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**Staff Reports  
on Research  
Under Way**

## 1. ECONOMIC GROWTH

### Productivity, Employment, and Price Levels

Policies to attain "prosperity without inflation" are bound to be highly controversial. Opinions differ sharply, as each day's news makes clear, on the relative values of the several goals subsumed under the quoted catch phrase: rapid economic growth, low unemployment, and a stable general price level. And the differences extend also to the worth of these goals when balancing the short-run against the long. It would be too much to hope that scientific research, no matter what its auspices or scale, could quiet all controversy over these policies. Yet, to a significant degree, the differences of opinion do reflect inadequate knowledge of the facts and the relations among facts. We may reasonably expect that the differences can be narrowed by the work reported in this section, which groups together studies aided by a grant from the Alfred P. Sloan Foundation and studies on related topics. Included are an examination of the reliability of the available price and employment data, analyses of the historical behavior of prices and productivity, an effort to develop theoretical models of price formation, and the construction of econometric models of the determination of prices, costs, and productivity.

The first National Bureau publication in this group was *The Behavior of Industrial Prices*, by George J. Stigler and James K. Kindahl, which was recently published. Several related articles have appeared or will soon appear elsewhere. These include Nadiri and Rosen's "Interrelated Factor Demand Functions," in the *American Economic Review*, September 1969, and two articles by Fabricant: "Prices in the National Accounts Framework: A Case for Cost-Benefit Analysis," which will be published in the *Review of Income and Wealth*, and "Inflation and the Lag in Accounting Practice," which will be in a volume on "Contributions to Accounting by Other Disciplines," to

be published under the auspices of the University of Kansas.

The individual studies still in progress are reported on in the following pages of this section.

Members of the National Bureau's Board of Directors have sometimes expressed the wish that, when an occasion offered itself, advantage should be taken of the opportunity to prepare and issue a Bureau volume, addressed to the public at large, on a broad theme of widespread interest. Such a volume should use the main findings of National Bureau studies, properly integrated and stripped of technical discussion and detail, regardless of the project under which they happened to be financed or the heading in the *Annual Report* under which the studies might be classified. The problem of inflation provides such a theme.

A report on the problem of inflation could help point up the relevance of the National Bureau's research, and—written in appropriate language—should help convey its results not only to specialist and nonspecialist economists, but also to other members of the concerned public, among whom are the National Bureau's supporters. I hope to use the next year to put such a volume together.

Over the next few years the National Bureau's studies in productivity, employment, and price levels will be aided by a new grant from the Walker Foundation.

Solomon Fabricant

### Price Trends and Economic Growth

Several economists have recently attempted to measure the effects upon wages and price levels of the guidepost policy followed during 1962-66, and of its abandonment afterward. The planned paper on "Wage and Price Guideposts in a Growing Economy" is being ex-

tended in order to weigh and to compare the validity of the very different conclusions reached. To judge from the review so far, it is doubtful whether any of the econometric equations or other analyses that have been made public yield significant evidence on the degree of effectiveness of the guideposts. For one thing, the available statistical data are for this purpose simply too poor in quantity and quality. Consider, for example, the rather wide discrepancies between the list prices used in these analyses and the prices actually realized, that are reported by Stigler and Kindahl. Given these data, the factors affecting short-term changes in wages and prices are too numerous and too powerful to permit disentangling and determination—with even minimally acceptable confidence—of the separate effect of the application of the guidepost policy. That equations which give very different results are all accompanied by high coefficients of multiple correlation can merely reflect the fact that the equations are the end results of a trial and error search by different people. The paper on the guideposts will, of course, discuss in some detail the considerations—theoretical and empirical—that lead to these conclusions.

During the year, work continued on an aspect of another subject of great current interest. This is the connection among changes in monetary and fiscal policy, changes in business conditions, and changes in price levels. It was widely expected that the tightening of monetary and fiscal policy that began during the winter of 1968-69 would soon be reflected in a slowdown in general business and, as a result and more or less simultaneously, in a significant reduction, if not a complete halt, in the pace of price inflation. That the pace of inflation still shows little evidence of a slowdown has surprised and troubled many people, especially since signs of a decline in general business have been mounting for some time.

But even a cursory inspection of the historical facts indicates that the short-term behavior of prices cannot be characterized as simply as has been assumed. Several facts tend to be overlooked. First, price behavior is not

the same throughout the price system. Second, the behavior in no part of the price system is always the same. Third, the response of prices to a tightening of monetary and fiscal policy may initially take the form, for a while, of an end to acceleration. And fourth, some groups of prices may continue to rise rapidly—sometimes even continue to accelerate—because of demand and supply factors peculiar to them.

To be more specific, the index of wholesale prices (or better, the index excluding farm and food prices, which conform poorly to business cycles) typically turns at about the same time as does general business. This is why the index is included in the National Bureau's list of "roughly coincident indicators." In contrast, the index of industrial material prices typically turns up or down before general business does; the index is a "leading indicator." In different contrast, retail prices and wage rates—the prices on which many people concentrate when worrying about inflation—tend if anything to lag behind turns in general business.

These uniformities are far from perfect, as Mitchell and the others who have worked on business cycles at the National Bureau have warned their readers. Departures from the usual behavior of the Wholesale Price Index, to continue with that example, have occurred in a significant proportion of business cycles. The departures sometimes ranged well outside the limits that one might infer from the term, "roughly coincident." And, as I have already hinted, the Consumer Price Index and the available indexes of wage rates, as well as indexes of prices in some other sections of the price system, have so infrequently been marked by downward movements that they could not properly be classified as "lagging indicators"—series that typically turn downward some time after a peak in business has been reached. The response of retail prices and wage rates to declines in business has often been visible only in a slowing down of their rates of growth.

Finally, the persistently rapid rises in the prices of health services and of construction costs, often cited as reflections of continued inflationary pressure, may instead be better

examples of the importance of special demand and supply factors.

The country's experience with prices during the past year should be less surprising when viewed in the light of its broader experience, of which I have given just a few examples.

There are also other grounds for not expecting a rigid relationship between changes in prices and changes in business. The impact of a given monetary-fiscal policy is bound to vary from time to time, if only because what happens to business in general and to prices in particular is influenced also by the policy that came before and the policy that is expected to come later.

Various studies under way at the National Bureau, such as those by Friedman and Schwartz, deal with these complicated matters in one way or another. In the present study, attention is being focused on the behavior, and variation in the behavior, of the several categories of prices during different periods in our history.

Work has also begun on a topic that may be thought of as bearing on the competition among national goals. This is the question, in what direction, to what extent, and for how long may efforts to attain or maintain a stable economy be expected to influence the rate of growth of national output, or more particularly, the rate of growth of a major factor of output, namely, output per man-hour worked. It is a subject to which rather less attention has been paid than the trade-off between full employment and inflation, to which Gordon refers in his progress report below. The question necessarily involves a good deal of speculation. What I shall be doing is to set down some of the factual and theoretical considerations useful in guiding and disciplining this speculation. These include the factors determining the trend of labor productivity, on which Kendrick has been working, and the factors—not altogether different—that cause fluctuations around the trend during successive stages of the business cycle. The latter subject was studied by Hultgren some time ago. New data make it possible to extend and check some

of his results. The Nadiri-Rosen study, reported below, also should be helpful.

Solomon Fabricant

### **Interrelated Factor Demand Functions**

The purpose of this work is to integrate empirical 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 some existing empirical 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. They also show that the primary role of variations in utilization rates is to adjust output levels rapidly in the face of the slow adjustment of capital stocks, as is predicted by our a priori hypotheses. These estimates are also capable of accounting for low estimates of the elasticity of employment with respect to output found in previous short-term employment function studies. In those studies, large short-run returns to inputs of labor seem to be due to the omission of input utilization rates, particularly that of capital.

The model has now been extended to include changes in inventories as another variable among the interrelated factors of production. We have completed the collection and processing of the quarterly time series data for seventeen two-digit manufacturing industries for the period 1947-68. The model has been re-estimated for these subindustries, and we are preparing to explore the interindustry differences in the estimates.

M. I. Nadiri  
Sherwin Rosen

## Problems in the Measurement of Nonresidential Fixed Capital

The purpose of the project is to revise existing capital input estimates to take better account of technological change in capital goods and of changes in service lives and utilization rates. The project is divided into six subtopics, on each of which considerable progress was made during 1969-70.

1. *Principles of Capital Measurement.* Analysis based on a theoretical model has suggested several principles. Deflators for investment spending should be adjusted for all changes in quality, whether or not they require a change in the base-year cost of production. But, in studies of economic growth, perpetual inventory capital stocks should be examined in accordance with three concepts of real investment. Using the first such concept, stock is corrected for all changes in quality; in the second, stock is corrected for changes in quality which increase the base-year cost of production of capital, and in the third, stock is completely uncorrected for changes in quality or productivity. Differences in the growth rates of the three stocks form the basis of studies of the sources of economic growth. This theoretical analysis has been set out in an article titled "The Advance of Knowledge and Measures of Total Factor Productivity."

2. *Techniques of Price Measurement.* In recent years considerable attention has been devoted in the literature to the possibility of adjusting price indexes for quality change through the use of the "hedonic" regression technique. The Census Bureau is now using the hedonic method in a new price index for single-family residential houses. A close analysis suggests that the Census price index and others may be biased upward, since the method cannot identify costless quality change in quality dimensions which are excluded (because of multicollinearity or data limitations) from the hedonic regressions. In the future more emphasis will have to be placed on detailed engineering studies to measure improvements in the ability of capital goods to produce output.

For the next few years, construction price indexes used to calculate capital stocks may have to be based on interim methods like those I proposed in the *Review of Economics and Statistics*, November 1968.<sup>1</sup>

3. *Revisions of Existing Price Deflators.* To supplement my earlier study of construction price deflators, I have done some work to assess the accuracy of the U.S. equipment price deflators. At present, most categories of equipment investment distinguished in the U.S. national accounts are deflated by product-class indexes of the Wholesale Price Index. A set of alternative data sources suggests that the WPI data contain a serious upward bias of as much as 2 per cent per annum during the period 1954-63. A National Bureau-type reference cycle analysis of cyclical fluctuations in the ratio of transactions to list prices suggests that the present official U.S. indexes understate cyclical fluctuations in equipment prices. While the information so far collected is not sufficient for a trustworthy estimate of the magnitude of this cyclical inaccuracy, government statistical agencies could sponsor research to extend my methodology. Such a study would be valuable not only in the study of capital stocks and economic growth, but also in revealing possible weaknesses in previous studies of the demand for investment goods, the results of which usually depend heavily on the cyclical path of real investment spending.

4. *Revisions of Investment Estimates.* Further Defense Department data have been collected. These will be used in future revisions and extensions of my original estimates of government-owned capital used by private contractors, as reported in the June 1969 *American Economic Review*.

5. *Utilization Estimates.* Detailed annual estimates of capacity and utilization in a large group of industries have been prepared from data for periods ranging back to 1910. The

<sup>1</sup> Robert J. Gordon, "A New View of Real Investment in Structures," *Review of Economics and Statistics*, November 1968.

data suggest that in many industries utilization rates in the late 1920's were low relative to the 1950's and 1960's. The time pattern of utilization rates in different industries is being examined in an attempt to determine the relative roles of aggregate demand and technical progress in causing the secular rise in utilization rates. Whatever the cause, changes in utilization rates were a major factor contributing to economic growth in the 1929-50 period and to the accompanying decline in the capital-output ratio.

6. *Changes in Service Lives.* Although data on changes in service lives are the most unsatisfactory of any used in this project, an attempt is being made to determine the rough order of magnitude of service-life changes in structures and equipment. Preliminary work suggests that service lives were stretched out during the 1929-50 period, contributing to an increase in the figure showing the ratio of actual capital stock to conventional capital stock. This figure was derived on the erroneous assumption of no change in service lives.

As the results of the six sections are completed, they are being written up in the form of a monograph, which it is hoped will be completed before the end of 1970.

Robert J. Gordon

### Problems in Predicting the Rate of Inflation

How rapidly would the general price level increase if the U.S. unemployment rate were to remain forever at the low rates reached between 1966 and 1969? Widely diverse answers to this controversial problem have been proposed in recent research. The most common empirical approach, employed by Perry, Brechling, and others, fits a stable Phillips curve and predicts that at steady 1969-type rates of unemployment the rate of inflation would be stable at between 3 and 4.5 per cent. Diametrically opposed to this approach are recent papers by Friedman and Phelps, who

argue that any attempt by policy makers to maintain forever the low 1969 unemployment rate would lead not to a stable but to an *accelerating* rate of inflation. In order to dampen and eliminate the accelerating rate of inflation, the unemployment rate must be raised to the "natural rate" at which there is no excess demand for labor. There is thus no permanent, stable trade-off between unemployment and inflation, as implied by the previous Phillips curve investigations. According to Friedman and Phelps, previous Phillips curve studies, like that of Perry, have fitted the wrong curve. Instead of attempting to estimate the Phillips curve relating the change in the *nominal* wage to the level of unemployment, previous studies should have used the change in the *expected real* wage as the dependent variable.

The present study is an attempt to appraise the two approaches by translating the implicit verbal argument of Friedman's 1967 Presidential Address to the American Economic Association into an econometrically testable model. Equations are derived which explain the growth of both wages and prices. The econometric equations are of the form:

$$(1) \quad g_{w/q'}_t = a_{10} + a_{11}m_t + a_{12}g_{m_t} + a_{13}g_{p^*}_t + e_{1t}$$

$$(2) \quad g_{p_t} = a_{21}g_{w/q'}_t + a_{22}g_{w/q_t} + a_{23}g_{m_t} + a_{24}g_{S_t} + e_{2t}$$

Here  $g$  means a proportional rate of growth,  $w/q'$  is "standard" unit labor cost,  $w/q$  is actual unit labor cost,  $m$  is the employment rate,  $p$  is the actual and  $p^*$  the expected price level,  $S$  is the ratio of new orders to shipments, and  $e$  is an error term. The first equation states that the rate of increase in standard unit labor cost is a function of the level and rate of change of the employment rate and of the rate of change of the expected price level; the second states that the rate of increase in the actual price level is a function of the rates of growth of standard and actual unit labor cost, the em-

ployment rate, and the ratio of new orders to shipments.

Considerable emphasis in the research is devoted to sensitivity tests of the results. Regressions are run with and without corrections for serial correlation, in levels and one- and four-quarter changes, for different subperiods of the postwar years, and for different methods of generating the expected price level ( $p^*$ ). The sensitivity analysis demonstrates that the coefficients on some of the variables are much more stable than those on others. Among the innovations is a new "unemployment rate of man-hours" which corrects the more familiar published unemployment rate both for disguised unemployment and for partial unemployment. When it is substituted for the published unemployment rate, this new variable improves our explanation of postwar inflation. This unemployment rate was high relative to the published rate in 1962-64 and low in 1969. It therefore helps to explain the low rate of inflation in the former period and the high rate in the latter. Considerable attention is also devoted to correcting the wage (compensation) data for changes in the industrial mix of employment.

While, at the present time, the statistical results are tentative, they tend to confirm the Perry-Brechling view of the inflationary process. The coefficient on expected prices ( $a_{13}$ ) in the wage equation is consistently .5 or less in all of the numerous regressions which employ several different methods of generating estimates of expected prices. Since the coefficients on standard and actual unit labor cost ( $a_{21}$  and  $a_{22}$ ) add up to 1.0, the results for wages and prices together suggest a damped inflationary process in which workers fail to adjust completely to changes in expected prices but nevertheless maintain their share of the national income because there is a rigid relation of prices to wages, as indicated by the price equation.

A preliminary version of the theoretical discussion and empirical results has been written up in the form of a journal article. Subsequent stages of the research will involve dynamic simulations of the wage-price model under

alternative economic policies and formal comparisons of the results with those of earlier investigators.

Robert J. Gordon

### Postwar Productivity Trends in the United States

A manuscript of this monograph has been sent to a staff reading committee for review. A basic objective of the study was to update the estimates and analyses of productivity in the U.S. economy contained in *Productivity Trends in the United States* (NBER, 1961), with particular reference to the post-World War II period, 1948-66. Extensive use of the series contained in *Productivity Trends* indicated the desirability of extending them, particularly since governmental statistical agencies have not yet provided regular estimates of total real capital stocks for the economy, by sectors and major industries, nor the derived capital and total factor productivity estimates.

The concepts behind the estimates are essentially those introduced in *Productivity Trends*, with the addition of gross real capital stock, gross capital productivity, and gross factor productivity measures. The sources and methods underlying the estimates are described in detail in an appendix, which also contains more than eighty basic tables with time series of output, input, and productivity estimates for the U.S. economy by major industry divisions and groups. The estimates were prepared with major assistance from Maude R. Pech prior to her retirement from the National Bureau in early 1969.

Some of the main findings of the study may be summarized as follows:

The trend-rate of increase in total factor productivity in the private domestic economy does not appear to have accelerated since World War II. At 2.3 per cent a year in 1948-66, the trend-rate is the same as that which prevailed in 1916-29, and again in 1936-66 following a



downward shift during the Great Depression. The 2.5 per cent rate between 1948 and 1966, obtained by the compound interest formula, reflects the fact that 1948 was somewhat below the trend, while 1966 was above. The slower average rate of growth from 1966 to 1969 at 1.2 per cent a year has brought total factor productivity back below the trend.

Output per man-hour and per unit of labor input (weighted man-hours) increased at average annual compound rates of 3.4 and 3.1 per cent, respectively, in 1948-66—an acceleration of 0.8 per cent in each compared with the 1919-48 rates. Over and above the trend considerations noted above, the acceleration reflected substantially higher rates of increase in capital per man-hour than in the 1919-48 period.

Real Net National Product increased at an average annual compound rate of 4.1 per cent between 1948 and 1966 (after a small upward adjustment to allow for a 1 per cent a year average increase in government productivity). Thus, the total factor productivity advance of 2.3 per cent a year accounted for well over half of economic growth as measured by real NNP.

Real average hourly labor compensation rose at an average annual rate of 3.3 per cent between 1948 and 1966—0.2 percentage points more than output per unit of labor input. The 0.2 per cent a year rate of increase in unit labor cost also indicates the rate of increase in the labor share of factor income originating in the business economy—from 69.7 per cent in 1948 to 72.5 per cent in 1966.

The relationship between the relative decline in labor input and the relative increase in the real price of labor indicates a historical elasticity of substitution of between .65 and .70. This is quite similar to the elasticities computed for earlier periods, when the labor share also increased mildly as the rate of relative increase in the real price of labor was proportionately greater than the rate of relative decline in the quantity of labor input.

There is a significant positive correlation between 1948-66 rates of change in output and

in the productivity ratios for the thirty-two industry groups of the "industry" sector (excluding agriculture, finance, and services), and for the twenty-one manufacturing groups. There is also a significant positive correlation between rates of change in output and output per man-hour for 395 four-digit manufacturing industries, 1954-63. Fuchs also found a significant positive correlation for seventeen trade and service sector industries. Our results confirm Fuchs' finding that the relationship does not hold for the ten one-digit industry segments.

A major theoretical explanation of the output-productivity relationship is that rates of change in productivity and in (net) price of outputs are negatively correlated, as are those between rates of change in price and in output, assuming that the effects of price elasticities of demand are not outweighed by other demand elements.

For the manufacturing and broader industry groups, there is a significant negative correlation between rates of change in productivity (total and labor) and in output prices. This is reinforced by the associated finding that rates of change in productivity and in factor prices are not significantly correlated.

To complete the chain of relationships, we can note that industry rates of change in price and in output have a significant negative correlation for the period 1948-66.

The degree of positive correlation between relative industry changes in output and in productivity is higher than can be explained by the negative relationships between rates of change in productivity and price, and between price and output changes. This fact suggests that scale effects reinforce the positive relationship between rates of change in productivity and in output.

In the case of the nine one-digit industry segments, the chain of relationships breaks down with regard to relative changes in price and in output, which are not negatively correlated. It appears that price-elasticity effects are outweighed by income elasticities and shifts in tastes operating in the opposite direction. This is notably the case for the extractive and service

segments; relative output of the former has declined despite relative price declines, while the opposite is true of services.

Our basic hypothesis as to the causal factors in productivity growth is that the rate of productivity advance is chiefly a function of the rate of growth of real intangible stocks of capital per unit of the tangible factors in which they are embodied, affecting their "quality" or productive efficiency.

Real intangible capital stocks grow as a result of net intangible investments designed to increase the output- and income-producing capacity of the tangible human and nonhuman factors. The chief types of intangible investment for which we developed estimates are research and development, education and training, health, and mobility.

Total intangible investment grew from 14.5 per cent of GNP in 1948 to 21.5 per cent in 1966. The relative upward movement represents a continuation of earlier trends. Real gross intangible stocks, obtained from the investment estimates, increased at an average annual rate 2.6 per cent higher than the growth rate of real tangible factor inputs in 1948-66—closely comparable to the rate of increase in total factor productivity.

Shorter-term productivity movements are closely related to the rates of utilization of productive capacity, and the ratio of employment to labor force.

The average age of tangible, reproducible fixed capital goods, as a proxy for the rate of diffusion of technological advance, also appears to be significantly related to productivity trends. The average age has declined between 1948 and 1966.

John W. Kendrick

### Other Studies

A draft of Phillip Cagan's study on "The Flexibility of Prices," which examines the speed of adjustment of prices to changes in demand and supply conditions, was reviewed by a staff reading committee. It now awaits revisions by the

author, who has been on leave to serve on the staff of the Council of Economic Advisers.

## Public Finance

### Introduction

Public finance is a field in which the potential for doing useful research has been broadened by recent technological progress to a greater degree than in many other fields of economics. This broadening has arisen from two sources. The increased availability of large-scale microdata sets, consisting of sizable cross-sectional samples of individuals and/or firms with data on a large number of characteristics of these decision units, has resulted in increased opportunity for detailed microeconomic studies of behavioral adjustments to tax differentials. The development of solution procedures to deal with large nonlinear models, such as the Brookings-SSRC model, has made feasible the development of complex general-equilibrium tax policy models which can potentially be used to measure the many interacting effects of changes in the structure of taxes, transfer payments, and certain types of public expenditures.

These advances in technology are of course attributable to the rapid rate of technological progress in computer hardware and software. Even in the very recent past, it was not technologically possible to measure all of the relevant effects of policy changes, such as the restructuring of the income tax system, the reform of unemployment insurance schemes, the introduction of a negative income tax, or the implementation of a substantial change in the mix of taxes collected by governments. It has been possible to predict some of these effects in an incomplete general-equilibrium context. Harberger, for example, has made important contributions to the measurement of welfare losses that are caused by the inefficient allocations resulting from tax distortions.<sup>1</sup> Until re-

<sup>1</sup> See Arnold C. Harberger, "The Incidence of the Corporation Income Tax," *Journal of Political Economy*, June 1962, pp. 215-240; Harberger, "The Measurement of Waste," *American Economic Review*, May 1964, pp. 58-76.

cently, however, it has not been feasible even to consider development of a general-equilibrium model in which redistributive effects, effects on allocative efficiency, and effects on aggregate savings and investment could all be incorporated. It has accordingly not been feasible for public finance economists to measure the trade-offs among effects on growth and redistributive effects which are at the heart of the crucial political issues involved in assessing structural reform of the tax/expenditure system.

The variety of effects that need to be analyzed and the nature of the analyses required have been described elsewhere.<sup>2</sup> From a policy viewpoint, the most relevant empirical question regarding any proposed structural change is normally the long-term effects of the change when accompanied by whatever compensating changes in monetary and fiscal policy are required to offset any effects of the proposed change upon the current level of aggregate demand or upon the current balance of payments. Measuring such compensated effects requires a complex general-equilibrium model that will not be easy to specify. The specification problems are compounded by the necessity of substantial disaggregation in analyzing many tax substitutions and by the usefulness of incorporating microeconomic models utilizing relatively large-scale microdata sets.

Much of the National Bureau's current research activity in public finance is concerned either with how to proceed in specifying a large-scale general-equilibrium tax policy model or with utilizing microdata sets to study the impact of changes in the structure of tax and transfer systems. The work on approaches to general-equilibrium model specification has been largely limited to analysis of the effects of substituting a value-added tax for all or part of the corporate profits tax, and is described below in sep-

arate reports by Bossons and Shoup and by Petersen.

Current analyses of the impact of structural changes in tax and transfer systems are largely focused on four topics: (1) the differential initial incidence of alternative income tax systems, (2) the differential secondary incidence of alternative transfer payment systems, including both negative income taxes and income maintenance programs, (3) analysis of the effect on labor effort of changes in the structure of the current income tax and unemployment insurance programs, and (4) an analysis of the impact of intergovernmental grants. Research on the first topic was begun last year and is described in a progress report by Bossons. The new research projects on the second topic are described in reports by Bossons, Hindle, and Robinson and by Bossons and Hosek. Current research on the third topic includes a continuing study by Holland on the effects of taxes on the work effort by managers and entrepreneurs in new businesses and an analysis by Bossons and Hosek of the work disincentive effects of unemployment insurance. The effects of intergovernmental grants have been analyzed in a study by Dresch and Struyk.

In addition to these projects, which are described below in separate reports, a previous study of corporate taxation and corporate growth by Challis Hall, interrupted by Hall's untimely death in September 1968, is being completed by Norman Ture.

John Bossons

### **Measuring the Effects of Tax Substitutions**

Following the priorities suggested in the outline of research on tax substitutions which we proposed last year, we have concentrated our initial attention on attempting to organize and clarify the research that will be required in order to build a general-equilibrium tax policy model that is adequate for the analysis of the redistributive, allocative, and growth effects of substituting a value-added tax for a corporate

<sup>2</sup> John Bossons and Carl S. Shoup, "Analyzing the Effects of Large-Scale Changes in Fiscal Structure: A Proposed Systems Approach," in *New Challenges for Economic Research*, 49th Annual Report of the National Bureau of Economic Research, New York, 1969, pp. 11-26.

profits tax. In the course of this discussion, two papers have been written to clarify some of the issues involved:

John Bossons, "Evaluating the Substitution of a Value-Added Tax for the Corporate Profits Tax."

Stephen P. Dresch, "An Urban-Regional Component for the General Equilibrium Tax Policy Model: Preliminary Considerations."

In addition to work done on these papers, a new, more detailed proposal embodying the results of discussions on the appropriate staging and likely costs of the proposed research has now been prepared.

John Bossons  
Carl S. Shoup

### **Industry Price/Output Effects of Substituting a Value-Added Tax for a Corporate Profits Tax**

In my study of the economic effects of substituting a value-added tax for the U.S. corporate profits tax, I have altered the direction of my research from balance-of-trade effects in terms of a general-equilibrium model, as I reported in the last *Annual Report*, to a partial equilibrium analysis of the short-run price/output effects of the tax substitution for a single industry. The reasons for this shift in emphasis are twofold.

First, the refinements necessary to describe adequately the tax substitution for the United States in terms of a simple general-equilibrium trade model are too many to provide useful a priori estimates of the tax substitution's trade effects. Although this type of model has been employed by Harberger, Mieszkowski, and others to yield interesting propositions on the incidence of broad-based taxes, it does not seem well-suited to answer questions about the trade effects of these taxes. The more elaborate general-equilibrium analysis that is needed would require more resources than I have at my disposal.

A second related reason for my shift in emphasis is that such a large-scale general-equilibrium analysis has been proposed as a major research effort for the National Bureau. (See the *1969 Annual Report*, pages 11-26.) I have therefore decided to concentrate on one necessary input to this analysis: the short-run price and output effects of the value-added tax/profits tax substitution.

The necessity for examining such price and output responses to the tax substitution arises from the possibility that oligopolistic interdependence in an industry will result in differing pricing policies for different industries, and that pricing policies, together with industry demand and cost conditions, will produce a variety of price and output responses to the tax substitution. To undertake any aggregate analysis of the effects of such broad-based taxes as the value-added tax and the corporate profits tax, it is therefore necessary to examine price and output effects for specific industries.

To accomplish this task, I am constructing a three-equation model which will incorporate an industry's price policy, demand conditions, and cost conditions. Substantial work has been done by others on the specification and estimation of demand and cost functions for various industries, but the price function remains the subject of considerable controversy and requires the most work. In addition to the general exploration of work already done on each of these functions, I am in the process of selecting a particular industry for which the short-run price and output effects of the value-added tax/corporate profits tax substitution may be estimated.

Bruce L. Petersen

### **The Initial Differential Incidence of Alternative Income Tax Systems**

Since this project was described in last year's *Annual Report*, only current work will be summarized here. Work on this project is proceeding in two areas: (1) the analysis of alternative

income tax systems, and (2) the specification of a model of the joint distribution of income and wealth. The latter model will be used as the basis for a more accurate analysis of the differential impact incidence of a tax change, as well as for analysis of the effect of a tax change on asset prices.

Two papers on alternative income tax structures have been completed this year:

“Integration versus Dividend Deductibility.”

“The Effect of Tax Rates on the Impact of Tax Reform: The White Paper vs. an Alternative.”

The first of these papers discusses alternative means of overcoming the effects of the “double taxation” of corporate income under the corporation and personal income taxes; the second discusses the impact of a new set of tax reforms recommended by the Canadian government in its White Paper of November 1969. Another paper on the design of rate schedules under different tax reforms is in progress.

Work on specifying a model of the joint distribution of income and wealth is proceeding in two stages. An initial paper analyzing individual responses to a 1963 Federal Reserve Board survey, a sample of 100,000 1962 income tax returns, and 1962 state tax data is near completion. This work is in part supported by the study described in Section 6 of this report by Raymond Goldsmith. Subsequent research will focus on the patterns of individual ownership of different types of assets as well as on updating the model.

John Bossons

### **The Cost and Incidence of Transfer Payment Programs in Canada**

The primary purpose of this work is to analyze the relationship between family income and the characteristics of families. Data on the composition of family income by intrafamily recipients and by income components is to be used

to examine the sources of income as a family moves through its total life cycle. Among other things, this work should yield insight into the causes of income differentials and the incidence of socially perceived poverty. In addition, the results will be used to assess the costs and incidence of the net fiscal transfers resulting from alternative negative income tax schemes.

In all of the forgoing, “incidence” is defined to mean the differential secondary incidence of a change in the tax/transfer structure that leaves the existing government deficit unchanged but allows for changes in labor force participation rates. Both interregional and urban/rural incidence patterns are to be examined, as well as the incidence of a scheme for individuals in different income and family status classes. For all the analyses, the primary data source being used is a sample of approximately 18,000 families obtained in the 1968 Survey of Consumer Finances in Canada by the Dominion Bureau of Statistics. Work-effort, behavioral adjustment equations will in part be based on the results of the companion study by Bossons and Hosek.

Work to date has concentrated on designing efficient computation procedures and on specifying a model of the source of income differentials. In addition, a preliminary analyses of a smaller sample of Ontario families has been undertaken by Colin Hindle; this study is described in a separate report. It is expected that this project will soon be completed.

John Bossons  
Colin J. Hindle  
T. Russell Robinson

### **Negative Income Taxation and Poverty in Ontario**

The objectives of this research are to determine the incidence of poverty in Ontario and to test the efficiency of alternative means of eliminating poverty. Poverty is measured as the amount by which adjusted disposable family income

falls beneath the "poverty standard." In this case the poverty standard is set equal to existing provincial general welfare assistance rates. These rates provide benefits, differentiated according to family size and composition, for food, shelter, clothing and other living expenses. Adjusted disposable family income consists of net money income plus imputed house rent for owner-occupiers, minus personal income taxes.

The process of negative income taxation is modelled by employing essentially static, initial incidence theory. The substitution of one system of negative taxes for another is assumed to leave all behavior, except work effort, unchanged. Adjustments in work effort are assumed to occur instantaneously in response to the impact of changes in net taxes or transfers. In the absence of further work on labor force participation effects, behavioral equations for heads of households and for spouses, estimated separately by Leuthold, have been used.<sup>1</sup> Decreases in work effort, of course, have the effect of increasing the cost of a negative income tax scheme.

The extent of cost increases due to decreased work effort provides some gauge of the desirability of different schemes. Other measures of relative efficiency, such as the amount of total poverty eliminated and poverty eliminated per dollar of negative tax paid, are determined by the pattern of secondary incidence. Programs that make payments to the nonpoor are, of course, less efficient when judged in this manner. However, differences also occur among schemes that transfer an equal proportion of their total payments to the nonpoor. Some exhibit what may be termed "poverty overkill," providing more funds for a given family within the set of families classed as poor than are necessary to completely extinguish poverty.

The effects and efficiency of various hypothetical negative income tax schemes have been generated by means of a computer simulation

<sup>1</sup> Jane Leuthold, "Formula Income Transfers and the Work Decision of the Poor," unpublished Ph.D. dissertation, University of Wisconsin, 1968.

utilizing microdata. These data are drawn from the 1966 Survey of Consumer Finances, Dominion Bureau of Statistics, and consist of a 1 per cent sample of Ontario "census families." The census family definition is a very close approximation of the nuclear family concept frequently mentioned as the most suitable negative tax unit. In addition, simulations have been carried out to measure the efficiency of existing Canadian programs—family allowances and old age security benefits. At the time of the survey, these schemes made payments to all children under sixteen years of age and all persons over sixty-nine years of age, respectively.

Preliminary results indicate that Ontario poverty is concentrated in urban areas and is most prevalent among unattached individuals, as is shown in Table II-1.

TABLE II-1  
Distribution of Families Below "Poverty Standard," by Family Characteristics, Ontario, 1965  
(per cent)

	Nonfarm	Farm	Total
Unattached individual	44.4	3.9	48.3
Married couple	7.0	2.3	9.3
Married couple with children	15.5	6.3	21.8
Male head (no spouse) with children	0.4	0.0	0.4
Female head (no spouse) with children	19.7	0.5	20.2
Total	87.0	13.0	100.0

Existing Canadian grant programs turn out to be a relatively inefficient means of eliminating poverty. More poverty could be eliminated by using equal-cost, universal negative income tax plans, as shown in Table II-2. In all cases, the poverty gap is defined as the difference between disposable income excluding the transfers being analyzed and the poverty standard previously defined. In the case of universal negative income taxes, each of the three negative income taxes analyzed is defined with

rates yielding a net cost after work-effort adjustments equal to the cost of the grants which it replaces. The ratio of total poverty eliminated (measured in terms of the dollar amount by which the aggregate poverty gap is reduced) to the aggregate cost of each program is a measure of program efficiency.

TABLE II-2  
Efficiency of Alternative Transfers  
(per cent)

	Ratio of Total Poverty Eliminated to Total Cost	Fraction of Poverty Gap Eliminated
Existing programs		
Family allowances	7.6	4.5
Old age security	43.6	36.5
Universal negative income taxes		
Replacing F.A.	63.5	59.6
Replacing OAS	77.4	56.2
Replacing F.A. and OAS	56.0	82.4

Among negative tax schemes proper, best results (in the sense of program efficiency) are achieved by utilizing proportional taxation as opposed to either progressive or regressive taxation.

Colin J. Hindle

### Effect of Taxation on Personal Effort

The design and scope of this project have been described in earlier reports. A preliminary account of some of the findings was presented to the Annual Conference of the National Tax Association in October 1969. This paper, which is to be published in the *Proceedings* volume of that Conference, covers the main findings from the interviews with respect to four general points: (a) The "price" effects on executive effort exercised by the income tax; (b) The influence of taxation on engineers and scientists who have gone into business; (c) The time spent by executives on management of personal tax af-

fairs; (d) The time demands of corporate tax management.

I expect to complete soon a first draft of the study.

Daniel M. Holland

### The Effects of Alternative Unemployment Insurance Programs

Research on this project is to center on two topics: the disincentive effects of unemployment insurance schemes and the analysis of alternative unemployment insurance schemes. Research on the first topic would focus on how unemployment insurance payments affect the duration of unemployment, studies being done for several different labor groups. The second topic involves an extension of an existing model, developed for the Canadian Unemployment Insurance Commission in 1968-69 to permit analysis of alternative unemployment insurance schemes in Canada. The extended models would incorporate information gained from study of the first topic as well as from other supplementary investigations and, in addition, would be expanded to allow study of further alternative programs.

The research will be based primarily on analysis of a large sample of Canadian individuals for whom data on labor force participation, wages, income, age, and family characteristics have been obtained from Unemployment Insurance Commission records and from income tax returns. The data set, a 5 per cent sample of Canadian individuals in the labor force in 1965 and 1966, has been assembled by the Dominion Bureau of Statistics, the Unemployment Insurance Commission, and the Department of National Revenue in Canada. The project is partially supported by the Canadian Unemployment Insurance Commission.

One measure of the efficacy of an unemployment insurance program is the degree to which it affects the size of the employed labor force, both through its effects on the duration of unemployment and through its effects on labor

force participation rates for various groups in the population. Surprisingly little work has been done on this subject. It is not clear whether the duration of unemployment is significantly affected by unemployment compensation, nor is it known whether different labor groups react differently to such payments.<sup>1</sup> Lack of adequate data has precluded empirical measurement of these effects and, at the same time, has blocked development of theories of behavior of the unemployed, particularly a theory of duration of unemployment. The data source developed by the Unemployment Insurance Commission is thus highly useful.

We propose initially to do a study concentrating on married men, ages 25-50. Since these men typically do not leave the labor force when unemployed, changes in their labor force participation rates will be minimal. Thus the participation decision will tend to be independent of decisions regarding job search and duration of unemployment. Also, by studying only married men we avoid the question of how the presence or absence of a wife affects the unemployment behavior of male participants; this question can be analyzed later. Subsequent studies will probably focus on elderly workers, teenagers, and married women.

Work on the second major research goal, development of a model to analyze alternative unemployment insurance programs, will profit from information gained in research on the effects of unemployment insurance on the labor force. We would like to use this information to construct an analytic model that goes beyond that developed to evaluate the present Unemployment Insurance Commission proposals. Our tentative plan is to retain parts of the computer program specifying the model in its present form, modifying other parts to allow for the analysis of other changes in unemployment insurance structure and to incorporate relevant information generated by the disincen-

<sup>1</sup>For a review of previous research, see Charles Lininger, "The Effect of Weekly Unemployment Benefit Amounts on the Duration of Unemployment Benefits," unpublished Ph.D. dissertation, University of Chicago, 1962.

tives study and other supplemental studies.

The details of such modifications remain unsettled. We would like to capture three effects, namely, anticyclical effects, effects of differential incidence of costs and benefits across individuals and industries, and disincentive effects. An integrated analysis of these effects seems necessary before one can specify compensation schemes which are equitable yet also promote the efficient allocation of labor.

A number of preliminary tasks must be completed before much of the above research can be undertaken. These tasks range from additional data validation to problems associated with the extension of the current simulation model. We expect to begin work on analyzing the 1965 and 1966 data in the summer of 1970. We expect that data for 1967 and 1968 will also become available at that time. In the meantime, we are concentrating on developing a model of labor force behavior under unemployment, assuming individuals to be maximizing utility subject to a full wealth constraint.

John Bossons  
James Hosek

### **Inter- and Intrastate Analyses of Grants-in-Aid and Local Fiscal Activity**

These studies are currently undergoing revision and staff review preliminary to publication by the National Bureau. Struyk's study, outlined in the *1969 Annual Report*, is an analysis of state grant-in-aid programs to local governments in New Jersey; Dresch's analysis, presented to Yale University as a doctoral dissertation, utilizes an interstate sample of local governments in metropolitan areas to examine the impact of varying state-local fiscal structures.

The basic model which is used to reconcile the two analyses can be indicated in brief outline. First, an adequate model of local fiscal behavior as it is influenced by grants-in-aid must reflect the structure of the grant-in-aid



system. The conventional model implicitly employed in much of the literature on local government finance assumes that variations in grants are independent of local characteristics and fiscal behavior. An alternative formulation would treat the aid level as dependent on local characteristics, such as income, or the level of local expenditure, as when grants are provided on a matching basis. In that case there is a simultaneous determination of grant and expenditure levels. Secondly, aid programs differ in terms of the intralocal incidence of aid financing, varying from the complete absence of local incidence to total local incidence. The impact of aid programs on local activity, in terms of both income and substitution effects, can be expected to depend on the degree of local incidence. Thus, it is necessary to consider the determinants of aid grants and the relationship between levels of aid and levels of local income net of aid-financing taxes.

In the interstate analysis of urban fiscal activity by Dresch, it is assumed that grants-in-aid have a complete local incidence and hence have no influence on the local budget constraint. This assumption is justified on the ground that, across states, gross differences in levels of aid reflect differences in the distribution of respon-

sibility for the provision of local revenue between the state and local governments. In this context, several alternative influences of grants are considered, most importantly possible differences in the *intralocal* incidence of state relative to local taxes and the imposition of state governmental controls over local activity accompanying increases in relative state revenue responsibility. Thus, the effect of grants is not through the level of payments but through the relative dependence of the locality on state financing. To measure this relative reliance, an aid rate (aid relative to expenditure) is utilized in the expenditure equations.

The effect of aid is quantified in the analysis of undeflated expenditures and local revenues; an increase in grants of one dollar is associated with an increase of \$0.15 to \$0.25 in total expenditures or revenue, and most of the coefficients measuring this association are not statistically significant. Alternative specifications of the aid variable are compared and these aid effects are attributed to the use of the aid rate; it is argued that conventional aid level variables vastly overstate the impact of grants.

Stephen P. Dresch  
Raymond J. Struyk

## 2. NATIONAL INCOME, CONSUMPTION, AND CAPITAL FORMATION

### Introduction

Two separate lines of research have been pursued during the past year. The household capital formation and savings project, under my direction, is concerned with the development of behavioral relations that underly the acquisition of both tangible and financial assets by households. These studies involve analysis of both time-series and cross-sectional relationships. The latter are based on a set of experimental survey data obtained by the U.S. Bureau of the Census, with which the National Bureau is collaborating on the over-all project.

The survey data will be used mainly for analysis of financial asset changes. In addition, the survey is designed to facilitate investigation of the potential uses of anticipatory data relating to changes in both tangible and financial assets.

A second research area, and the major one, concerns analysis of economic and social accounts. Here, Richard and Nancy Ruggles are studying disaggregation problems. They have been concentrating on the construction of sub-sector estimates, using existing data, and on the development and exploitation of microdata sets that would permit types of disaggregation not otherwise possible. John Kendrick and