaches — systems necessary for the execution of large-scale simulations and for the development and operation of complex econometric models.

Our general-purpose programming now consists largely of program modifications. A Principle Components and Factor Analysis program has been developed from a number of IBM-subroutines (Sidney Jacobs). An existing NBER analysis-of-variance program has been modified to permit weighting of variables (Sidney Jacobs). The Bureau's Standard Business Cycle Analysis is being rewritten in FORTRAN to make it useable on a variety of machines (Lora Weinstein and Antonette Burgar). We are also adapting a large-scale regression program, written for the IBM-360, to the needs of the National Bureau.

Among the programs written for specific research projects, the following are of general interest: In connection with Yoel Haitovsky's work on multicollinearity, Sidney Jacobs developed (1) a program to generate multivariate observations from user-specified populations (to be published as a joint paper); (2) a program computing regression measures by Scott's Method, using principle components; and (3) a program computing regression measures by constrained least squares. In connection with the American Statistical Association's new quarterly survey of forecasts by professional economists, we have specified and programmed a survey analysis (Charlotte Boschan). The analysis is processed on the Bureau's IBM-1130 (Irene Abramson) and the results are interpreted by Victor Zarnowitz for a joint ASA-NBER press release. Eventually the survey data will be used in an analysis of forecasting efficacy.

Other special-purpose programs are directed toward large-scale data reduction and manipulation of data collections acquired from government agencies and other sources, such as the Consumer Expenditure Survey of the Bureau of Labor Statistics, the Dun and Bradstreet Market Identifiers, the Census Bureau's one-in-a-thousand sample, and the data collection of the Blue Cross of Western Pennsylvania (Susan Crayne and others).

The E.D.P. Unit is also participating in the computerization of housekeeping operations such as budgeting, payroll preparation, purchase control, and other accounting tasks (Lora Weinstein).

The broader goals of setting up an integrated system of data retrieval and econometric analysis is approached by the National Bureau along several paths, as reported on by Richard and Nancy Ruggles and M.I. Nadiri. The E.D.P. Unit pursues these aims by its participation in "Project Economics" — a cooperative effort by the economic research departments of various banks, insurance companies, and other institutions, with the aim of setting up an interactive system of economic time series and of programmed statistical analyses. Data and programs are accessible to all members through time-sharing terminals. While presently provided programs are limited in scope and sophistication, the project may eventually be expanded to handle econometric model building and simulation problems.

Charlotte Boschan