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Introduction

John W. Kendrick and Beatrice N. Vaccara

Seventeen years elapsed between the previous Income and Wealth conference on productivity held in 1958, which eventuated in the volume *Output, Input and Productivity Measurement* (1961), and the 1975 conference, of which the proceedings are contained in the present volume. During the intervening years, interest in productivity measurement and analysis grew perceptibly. The chief impetus for the first conference was concern with the role of productivity in economic growth and development. Since that time, the course of the U.S. and world economies has focused attention on other aspects of productivity. In particular, the apparent slowdown after the mid-1960s in the U.S. average rate of productivity growth has been associated with an acceleration of general price inflation, a sluggish growth in real wage rates and income per capita, and problems of the international competitiveness of American goods. In addition to the observed decline in the longer term growth rates for productivity there was increased cyclical variability of production and an absolute decline in productivity during the contraction of 1973–75. One of the papers in this volume suggests that, as far as major manufacturing industries are concerned, the increased variability of changes in output completely explains the retardation in growth rates. Be that as it may, the economic developments of the decade prior to the 1975 conference definitely enhanced interest in concepts, measurement, and analysis of productivity—with respect not only to causal factors, but also to the interrelationships of productivity, costs, and prices (both cyclically and secularly) in the U.S. and other major economies.

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One visible evidence of increased federal government concern over productivity was the creation in June 1970 of a National Commission on Productivity, and the continuance of its objectives via the National Center for Productivity and Quality of Working Life (1975–78), and the present National Productivity Council. A number of states have also established productivity centers or their equivalents. In early 1977, C. Jackson Grayson, former chairman of the Price Commission (1971–73), founded the private-sector American Productivity Center to help promote productivity growth. As an objective measure of increasing work on productivity matters, the successive annotated bibliographies on productivity compiled by the Bureau of Labor Statistics have become progressively thicker.[1]

The purpose of the 1958 conference was to "bring theoretician and statistician together to try to sharpen our concepts of output, input, and productivity, and to suggest needed improvements in methods of estimation and basic data."[2] The 1975 conference provides a sampling of the subsequent work designed to sharpen concepts and improve measures of productivity and to analyze relationships of productivity changes or differences to selected associated variables. In this Introduction, we present an overview of the contents of the volume but not full summaries of the papers, which are included in the reviews of the discussants. We also provide background and perspective on developments relating to the concept and measurement of productivity, which is a major focus of four of the papers. This orientation may also help in interpreting the primarily analytical papers.

Conceptual and Methodological Developments

Prior to World War II, all productivity estimates were of the simple output-per-worker or per-hour variety. This was true of the first estimates prepared in the Bureau of Labor by Carrol Wright in the nineteenth century, the work of the National Research Project of the Works Progress Administration in the 1930s, the subsequent program of the Bureau of Labor Statistics, and the various industry studies of the National Bureau of Economic Research—to mention only the major productivity measurement initiatives. The concept of a production function involving capital as well as labor inputs had been developed in the

1. See Bureau of Labor Statistics, U.S. Department of Labor, *Productivity: A Selected Annotated Bibliography, 1971–75*, Bull. 1933 (1977) and Bull. 1914 (1966). The earlier volume contained an average of 60 items per year; the latest an average of 216 items per year.

2. *Output, Input and Productivity Measurement*, Studies in Income and Wealth, vol. 25 (Princeton: Princeton University Press for the National Bureau of Economic Research, 1961), p. 3.

1920s by Paul Douglas and Charles Cobb in a simple form amenable to statistical estimation of parameters. But their results using available figures for U.S. manufacturing did not indicate any upward trend in the "technological scalar," and this evoked skeptical comments by Sumner Slichter and J. M. Clark on the Cobb-Douglas paper at the American Economic Association meeting in 1927. Little further empirical work by others trying to measure productivity change within the framework of a complete production function was undertaken for a couple of decades.[3]

At the first meeting of the Conference on Research in Income and Wealth in 1936, Morris Copeland did suggest that the relationship of real product to real factor costs (input), using the framework of the national income and product accounts (which, of course, are grounded in the theory of production), yields an efficiency measure.[4] But, as pointed out in the paper by Christensen, Cummings, and Jorgenson (CCJ), the first empirical attempt to measure total factor productivity was made by Jan Tinbergen in 1942 in a remarkable but neglected article in which estimates were presented for four countries, including the United States, over a forty-four-year period. The first estimates of total factor productivity we know of prepared in the United States were those of George Stigler for manufacturing presented in a 1947 volume of the National Bureau of Economic Research.[5]

The concept of total factor productivity (TFP) was further elaborated by John Kendrick at a 1951 Income and Wealth conference, and he used it as the framework for his subsequent NBER study of total and partial productivity trends in the United States private domestic economy.[6] Work by several others during the 1950s (as noted by CCJ),[7] including Robert Solow who explicitly used a production function framework, helped to establish TFP as an operational concept.

In 1962, the conceptual and analytical frontiers of the field were expanded further by the imaginative work of Edward F. Denison in his

3. See Solomon Fabricant, "Perspective on Productivity Research," *Conference on an Agenda for Economic Research on Productivity* (Washington: National Commission on Productivity, April 1973).

4. Morris A. Copeland, "Concepts of National Income," Studies in Income and Wealth, vol. 25 (New York: National Bureau of Economic Research, 1937), p. 31.

5. George J. Stigler, *Trends in Output and Employment* (New York: NBER, 1947).

6. John W. Kendrick, *National Productivity and Its Long-Term Projection*, Studies in Income and Wealth, vol. 16 (New York: NBER, 1954); *Productivity Trends: Capital and Labor*, Occasional Paper 53 (New York: NBER, 1956); and *Productivity Trends in the United States* (Princeton: Princeton University Press for NBER, 1961).

7. They might also have included the comprehensive Columbia University dissertation by Irving Siegel, "Concepts and Measurement of Production and Productivity," unpublished.

Sources of United States Economic Growth and the Alternatives before Us. In his 1957 article, Solow had already noted the substantial magnitude of the residual difference between rates of growth of real product and weighted rates of growth of labor and capital inputs as conventionally measured. This residual was challengingly called by Abramovitz a "measure of our ignorance,"[8] and the search was on for the factors that would explain changes in TFP, narrow the residual, and thus reduce our ignorance concerning sources of economic growth. In his initial work (1962), later updated and refined (1974),[9] Denison sought to narrow the residual in two ways: One was by including in his labor input measure estimates of the effect of increased education, shortened hours of work, the changing age-sex composition of the labor force, and other factors that changed the quality of labor over time. The second way was to attempt to quantify the contributions to growth of all major factors other than advances of knowledge, so that his final residual would primarily reflect the impact of that basic dynamic element.

Following Denison, Dale Jorgenson and several collaborators—Griliches (1966, 1967, 1972), Christensen (1969), and Gollop in the present volume—extended to capital the principle of weighting input components by marginal products, and they used a more elaborate system than Denison in adjusting labor inputs for quality shifts. After correction of the early Jorgenson-Griliches estimates for errors pointed out by Denison in their famous exchange (1972),[10] the estimates by Jorgenson and Christensen, and by Gollop and Jorgenson (GJ) in this volume show a substantially larger increase in real factor inputs and a correspondingly smaller increase in the residual than Denison's. Most of the difference is due to the different methodologies used in measuring capital.

As described in their paper, for each of the 51 industries examined, GJ differentiated four types of real capital, which are weighted by the rates of return in four economic sectors. These rates of return are adjusted for the effects of taxation of property income, and for the impact of differences in service lives and rates of change in prices of different types of capital assets.

With respect to labor input, GJ decomposed hours worked by eight age groups, ten occupational categories, five educational attainment

8. See Moses Abramovitz, *Resource and Output Trends in the United States since 1870*, Occasional Paper 52 (New York: NBER, 1956).

9. Edward F. Denison, *The Sources of Economic Growth in the United States and the Alternatives before Us* (New York: Committee for Economic Development, 1962); and *Accounting for United States Economic Growth, 1948–1969* (Washington: the Brookings Institution, 1974).

10. See *Survey of Current Business*, Part 2, May 1972.

levels, two employment classes, and both sexes. They then weighted hours worked by average hourly labor compensation in each of the 1600 cells. This is the most elaborate measure of labor input yet prepared. By dividing indexes of labor and capital inputs adjusted for quality by the corresponding indexes of unadjusted input, GJ obtained measures of the increase in efficiency of labor and capital inputs stemming from relative shifts in the composition of the inputs.

In his more recent work on productivity,[11] Kendrick continued to compute factor inputs unadjusted for quality change, preferring to view the increases in quality as part of the explanation of the broader residual. In a still more recent volume, Kendrick has tried to measure the impact of improving quality of the factors by an approach which differs from those of both Denison and Jorgenson et al.[12] He estimates the real capital stocks resulting from intangible investments designed to improve the efficiency of the factors—R and D, education and training, health and safety, and mobility. He then estimates the contribution of the growth in these intangible capital stocks to economic growth generally, and to the productivity residual in particular. His final residual, while of the same order of magnitude as Denison's, has a somewhat different meaning, of course.

In the last analysis, it is perhaps not so important whether input quality changes are counted as part of changes in the quantity of inputs or as part of the explanation of productivity change, so long as the variables are identified and their separate contributions to growth are quantified. The differences in accounting schemes can then be reconciled.

The separate presentation of quality improvement indexes by GJ also makes possible comparisons with other estimates of the same variable. Although CCJ in principle use the same theoretical framework as GJ, the necessity of preparing consistent total factor productivity estimates for all nine countries necessitated some differences from GJ in the factor input measures for the United States. Thus, CCJ adjusted labor inputs based only on educational attainment data. Surprisingly, for the United States the results are very similar to those obtained by the much more elaborate GJ procedure. The basic capital adjustment procedure was similar in both studies, except that disaggregation and weighting by industry was not done by CCJ, with the result that the indicated increase in capital quality is less in that study than in GJ's.

A valuable contribution to the range of productivity estimates was also made by GJ through relating gross output to total input including

11. John W. Kendrick, *Postwar Productivity Trends in the United States, 1948–1969* (New York: NBER, 1973).

12. John W. Kendrick, *The Formation and Stocks of Total Capital* (New York: NBER, 1976).

intermediate products consumed as well as factor services. For consistency with the nonduplicative national income accounts framework, most previous studies have related real product to factor inputs. But GJ persuasively argue that for purposes of analyzing industry productivity movements, gross output measurement is a preferable approach since substitutions occur among all inputs in response to relative price changes, and innovations affect requirements for intermediate inputs as well as for primary factors.

Perhaps the most important contribution of the GJ and CCJ papers, as stressed by discussant Berndt, is that they incorporated significant recent developments in production and cost theory and in index number theory and practice. Specifically, they used translog production functions, suitable for their multiple-output, multiple-input models; and they consistently employed Törnquist's discrete version of the Divisia form of index numbers for the major components and aggregates of output and input. CCJ also develop the dual of their production function, demonstrating that changes in total factor productivity are equal to changes in the ratio of input price to output price composites. Although Berndt notes several problems with the GJ and CCJ methodology, he considers it a major advance over earlier work employing more restrictive production functions and inflexible Laspeyres or Paasche quantity and price indexes, which are still standard in federal government statistical time series.

A contribution of the GJ and CCJ papers is that they provide future researchers a body of total productivity estimates with factor quality components for the U.S. business economy by industry group, and for nine countries on a consistent basis. CCJ note that, after Tinbergen's pioneering work in 1942, five other economists between 1964 and 1974 prepared total factor productivity estimates for five to nine countries. But the CCJ estimates are the most comprehensive. Their discussant, Don Daly, offers a number of criticisms, some of which the authors used to improve their estimates as described, others of which they reject in a reply to Daly.

Two of the other papers make considerable contributions to matters of methodology, particularly with regard to problems of defining and measuring outputs and inputs in selected service sectors—transportation and government. In the first of these, Meyer and Gómez-Ibáñez (MGI) investigate in some depth the special characteristics of three major transportation modes, with particular reference to the specification and weighting of outputs and of inputs. The measures they produce show significant differences in movement from earlier estimates, although the authors have admittedly not solved all of the puzzles they pose. The inference is inescapable that studies which use standard conventions for measuring outputs and inputs for many industries may, though consistent in a narrow sense, lead to distortions in productivity measures for industries that are regulated or have other special characteristics. Certainly, more careful monographic industry studies of productivity such as GMI's should result in noticeable improvements in the measures available for interindustry comparisons, as well as for analysis of the specific industries. Actually, a considerable monographic literature on productivity in individual industries and sectors has accumulated,[13] but much more remains to be done.

The paper by Searle and Waite (SW) assesses current efforts to measure productivity in the public sector from the viewpoint of adequacy for developing true real product estimates for general government. At present, real government product is measured in terms of real labor compensation, without allowance for productivity change. Granted the input approach as a proxy for measuring real product of nonbusiness sectors, real property compensation should also be included. SW note that BEA is developing estimates of real capital stocks owned by general governments which could serve as a basis for estimating real capital inputs into the public sector.

After reviewing earlier private and governmental efforts to measure outputs, inputs, and productivity in the public sector, SW concentrate most of their attention on the federal program, begun in 1971, which eventuated in productivity estimates prepared annually by BLS covering outputs produced by 65% of federal civilian government employees in 245 organizational elements in 48 agencies. When government enterprises are excluded, coverage drops to approximately 50% of civilian employment. SW observe that the output indicators do not represent ultimate public goods, but rather the flow of work units defined in an instrumental sense. Even if this narrower concept were accepted, they point out various problems such as uneven coverage of functions and the mixing of intermediate with final outputs, particularly from a consolidated, government-wide viewpoint. Whereas the measures are undoubtedly valuable for their primary use as a management tool, SW review the kinds of improvements in the measures needed to warrant their use for adjusting federal civilian labor inputs for productivity change as a means of producing more adequate measures of real product. The discussant, Jerry Mark, is optimistic that continued gradual improvements in coverage and measurement of outputs will eventually justify their use for national-income accounting purposes. This is encouraging, since Mark, as head of the BLS Office which prepares the estimates, is in a position to promote their improvement.

Productivity measurement at the state and local government levels lags far behind the federal government work. But, as SW point out, the

13. See Bureau of Labor Statistics, *Bulletin 1933*, pp. 15–21.

BLS achievements point the way to progress at that level, which now employs over twice as many civilian workers as the federal government. Continued encouragement from the National Productivity Council will help, but it would appear that it will be many years before coverage of state and local government outputs and inputs, even in noneducational functions, is adequate to permit true real product and productivity estimates for the sector.

The Analytical Papers

The remaining seven papers presented at the conference are concerned primarily with analyzing the effects of selected variables on productivity change. None of the papers essays the heroic task Denison set for himself of quantifying the effects on economic growth and productivity of all the major causal factors. Rather, most of the authors attempt to study in depth the productivity effects of one, or a few, variables. This is, of course, the kind of specialized research that will eventually make possible increasingly satisfactory comprehensive explanations of productivity changes and differences.

The broadest in scope of the primarily analytical papers is one by Yamada and Ruttan (YR) on international comparisons of productivity in agriculture. They assemble estimates of agricultural output per worker for six countries for the period 1880–1970, building on an earlier work by Hayami and Ruttan (1971) which contained data only for the United States and Japan. Although they note that total productivity estimates are available for the agricultural sector of at least nine countries, they choose to work with labor productivity estimates which they are also able to assemble for a cross-sectional analysis of forty-one countries for 1970, supplementing the analysis for 1960 conducted in the earlier study. They find it analytically useful to view output per worker as the product of output per hectare of land and the number of hectares per worker, for which they also provide data, as well as for a number of interrelated variables. They then proceed to analyze and interpret both bodies of data within the framework of the induced innovation hypothesis. Their results, summarized succinctly by discussant Schuh and shown graphically in the YR paper, add significantly to our understanding of the interrelationships between differences and changes in relative factor endowments, relative factor prices, types of technological innovation (biological and mechanical), patterns of input use, partial productivity ratios, and several associated variables. Schuh does question YR's use of a Cobb-Douglas production function and the significance of a number of coefficients. For example, he believes the high degree of importance their regression analysis accords to human capital in the form of general and technical education may be picking up the effect of interrelated variables of scale and specialization not included in the analysis. We agree with Schuh's assessment that the YR paper is, nevertheless, a particularly rich bag, and the data are there for those who may prefer to try different types of statistical analysis.

In view of the importance of R and D as a fountainhead of technological progress, three of the conference papers were devoted to empirical studies of the productivity effects and returns to R and D in the private sector. Terleckyj attempts to estimate both the direct and indirect effects of industrial R and D on the productivity growth of twenty manufacturing and thirteen nonmanufacturing industry groups, using Kendrick's estimates of total factor productivity. Employing a Cobb-Douglas production function and standardizing for a number of other related variables, he confirms the findings of his earlier study (1974), that returns to private R and D financed within the various manufacturing industries is high; and that returns to indirect R and D embodied in capital goods and intermediate products purchased from other industries is much higher. For the nonmanufacturing industries, he finds no return to direct R and D (which is small in most of them), but a very high return to indirect R and D. No productivity effects of government-financed R and D are discovered.

Interesting aspects of Terleckyj's paper are his use of the GJ factor quality indexes as standardizing variables, and his later substitution of the GJ total factor productivity indexes for Kendrick's in the twenty manufacturing industries. As might be expected, introduction of the quality indexes results in a significant decrease in the privately financed direct R and D coefficient. Use of the GJ productivity measures not only decreases the R^2s, but both the direct and indirect privately financed R and D coefficients become statistically insignificant. These findings suggest that there may be a high degree of correlation between the education level of the employees and the degree to which a firm invests in R and D, a good portion of which could be "in-house." Indeed, discussant Globerman suggests that possible collinearity between the factor quality indexes and other variables included in the productivity equation may explain the disappearance of productivity effects of R and D with use of the GJ productivity measures. Globerman also comments on various issues relating to model specifications, measurement problems, and the single-equation estimation procedure, although he judges Terleckyj's findings to be generally plausible. He notes that publication of the author's data series will facilitate further testing and extension of his work by others.

Griliches based his analysis of returns to R and D in six industry groups on time series data (1957–65) for 883 large U.S. manufacturing companies. These companies accounted for about 90% of sales and a bit more of R and D. Information from the annual NSF Census R and

D surveys was supplemented by data on value added, assets, and depreciation based on a match with the 1958 and 1963 Census of Manufactures and Enterprise Statistics. Although constrained by confidentiality restrictions, inability at the time to include still other bodies of data, and various simplifying assumptions, Griliches was able to develop some interesting findings and suggest directions for future research.

Specifically, fitting Cobb-Douglas type production functions with data for levels in 1963 and rates of growth for the period 1957–65, Griliches obtained an elasticity of output with respect to R and D investments of around .07, which is consistent with findings of others. The elasticities were higher for the research-intensive groups, and lower for the less intensive groups. For most of his groups, total private rates of return were in the 30 to 40% range, about double that earned by physical capital during the same period, but lower than the Terleckyj estimates which Globerman suspects are too high. But supporting the direction of Terleckyj's results, Griliches found that the two industries with the largest proportion of federal R and D financing showed the lowest rates of return on R and D. Finally, he finds no support for the notion that larger firms (among those with over 1,000 employees) "have either a higher propensity to invest in R and D or are more effective in deriving benefits from it." This also accords with findings of prior studies.

In his comments, Mansfield notes the lag between R and D investments and derived commercial innovations, and presents some relevant data. He also offers results of a case study of private rates of return from investments in R and D and related innovative activity, which are not inconsistent with the findings of Griliches. He suggests that the social rates of return are higher than the private, but that both have probably fallen since the period studied by Griliches. Griliches agrees that a study of the post-1965 period would be useful, particularly since it is a period when real R and D growth ended for many firms.

Nadiri and Bitros (NB) approach the analysis of R and D and productivity growth at the level of the firm. The discussant, Richard Levin, notes that the novelty of their paper lies in its focus on the short-run disequilibrium dynamics of R and D outlays, within a general dynamic model of input demands and factor substitutions. Using data for sixty-two firms for the period 1965–72, NB find that the firm's decisions regarding employment, capital accumulation, and R and D are closely related in a dynamic interaction process. All of the decisions, including R and D activities as well as demands for labor and tangible capital, are influenced significantly by both sales and relative input prices. The output elasticities of the inputs over the long run are quite similar, suggesting constant returns to scale. Demand for the inputs, including R and D, appears quite stable when firms are stratified by asset-size classes. The most important conclusion from the viewpoint of the conference topic is that both labor productivity and tangible investment demand of firms are significantly affected by their R and D outlays, particularly over the long run.

Levin notes various data problems, and expresses serious reservations concerning NB's basic model. Nevertheless, he considers the paper an important step forward and hopes the authors will pursue their line of inquiry further using richer bodies of data and appropriate joint estimation information techniques.

Klotz, Madoo, and Hansen (KMH) address themselves to a study of high and low value added per production worker-hour (VA/H) establishments in U.S. manufacturing. Because of confidentiality restrictions, KMH deal with quartiles of establishments (discussant Siegel recommends deciles) in a maximum set of 195 four-digit industries for which data were deemed satisfactory, and a subset of 102 industries. Although KMH had initially referred to VA/H as "labor productivity" in their title, in the floor discussion Lipsey pointed out that VA/H is not really an efficiency measure but is more like a proxy for factor proportions, reflecting differences in capital and nonproduction workers per production worker, plus differences in factor prices (including profits) and indirect business taxes among establishments.

Since Lipsey's comment was well taken, it is not surprising that KMH's multiple regressions indicate that differences in factor proportions and in monopoly power contribute to an explanation of high VA/H. But even these factors explain a relatively small portion of interquartile differences, particularly in the low VA/H plants, and experiments with other presumably explanatory variables do not help. This leads KMH to conclude that the strength of transitory, disequilibrium elements casts doubt on any static explanation of productivity differences. In one of the more humorous comments at the conference, Siegel stated: "Any reader of the paper who stays the course not only feels sadder and wiser at the end but is also inclined to congratulate the data for withstanding the torments of advanced technique without confessing what they did not really know and, therefore, could not tell." Siegel concurs with the authors that longitudinal studies, relating differential rates of change in real value added per unit of input to associated variables among groups of establishments, would yield more useful results.

Certainly, firm and establishment level productivity studies are of great potential importance, since that is where the action is with respect to innovational decisions, large and small, and relative efficiency of operations under given technologies. The promising BLS program of plant level productivity measurement and analysis, started after World War II, was terminated after several years because of high cost. But the OECD and some other countries have continued to stress interfirm and interplant comparisons. In recent years, the National Center for Productivity, the Department of Commerce, the Conference Board, and most recently the American Productivity Center have promoted company productivity measurement. The expansion of company information systems to include productivity data is not only helping internal management programs to increase efficiency, but, as Siegel points out, the increased quantity and quality of "atomic" information will contribute to improved productivity measurement, analysis, and policy formulation at the macro as well as the micro levels.

Myers and Nakamura (MN) contribute a paper on the timely topic of the effects on investment and productivity of antipollution and occupational safety and health requirements, and of large unexpected increases in the price of energy. MN develop a putty-clay model with the usual assumptions, including one of steady cost-reducing technological progress over successive vintages of capital—and two outputs, a good and a bad (with a negative price). They conclude that the accelerated obsolescence and induced investment effects of environmental and health-safety standards and energy price hikes will provide significant productivity offsets to the trade-off of fewer goods with given inputs, which reduces productivity as usually measured.

Their discussant, Cremeans, argues that MN have not realistically assessed the management decision to invest in new and presumably better facilities, in light of actual regulatory practices and uncertainties regarding future standards. He also notes that they fail to take account of effects on the cost of capital of increased capital demand stemming from accelerated obsolescence. Cremeans advises MN to examine empirically their assumption that new vintages of facilities incorporating antipollution and energy-conserving features have significant cost advantages over older vintages. For these and other reasons, he recommends that the authors revise their model and research plan. Despite the criticisms, MN are congratulated on pioneering and imaginative work on assessing the productivity effects of contemporary developments that are widely believed to have contributed to the productivity slowdown of recent years.

To test the proposition that the productivity slowdown after 1966 was due to greater cyclical output instability than in the 1956–66 period, Michael Mohr uses a translog model of interrelated (stock-adjustment) factor demand with quarterly data on six inputs for ten two-digit SIC manufacturing industries. Without our trying to describe his complicated model (which discussant Humphrey does admirably), suffice it to say that Mohr maintains that, when demand exhibits increasing variation, firms adjust by altering labor hours and capacity utilization rates in preference to adding to fixed capital stocks. Consequently, output per hour is lower when demand is more erratic because more of the adjust-able short-run labor input is used to produce a given output than during periods of steadier growth in demand and production. His estimate of labor and other factor demands that are independent of changes in the adjustment sequence due to increased variability of output indicates that labor productivity would have grown as fast in the 1966–72 period as in the prior decade if output growth had been as steady.

This is an important conclusion, if valid. Humphrey points out that the results are affected by exclusion from the model of variables such as changes in age-sex mix, to which the slowdown has also been attributed. But if Mohr is right, it means that the retardation in productivity growth is reversible. If his results can be generalized from manufacturing to the business economy as a whole, it means that we may return to the pre-1966 trend rate of productivity advance in coming years if macroeconomic policies result in at least as stable a rate of growth as was experienced in the 1946–56 decades.

Despite the findings of Mohr, it is most likely that a combination of factors, only one of which was increased cyclical instability, was responsible for the 1966–76 slowdown in productivity growth. Certainly, the significant changes in age-sex mix of the work force, the changing industrial distribution of employment, the decline in R and D outlays relative to GNP, accelerating inflation, the decline in the rate of growth of physical capital per worker, environmental, health, and safety regulations, and the 1971–74 wage-price control episode, as well as other socioeconomic trends, have all contributed to the retardation. Consequently, policies to accelerate productivity growth will require more than just the resumption of steadier economic growth, although that is an important economic objective for reasons transcending its favorable impact on productivity.

In any case, the important progress that has been made in the past couple of decades, as evidenced in this volume, puts us in a far better position to track and analyze productivity developments. This in turn improves our ability to prescribe policy measures that can promote productivity advance and thereby the attainment of the important economic goals that are associated with it.