The remainder of this paper examines the statistics available to address a set of important economic policy issues. The discussion is designed to outline some of the challenges faced by the statistical agencies in providing answers to even the most basic economic questions and survey some of the more important problems that have emerged in recent years resulting from inadequate planning, budgets, or coordination. Some of the problems identified are not new, some may be difficult or impossible to resolve completely given even the most perfect system. The purpose of this discussion is not to propose specific solutions to the problems raised but to demonstrate that important problems exist and that there is a need for a coordinated effort to address them.

A. How Rapidly is the U.S. Economy Growing?

New technology, the pressures of highly competitive domestic and international markets, and changes in the tastes and values of the American market have changed the direction of economic growth in basic ways. The number of pounds of materials and the total amount of energy used by the economy did not increase significantly between 1977 and 1987 even though the total output of the economy measured by the real Gross National Product (GNP) increased 28 percent (see figure 1).[1] The products produced by the economy has obviously taken the form of adding more and more value to a given amount of basic materials. Much of this value is difficult to measure with the precision possible in a economy dominated by raw materials. Growth must be measured not only in terms of the number of items produced, but by changes in the quality of products ranging from optic fiber cables to fresh produce. In turn, quality should reflect the growth in the variety of products offered, and the extent to which people are able to purchase products well tailored to their specific tastes and interests. For example, the magazine publication industry, once dominated by large national journals, now has some 11,500 titles.[2] The problem of adjusting for quality becomes more complicated when the product being produced is a service: how do you measure quality changes in legal services?

Tracking an economy where growth depends on qualitative factors is obviously more difficult than tracking growth when output is easily weighed or counted. It is necessary to acknowledge the fact that the precision with which we measure economic growth is likely to decline even given the most heroic efforts by statistical agencies. But policies designed to encourage economic growth need to be made with the best possible description of the areas where growth is likely to be important.

Measuring Real Economic Growth

The primary tool for measuring changes in the size of the economy is the Gross National Product Accounts (GNP) (see box B). The GNP estimates produced by the Bureau of Economic Analysis (BEA) have been the subject of a number of reviews, and improvements are constantly being made,[3] BEA received a total of 75 recommendations from various groups and commissions and was able to implement 51 of them.[4] BEA maintains a long list of additional improvements they would like to incorporate into the accounts.

Two kinds of improvements to the GNP have been discussed over the years. The first deal with the basic structure and coverage of the accounts—e.g. should government spending be treated as consumption or should government spending on roads, airports, research, or education be considered an investments should the value of economic activity that occurs outside of the formal marketplace such as

[1] U.S. Congress, Office of Technology Assessment, Technology and *the American Economic Transition" Choices for the Future,* OTA-TET-283 (Washington, DC: U.S. Government Printing Office, May 1988), p. 277.

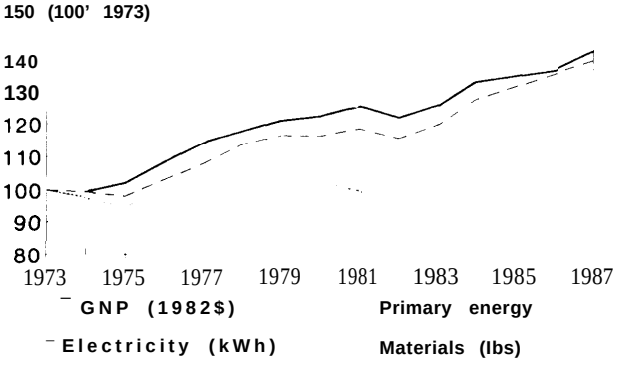
[2] U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States, 1989,* table 913, p. 549.

[3] Most of the recent studies are reviewed in C.S. Carson and G. Jaszi, "The Use of National Income and Product Accounts for Public Policy: Our Successes and Failures," U.S. Department of Commerce, Bureau of Economic Analysis, Staff Paper No. 43.

[4] The groups included the National Accounts Revie, Committee, the Contributors to the *Retrospect and Prospect,* the *GNp Data* improvement Project, and the Round Table of GNP Users. See Allan H. Young "Evaluation of the GNP Estimates," *Survey of Current Business,* August 1987, p. 20.

[5] See R, Ruggles and N.D. Ruggles, "Integrated Economic Accounts for the United States, 1947 -80," *Survey of Current Business,* May 1982; R. Eisner, "The Total Incomes System of Accounts," Survey *of Current Business,* January 1985; and Anthony S. Campagna, Macroeconomics *Theory and Policy* (Boston, MA: Houghton Mifflin, 1974), ch. 1, pp. 7-21,

Figure I-Index of GNP Growth and the Use of Energy and Materials in the United States



SOURCE: R. Williams, E. I-arson, and M. Ross, "Materials, Affluence and Energy Use," *Annual Review of Energy*, No. 12, 19S7, pp. 99-144.

housework or illegal activities be included in the national accounts?[6]

The oil crises of the 1970s and growing concern about environmental issues in the 1980s has led to concern that the formal national accounts do not properly reflect changes in natural resource assets or environmental quality and thereby give a misleading view of changes in real national wealth.[7] It would be possible to maintain statistical series that would track resource and environmental issues as "addenda" to the traditional accounts. More precise tracking of resource and environmental changes would require statistics on the inputs and outputs of different production technologies not available within standard statistical series.[8]

The existing statistical system makes it extremely difficult to anticipate the potential impact of emerging technologies. Statistics document changes in **average** businesses inputs and outputs but provide little information about the performance of facilities using new technology. The accounts do not distinguish between capital investments that simply replace obsolete or worn equipment from capital investments that represent real growth or replacement of old technologies with new.[9] These limitations makes analysis designed to show the net impact of new technology on employment, profitability. job quality, energy use and other factors difficult to track.

A second class of improvement, which will be the primary focus of this discussion, deals with more technical issues—how accurate are records maintained within the existing accounting framework.

The problem of improving, or indeed even of maintaining the quality of the GNP accounts has been made more difficult in recent years for a number of reasons:

- Rapid changes in the quality of goods (especially in computers and other information equipment) and rapid growth of service industries makes the problem of adjusting for inflation increasingly difficult.
- Rapid increases in the number of comparatively small manufacturing establishments (many of which may be subsidiaries of large Fins) and increases in the role of service businesses (service businesses have always been comparatively small establishments), have made census counts more difficult. It is easier and less expensive to obtain accurate data from a small number of large establishments than a large number of small ones—if only because the larger establishments keep more precise records.
- In some instances, data formerly available from accounts provided to regulators in businesses like trucking, railroads, and airlines now must

[6]Carol S. Carson, "The Underground Economy: An Introduction, ''Survey *of Current Business*, May, pp. 21-37, and July 1984, pp. 106-1 17; Frank de Leeuw, "An Indirect Technique for Measuring the Underground Economy: A Note on Revised Data," Survey *of Current Business*, September 1986, pp. 21-22; Joel F. Houston, "The Underground Economy: A Troubling Issue for Policy makers," *Business Review*, September-October 1987, pp. 3-12; and James D. Smith, "Measuring the Informal Economy, " *The Annals of the American Academy*, vol. 493, September 1987, pp. 83-99.

[7]See Robert Repetto, "Wasting Assets: Natural Resources in the National Income Accounts" (Washington DC: World Resources Institute, 1989); "A System of National Accounts," U.N. Statistical Papers Series F-2, 1968; U.N. Department of Economic and Social Affairs, "Provisional International Guidelines on the National and Sectoral Balance Sheets and Reconciliation Accounts of the System of National Accounts." Statistical Papers Series M60, 1979; U.N. Statistical Office, "Future Directions for Work on the System of National Accounts," 1979.

[8]Faye Duchin, "Framework for the Evaluation of Scenarios for the Conversion of Biological Materials and Wastes to Useful Products: An Input-output Approach," presented at the joint session of the American Economics Association/American Association for the Advancement of Science, New York, Dee. 29, 1988.

[9]Faye Duchin, "Analysing Structural Change in the Economy," *Input-Output Analysis: Current Developments*, M. Ciaschini (ed.) (London: Chapman and Hall, 1988).

Box B—The National Income and Product Accounts

The U.S. GNP accounts are constructed in two ways: (i) the "product accounts" that measure the value of all products and services sold for final consumption by households and the government, as business investment (gross private domestic investment), and net exports (exports less imports), and; (ii) the "income accounts" that measure the value of all income earned as wages, benefits, profits, and the like (see tab. 2).[1]

In principle, the income and product accounts both sum to the GNP. In practice, adjustments need to be made to achieve balance. The product estimates are generally considered most reliable. Even after both sides of the accounts are adjusted using a variety of data sources a small "statistical discrepancy" remains. It was 0.2 percent of the GNP in 1987 and appears to be declining slowly.[2]

It is necessary to recognize that the GNP accounts were never intended to be a complete tool for describing the economy and its limitations must be recognized. Many activities of enormous value do not appear in the accounts (i.e., the value of education received from parents at home, environmental damage resulting from economic activity) largely because they occur outside of the formal marketplace. GNP accounts no longer provide any information about the way income is distributed among households—in fact the GNP can grow while the real income of many groups declines.[3]

[1]Carol S. Carson, "The History of the U.S. National Income and Product Accounts: Development of an Analytical Tool," *Review of Income and Wealth*, June 1975. Carol S. Carson,' 'GNP: An Overview of Source Data and Estimating Methods," *Survey of Current Business*, July 1987.

[2]A.H. Young, "Evaluation of the GNP Estimates," Survey *of Current Business*, August 1987, pp. *20-21.*

[3]In the 1970s, the BEA had a program of non-market aspects of economic wellbeing and presented household income distribution ss a part of GNP accounts, but both were eliminated because of budget cuts in the late 1970s and early 1980s.

Table 2—Distribution of the GNP in 1987
(percent of total)

Income accounts:	
Compensation of employees	59.2
Property-type income[a]	22.0
Depreciation [b]	10.6
Other [c]	8.2
Statistical discrepancy	-0.2
Total	100.0
product accounts:	
Personal consumption expenditures	66.7
Government purchases of goods and services	20.4
Gross private fixed investment	15.7
Net exports of goods and services	-2.8
Total	100.0

[a]Proprietor's income, rental income, corporate profits, net interest.
[b]Capital consumption allowances with capital consumption adjustment.
[c]Business transfer payments, indirect business tax and nontax liability less subsidies less current surplus of government enterprises.

SOURCE: U.S. Department of Commerce, Bureau of Eonomic Analysis, National Income and Product Accounts.

be obtained from trade associations or census surveys.

. During the past few years there has been an 8 percent *real* reduction in the funding available to the BEA, which maintains the GNP accounts. 10

Technical Measurement Issues

Adjusting for Inflation—The question of how to adjust for inflation is probably the most difficult to solve. Yearly measurements of the value of goods and services purchased cannot provide an adequate measure of economic growth. In order to obtain a consistent comparison over time, products valued in current dollars must be revalued into a constant set of prices that adjust not only for the changes in prices, but also for changes in the quality of products.

The Bureau of Labor Statistics provides the basic data for inflation adjustments primarily by using the results of three major surveys (box C); each of which has its share of drawbacks. Some are chronic while others result from changes in the economy.

- Perhaps the most vexing problem arises from changes in the quality of the products offered for sale. Price adjustments work well only

[10]In fiscal year 1978, BEA's budget (excluding transfers) was $16.2 million (in 1980$). In 1986 the budget was $14.9 million. U.S. Congress, General Accounting Office, "R&D Funding: The Department of Education in Perspective" (GAO/PEMD-88-18FS), May 1988, pp. 9-11. For a more detailed discussion of the budgets of the statistical agencies, see National Association of Business Economists, "Report of the Statistics Committee of the National Association of Business Economists," February 1988, pp. 10-15, 25.

Box C—Deflator Series

- The "Consumer Price Index" (CPI) is used to compare prices of a fixed "market-basket" of products and services purchased by consumers-about two-thirds of the GNP. Surveyors are given a precise list of products, an item might be a jar of peanut butter, and check the prices of these items in a scientifically selected set of retail establishments throughout the country. Changes in the prices of the selected products are used to estimate price changes in most areas of consumer spending. They are also used to estimate price changes for many areas of government spending. * The ratio of priced changed for a product in a given year to the price charged in a baseline year (e.g., 1982) is called the "deflator" for that year.
- The "Producer Price Index" (PPI) is used to adjust the value of most products purchased as an investment by businesses and business inventory changes. This index uses techniques similar to those used in the CPI but in this case surveyors ask individual businesses for the prices of their products.
- The "International Price Program" measure price changes for products imported and exported from the united states.

Separate series are provided for housing and other structures and for some other products. The PPI is used to deflate some government purchases of goods and services for which a reasonable analogy can be found in the private sector and which are not covered by BEA price series on defense expenditures and compensation paid to government employees.[2]

[1] "The U.S. National Income and Product Accounts: Revised Estimates," *Survey of Current Business*, July 1988, table 7, pp. 31-33.

[2] Ibid.

when quality changes occur comparatively slowly. 'But in today's economy, growth must increasingly be measured in terms of product quality and consumer choice.

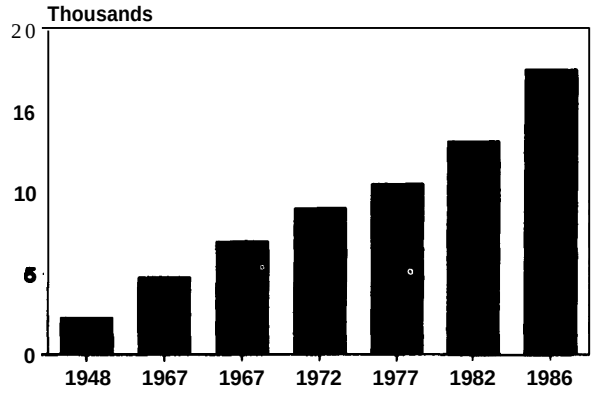
Quality adjustments are comparatively easy when a new feature is added to a familiar product. If a new car is sold with white side-wall tires as standard equipment, for example, the Consumer Price Index (CPI) can be adjusted to reflect the extra marginal cost of these tires. Other kinds of quality adjustments are more difficult-both conceptually and mechanically. Electronic products are perhaps the most striking example of change. New kinds of television receivers, home computers, telephones, and a variety of other devices redefine consumer electronic markets yearly.

Even more troubling, the inflation adjustments miss an important dimension of quality that seems to have proven appeal to the American market: the value of growing choices available to consumers. While the BLS surveyor accurately assesses price changes in the 12-ounce jar of peanut butter, a grocery store customer may be selecting the jar from an enormous variety of different types of peanut butter in 1989 'while having few choices in 1983. For example, large groceries have also introduced many other amenities (salad bars, bakeries, fish specialties, etc.) without significant increases in product cost. Is this an improvement in quality? Consumers and grocery store owners seem to think so, "Generic brand" offerings have declined while stores offering 20,000 or more different products have prospered (see figure 2).[11] The value of variety embodied in grocery purchases is not captured by the BLS surveyors. As a result, BLS may measure a price **increase** while in fact the real cost of the bundle of goods and services purchased at groceries may have **decreased** because sophisticated technology and management techniques make variety increasingly inexpensive.

. It has become increasingly difficult to develop good measures of changes in the quality of products purchased as capital equipment by businesses (7 percent of GNP). In particular, new information equipment presents the most serious challenges. Working with IBM, BEA has attempted to find a way to adjust the prices

11- N, Baily and Robert J. Gordon, "The productivity Slowdown, Measurement Issues, and the Explosion of Computer power," *Brookings Papers on Economic Activity, vol. 2, 1988,* p. 412.

Figure 2—Products Carried Per Supermarket



SOURCE: M. Baily and R. Gordon, "The Productivity Slowdown, Measurement Issues, and the Explosion of Computer Power," *Brookings Papers on Economic Activity, vol. 2,* 1988, p. 413.

of computers for quality changes.[12] The deflator uses an index not strictly tied to the price of products, but instead makes adjustments by comparing specific characteristics over time, such as how many million of instructions are executed per second (MIPS) or how memory capacity has changed, to get an indication of the change in the value of computer power.[13] Not surprisingly the change has been dramatic. For example, the price of one megabyte of main memory fell by a factor of 20 between 1972 and 1984.[14] Changes of this magnitude have a large affect on the deflator. While the deflator for all producer durable equipment (PDE) was 1.078 in 1987 (1982=1.00), the deflator for the "office, computing, and accounting machinery" (OCAM) category was 0.55.[15] This single deflator has an enormous effect on the "real" purchases of PDE measured, the real growth of GNP, and the productivity growth rate of manufacturing. For example, PDE in constant 1982 dollars increased at an annual growth rate of 13.8 percent between 1983 and 1987. If the OCAM deflator had been the same as the average of the other parts of the PDE deflator, growth would have been only 4.3 percent.[16]

The process used to reflect quality improvements in computers has not been extended to other high-technology equipment like semiconductors and communications equipment, although work is beginning. As a result, the output price deflators for microelectronics actually rose from 1972 to 1982 while the index for computers fell drastically .17 This inconsistency could lead a researcher unaware of the problem to erroneously conclude that productivity gains in the computer industry were achieved without, or in spite of, corresponding gains in the semiconductor industry.[18] Similar problems exist in many areas where new products are radically different than the ones they replace.

- Measuring changes in the quality of computers, however, can seem easy in comparison with the challenge of measuring changes in the quality of services. Services are a growing fraction of the GNP before adjustments are made for inflation. Changes in the quality of health care (10 to 11 percent of the GNP) and education (7 percent of the GNP) are poorly measured or not measured at all. Fundamental conceptual problems must be confronted in developing deflators for these sectors. BLS has research projects underway in health care and other difficult service sectors, A deflator for health care should, in principle, adjust for changes in the quality of care received. But while it may be possible to develop a deflator for a specific medical test or a specific set of medical

[12] R. Cole, Y.C. Chen, J.A. Barquin-Stolleman, E. Dulberger, N. Helvacian, and J.H. Hedge, "Quality-Adjusted Price Indexes for Computer Processors and Selected Peripheral Equipment," *Survey of Current Business,* January 1986, pp. 41-50; David W. CartWright, "Improved Deflation of Purchases of Computers," *Survey of Current Business,* March 1986; and David W. Cartwright and Scott D. Smith, 'Deflators for Purchases of Computers in GNP: Revised and Extended Estimates, 1983 -1988," *Survey of Current Business,* November 1988, pp. 22-23.

[13] Cole, et al., op. cit., pp. 41-50.

[14] Cole, et al., op. cit., p. 47.

[15] U.S. Department of Commerce, Bureau of Economic Analysis, National income and Product Accounts, table 5.7.

[16] Ibid., tables 5.6 and 5.7.

[17] Show-Ling Jang and J.R. Norsworthy, "Scale Economies, Learning Curves and Downstream Productivity Growth: A Study of Technology in the Us. Microelectronics and Computer Industries," Technical Report *02-88,* Center for Science and Technology Policy, School of Management, Rensselaer Polytechnic Institute, August 1988, p. 13.

[18] Ibid., p. 12.

procedures, it is difficult to measure whether the patient's health has benefited from additional tests that may be administered.

. Changes in the quality of structures (8.4 percent of the GNP), particularly nonresidential structures, are measured very poorly .19 The value of new housing is adjusted using 10 measures of housing quality.[20] The value of nonresidential structures is adjusted for inflation using a mixture of the residential deflator and a standard set of building inputs.[21] There are many reasons to believe that the construction deflators prepared in this way do not provide an accurate measure of changes in product quality.

The residential deflator, for example, does not reflect the addition of new amenities such as dishwashers, energy-efficient improvements, and landscaping which have become common.[22] The use of a standard mix of labor, material, and equipment inputs, is used to represent nonresidential buildings ranging from warehouses to hospitals has obvious deficiencies. Changes in quality and productivity improvements are not incorporated. The Canadians, who do a much more thorough job of measuring construction quality, estimate that the price of construction products rose only 3.5 percent more than the Canadian GNP average between 1967 and 1986 while the U.S. estimates show construction prices rose 15 percent more than the U.S. average.[23] Because the price index is so high, output of the construction industry tends to be over adjusted for inflation, resulting in an underestimate of real output.

Adjustments for inflation can lead to misleading measures of growth rates. For example, the deflator for computers is so much lower than the deflator for the economy, a significant fraction of the percentage growth of GNP in constant dollars results from the methods, particularly the selection of a fixed base year, used to adjust for inflation-not an increase in current spending for computers. The deflators can thereby create a distorted view of growth rates. For example, growth in producer durable equipment between 1982 and 1988 measured in *constant 1987 dollars* averaged 5.9 percent per year but was 8.4 percent per year when measured in *constant 1982 dollars. The* BEA is examining alternative ways to express GNP growth in preparation for the comprehensive revision scheduled for 1990.[24] One way to avoid distortions due to different base-year weights is to compute growth rates by determining the constant dollar growth rate for each product separately and weighting each product by the average *current dollar sales* of each product for the first year.[25]

It would also be useful to develop explicit "addendum" accounts that report changes in production and use of physical commodities whenever such data is available. Many of these series are already maintained to develop deflator series. Published series consistent with the national accounts would provide a view of changes in demand for energy, materials, and other countable products and services that would be a valuable addition to "constant dollar" measures.

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[19] The problem is complicated by the fact that structures are very heterogeneous products produced by a diverse industry composed of generally small fins. See Committee on Construction Productivity, Building Research Board, Commission on Engineering and Technical Systems, National Research Council, *Construction Productivity* (Washington DC: National Academy of Sciences Press, 1986); and P. PiePer, "The Measurement of Structures Prices: Retrospect and Prospect," 50th Anniversary Conference on Research in Income and Wealth, NBER, May 12-14, 1988.

[20] Floor area, number of stories, number of bathroom, presence of central air-conditioning, type of parking facility, type of foundation, geographic region, metropolitan location, presence of fireplaces, and lot size. See "price Index of New One-Family Houses Sold" (Bureau of the Census), various issues.

[21] The Turner Construction Co., a large builder of commercial and industrial structures, estimates the cost plus profit using a standard mix of inputs. See "Revised Deflators for New Construction, 1947-73," *Survey of Current Business*, August 1974.

[22] Baily and Gordon, op. cit., footnote 11, pp. 402-406.

[23] Baily and Gordon, op. cit., footnote 11, pp. 402-409.

[24] Allan H. Young, "Alternative Measures of Real GNP," Survey *of Current* Business, April 1989, pp. 27-34.

[25] See National Income and Product Accounts, op. cit. footnote 15, table 8.1.

Box D-Classifying Businesses

Measuring the output of industries is contingent upon defining the industry itself. The fundamental identifying system for industry classifications is the Standard Industrial Classification (SIC) Code-the official existence of an industry. After 15 years, several false starts, and the input of over a thousand public and private opinions, the SIC was revised in 1987.

Nevertheless, several observers think that this effort was incremental in nature and that a more complete overhaul is needed.[1] The concern is that emerging industries that typically enjoy tremendous growth can not be tracked because they are not identified by the SIC system. Instead their growth is lumped into a broader category that obscures the source of the change or a category that is a grab bag of leftovers such as SIC 7389 "Miscellaneous Business Services" which includes everything from meter readers to yacht brokers.

Even though the 1987 SIC revision created three new 4-digit categories for computer equipment like storage devices, terminals, and computer equipment n.e.c. (not elsewhere classified), it still left ail computer manufacturing (minis, micros, and mainframes) under one 4-digit SIC. Similarly all eating places (McDonalds to the 21 Club) are under one 4-digit SIC (no change from 1972). Meanwhile, footwear gets broken into rubber and non-rubber categories (at the 3-digit level) and then under non-rubber footwear there are four, four-digit categories: men's footwear (except athletic), women's footwear (except athletic), house slippers, and footwear, except rubber n.e.c.[2] Although attempts to retain consistency over time are important, additional detail for large and growing industries at the 4-digit level seems warranted.

[1]National Association of Business Economists, "Report of the Statistics Commi [tee of the National Association of Business Economists," February 1988, p. 17; statement of Courtenay Slater before the Subcommittee on Government Information and Regulation, Committee on Governmental Affairs, U.S. Senate, May 15, 1989, p. 5; National Academy of Sciences, Committee on National Statistics, *Statistics About Service Industries* (Washington, DC: National Academy of Sciences), 19S6, p. 10.

[2]Office of Management and Budget, *Standard Industrial Classification Manual,* 1987 (Washington, DC: U.S. Government Printing Office).

B. Which Businesses Are Responsible for Growth and Has Growth in the Complexity of the Networks Connecting Different "Kinds of Businesses Changed the Interdependence of Businesses?

While many difficulties are encountered in measuring the gross output of a modem economy, even greater problems are faced when attempts are made to trace this output to the activities of different kinds of businesses. Just defining and classifying a business is a difficult task (see box D). The contribution each business type makes to GNP is important for a number of reasons: it is needed to assess rates of innovation and productivity growth in different types of business, it is needed to understand which kinds of economic activity are likely to be the basis for future growth, and it is needed to understand the way businesses operate together as parts of complex production networks .40

Data published by BEA indicate that the share of the GNP provided by natural resource industries, such as farming and mining, has decreased sharply since 1950 while output from the service sector, particularly services that play a transactional role in the economy such as finance, communication, and business services, has increased (see figure 3).[27]

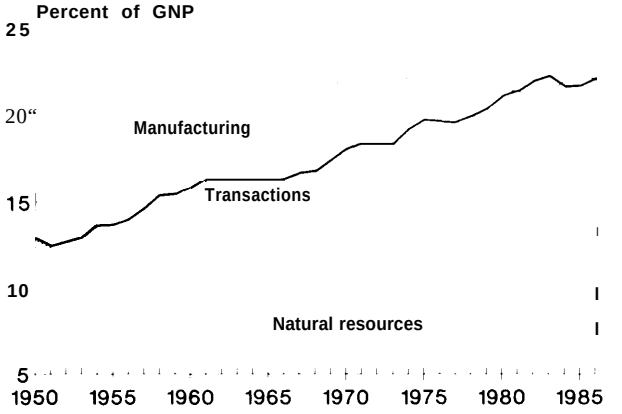
BEA's data show that manufacturing's contribution to GNP has stayed remarkably stable at roughly 20 to 22 percent of the GNP over the 36-year period from 1950 to 1986 when measured in constant 1982 dollars.[28] This estimate has been the subject of a

[26]Jerome A. Mark, "Problems Encountered in Measuring Single- and Multifactor Productivity," *Monthly Labor* Review, December 1986, p. 6; and Edwin Dean and Kent Kunze, "Recent Changes in the Growth of U.S. Multifactor Productivity," *Monthly Labor Review, May 1988,* p. 20.

[27]Business services as defined in the input/output accounts includes activities such as consulting, law, advertising, and computer services, to name a few.

[28]National Income and Product Accounts, op. cit., footnote 15, table 6.2.

Figure 3-Shares of GNP in Constant 1982 Dollars



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*, table 6.2.

considerable amount of criticism during the past year.[29] Manufacturing's stability appears to be inconsistent with other events in the economy such as a huge trade deficit in manufactured goods, lagging investment in plants and equipment, and the loss of 2 million manufacturing jobs between 1979 and 1986.[30] BEA has responded to some of the criticisms and has undertaken an effort to revise the constant dollar value-added by industry series (termed gross product originating) .31 Although firm conclusions cannot be drawn about biases in the present series until the revised series is available, it appears likely that manufacturing's growth in output from 1979 to 1985 will be revised downward.[32]

Assuming that the gross national product of the economy is properly measured, overestimating the contribution of one business sector (e.g., manufacturing) necessarily is balanced by an underestimate of the contribution of other sectors (e.g., business services).

Understanding Linkages

Tracing the source of growth in the economy to individual business sectors requires an ability to describe the complex business networks that now operate in virtually every part of the economy. The transformation of the American economy can be seen in the growing complexity of these networks and the service businesses needed for their efficient operation.[33] Understanding the complex patterns of interdependence that result from these networks *is critical* for understanding the way national policies can affect economic performance. Imports that affect manufacturing industries have a strong indirect effect on the service firms that supply these industries. The prosperity of services and manufacturing depends as never before on the quality of infrastructures like communications and a responsive transportation system.

In an effort to cut costs many firms have begun to specialize and purchase products and services from other specialized fins. Manufacturing firms may, for example, purchase legal, bookkeeping, or janitorial services from outside suppliers rather than performing these activities "in-house."[34] As a result of this growth in subcontracting, and the wider geographical dispersion that it entails, service sector businesses have thrived because of the increased need for financing, legal assistance, consulting services, communication, transportation, and wholesale and retail trade. These transactional and distributional service sectors represent the two fastest growing parts of the economy over the past two decades. Separately, each of the two groups contributes more to the GNP than all of manufacturing.

The basic source of information about the way businesses depend on each other is the input/output

[29] *Technology and the American Economic Transition: Choices for the Future,* op. cit., footnote 1, pp. 168-175; Lawrence R. Mishel, "Manufacturing Numbers: How Inaccurate Statistics Conceal U.S. Industrial Decline" (Washington, DC: Economic Policy Institute, April 1988); Edward F. Denisen, *Estimates of Productivity Change by Industry* (Washington, DC: The Brookings Institution, 1989); Robert Kuttner, "U.S. Industry is Wasting Away—But Official Figures Don't Show It," *Business Week,* May 16, 1988; "The Factory Rebound maybe More Fantasy Than Fact," *Business* Week, Dee. 12, 1988, p. 98., and Anthony Harris, "Figures Calculated to Deceive," *Financial Times,* July 11, 1988, p. 11; Toddi L. Gutner, "U.S. Economic Statistics Off the Mark," *National Journal,* Sept. *3, 1988,* p. 2200.

[30] See Lawrence R. Mishel, "The Late Great Debate on Deindustrialization," Challenge, January/February 1989, p. 35.

[31] U.S. Department of Commerce, Bureau of Economic Analysis. "Gross Product by Industry: Comments on Recent Criticisms," Survey *of Current Business,* July 1988, p. 132.

[32] Ibid. p. 133; Mishel (1989), op. cit., footnote 30, p. 40, Baily and Gordon, op. cit., footnote 11, p. 367; and Denison, op. cit., footnote *29,* p. 23 and p. 37.

[33] *Technology and the American Economic Transition, op.* cit., chs. 4 and 5, pp. 143-177.

[34] John Tschetter, "Producer Services Industries: Why Are They Growing So Rapidly?" Monthly *Labor Review,* December 1987, pp. 31-40.

(I/O) tables, compiled by BEA. These tables show what each of 537 industries purchase from other industries. Input/output data provide an essential tool for tracking the effects of new technologies; they alone provide a detailed description of how new technologies affect the inputs needed by different businesses. I/O tables also provide a key tool for monitoring the performance of the complex business networks that are coming to dominate the U.S. economy, showing how the value of products sold to final consumers combine the skills and technologies of the retail, wholesale, transport, production, and natural resource industries. They also provide a key insight into the way the rapidly expanding service industries are used by other businesses.

Since so much detailed information is needed, it takes many years to create input/output tables using current methods. The most current "benchmark" table, called a benchmark because it is largely based on quinquennial industrial censuses, dates to 1977 and was published in 1984. The 1982 benchmark table will not be published until later in 1989. Unless something changes we will be using the recession year of 1982 as a "benchmark" until 1994.

BEA produces input/output tables for years between benchmarks using a variety of approximation techniques. Until the past few months, the "updated annual tables" were published 6 years after the year for which they apply (e.g., the 1983 table was published in 1989).[35] Partly in an effort to fully integrate the gross product originating series with the I/O tables, the BEA has accelerated the process of constructing annual I/O tables and a 1986 table will be published late in 1989.

Although more up-to-date, the annual input/output accounts suffer from an industrial classification scheme that has a strong manufacturing bias. Of the 85 industries, 52 are dedicated to manufacturing, 15 are services, 12 are in natural resource, and 6 are "other." This occurs even though only a fifth of the GNP is attributable to manufacturing. The end result is great detail on the production of wooden boxes, about two-one hundredths of a percent of GNP, while the private health, education, and social service industries, about 8 percent of GNP, are lumped together into one category. Obviously, these classifications present a severe constraint on analysis.

Another limitation with the more timely annual tables is that they are forced to use the 1977 benchmark table as the basis for scaling, limiting the ability to track areas where the economy has changed rapidly. Unfortunately these are often precisely the areas where most policy analysis focuses. Difficulties in tracking the role of services is an important example. The fastest growing intermediate input in the economy, and particularly to manufacturing, is the purchase of a group of services collectively called business services, which contains services like accounting, advertising, legal help, computer services, and temporary help services. The 1982 input/output table shows business services as the third largest intermediate input to manufacturing—above commodities like steel, rubber, paper, and transportation.[36]

The basic data source on intermediate inputs for the manufacturing sector, the quinquennial Census of Manufacturing, does not collect data on purchased business services. The smaller, sample-based Annual Survey of Manufacturing collects data on only a few purchased services such as repair and communication services once every five years. This means that a number of approximation techniques were used even to establish the benchmark 1977 input/output table. Attempts to scale up from this benchmark to a more recent year are highly approximate.[37] It is extremely difficult to track many technical changes resulting from greater purchases of services by businesses. For example, employment in temporary help agencies (one component of the 1/0 business services sector) grew by 70 percent from 1982 to 1984.[38] This "out-sourcing" has

[35] U.S. Department of commerce, Bureau of Economic Analysis, Survey *of Current Business,* "Annual Input-Output Accounts of the U.S. Economy, 1983," February 1989, pp. 21-36; U.S. Department of Commerce, Bureau of Economic Analysis, Survey *of Current Business,* "Annual Input-Output Accounts of the U.S. Economy, 1982," April 1988; U.S. Department of Commerce, Bureau of Economic Analysis, Survey *of Current Business,* "Input-Output Accounts of the U.S. Economy, 1981," January 1987.

[36] U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business,* "Annual Input-Output Accounts of the U.S. Economy, 1982," April 1988, pp. 31-46.

[37] "Gross Product by Industry: Comments on Recent Criticisms," op. cit., footnote 31, p. 132.

[38] Max L. Carey and Kim L. Hazelbaker, "Employment Groin in the Temporary Help Industry," *Monthly Labor Review,* April 1986, p. 37.

obviously reshaped business networks and affected the difference between sales and value-added contributed by the business, but the impact is almost impossible to trace. The fast growth of business services means that it is likely that they have not been fully accounted for, causing an overestimate of manufacturing's contribution to GNP that has grown in severity recently .39

Data on the services used by businesses at the establishment level are difficult for Census to obtain because services like accounting and advertising are often purchased by corporate headquarters while the questionnaires go to individual establishments. The managers in the establishment often do not know how much corporate advertising is done in their interest. This problem could be reduced if the information was collected at the headquarters of the firm and then allocated to the fro's individual establishments through an imputation scheme.

There are also defects in the way the input/output statistics can track the performance of the new kinds of transportation systems required by a flexible, highly interconnected economy.[40] One important source of data is a Census Bureau product called the Commodity Transportation Survey which measured what types of manufacturing output were transported by a particular mode of transportation: truck, rail, air, or water. As the economy shifts toward a system of flexible production networks that relies more on "just-in-time" inventories, quick reactions to competitors, and better responses to consumer demand, transportation data like those provided in the Commodity Transportation Survey (CTS) are of considerable importance in tracking this change.[41] Due to methodological problems, the 1982 CTS was postponed to 1983 and conducted in a modified form. Because of the deficiencies found in the quality, the 1983 CTS was never published.[42] The 1987 CTS was canceled due to methodological problems and budget constraints.[43]

The input/output tables are important for many reasons other than computing accurate estimates of value-added in each type of business. They are also used extensively in preparing detailed tables throughout the National Income and Product Account.[44] The Bureau of Labor Statistics relies on input/output data to generate its industry-level multifactor productivity series,[45] construct the producer price index,[26] and estimates of what occupations will be in demand in the future.[47] Input/output is at the heart of the Department of Agriculture's projections of agricultural output and the Department of Energy's estimates of energy use.

Since input/output statistics are so important, and BEA tables are often many years out of date, private analytical firms and other Federal statistical agencies have developed their own updated tables using a variety of methods. The Bureau of Labor Statistics estimates its own updates of input/output tables independently of BEA. Because of this independent effort there are disagreements between BLS and

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[39] Denison, op. cit., footnote 29, p. 47.

[40] U.S. Congress, General Accounting Office, *The Bureau of Economic Analysis Should Lead Efforts to Improve GNP Estimate,* GAO/GGD-83-1 (Washington, DC: U.S. Government Printing Office, Dec. *27, 1982),* p. *58.*

[41] Robert H. Hayes and Ramchandran Jaikumar, *'Manufacturing's* Crisis: *New* Technologies, Obsolete Organizations," *Harvard Business Review,* September-October 1988, pp. 77-85.

[42] U.S. Congress, Office of Technology Assessment, *Transportation of Hazardous Materials,* OTA-SET-304 (Washington, DC: U.S. Government Printing Office, July 1986), p. 44.

[43] K.R. Polenske, "Relevance of U.S. Regional Statistics," presented at the American Association for the Advancement of Science, Jan. 19, 1989, p. 3.

[44] Carson, op. cit., footnote 6, p. 112.

[45] Edwin Dean and Kent Kunze, "Recent Changes in the Growth of U.S. Multifactor Productivity," *Monthly Labor Review,* May *1988,* p. *20.*

[46] A.G. Clem and William D. Thomas, "New Weight Structure being Used in Producer Price Index," *Monthly Labor Review,* August 1987, p. 12; and Robert Gaddie and Maureen Zoner, "New Stage of Process Price System Developed for the Producer Price Index," *Monthly Labor Review,* April 1988, pp. 3-16.

[47] U.S. Department of Labor, Bureau of Labor Statistics, *BLS Economic Growth Model System Used for Projections to 1990,* Bulletin 2112, April 1982, p. 2,

BEA estimates of industrial output.[48] The Forest Service, a division of U.S. Department of Agriculture, creates another set of updated input/output tables for its own use (IMPLAN).[49] Even the Department of Commerce, the source of the input/output tables, contracts out to consultants for updated input/output tables.[50]

In an era when computers are easier to use and vastly more powerful, delays in creating input/output tables should be growing shorter. Significant problems remain in data communication. Until 1985 the massive amounts of data from the Bureau of the Census needed to construct the input/output accounts were delivered to the Bureau of Economic Analysis in printed form. Every number had to be reentered by hand and rechecked. In the last few years computer tapes have been delivered to BEA. Unfortunately the data are still not in the form needed by BEA, but instead, are simply a digital representation of the pages that formerly appeared in printed form. The tapes contain tables with lines, headings, and notes, which must be removed in a laborious process. After the irrelevant characters are removed, the arduous process of converting the data to forms useful for input/output work can begin. As the process proceeds, it is often discovered that some data items may not be provided by Census for reasons of confidentiality. In part because the Census does not have money set aside for retabulation, BEA can seldom get additional information from the Census Bureau (e.g., data aggregated in a way that does not reveal confidential information).

Other nations manage to produce detailed input/output data much faster than we do—though possibly with less accuracy-in part because 1/0 plays a more fundamental role in policy making in these countries. Japan already has input/output tables based on data collected in 1985. And the Japanese government is involved in creating an input/output model for a major portion of the international enconomy.[51] (See box E for a description of this effort.) The United Kingdom has a benchmark table for 1984. China is about to complete a 1987 table.[52]

Computing Business Output by Sector

Each business in a network delivering a final product or service to a consumer adds some value (value-added) to the product. The sum of "value--added" in all businesses in the United States equals the GNP. The input/output tables described above provide the basic tool needed to see how much value each business in the economy contributes in constant dollar terms.53

The value-added by a business can be computed by subtracting the value of all products (both goods and services) purchased by a business from total sales (or gross output) .54 In this sense, value-added is a better indicator of performance than sales (gross output) because it shows the contribution made by the company-not the aggregate value of the company's contribution ***and the*** value of inputs produced by suppliers. An automobile company can, for example, decide to purchase components from abroad instead of producing them internally. Its sales

[48]For example, the BLS 1982 estimate of gross output for the office, computing, and accounting machines industry (SIC 3572,3573,3574,3576, and 3579) was over a billion dollars less than the BEA 1982 estimate. Other discrepancies occur in industries such as eating and drinking places (SIC 58) and non-metallic minerals, except fuels (SIC 14), but exact SIC matches between the two series are difficult. U.S. Department of Commerce, Bureau of Economic Analysis, *Survey occurrent Business,* "Annual Input-Output Accounts of the U.S. Economy, 1982," April 1988, p. 35, and U.S. Department of Labor, Bureau of Labor Statistics, Office of Economic Growth, "Output and Employment Database," January 1988. A similar discrepancy occurs between Federal Reserve Board estimates of production (the Index of Industrial Production) and those issue-d by Department of Commerce (sales adjusted for inventories). See Jeffrey A. Miron and Stephen P. Zeldes, "Production, Sales, and the Change in Inventories: An Identity that Doesn't Add Up," Working paper No. 2765, National Bureau of Economic Research, Cambridge, MA., November 1988.

[49]Leif E. Siverts and Daniel E. Chappelle, "A Comparison of Actual Changes in Employment and Income with predictions Using IMPLAN Models," presented at the Western Regional Science Association, Feb. 19-22, 1989, San Diego, CA, p. 4.

[50]Lester A. Davis, "Contributions of Exports to U.S. Employment: 1980 -1987," U.S. Department Of Commerce, International Trade Administration, Trade Research Division, Project DTR-014-89, March 1989, p. 22; and Ken Young, Ann Lawson, and Jennifer Duncan, U.S. Department of Commerce, Office of Business Analysis, "Trade Ripples Across U.S. Industries," January 1986, p. 9.

[51]M. Sato, Japan's Ministry of International Trade and Industry, "Compilation of an International Input-Output Table," paper presented at the OECD Workshop on Intonational I-O Tables and performance Analysis of Structural Adjustment, Dec. 14, 1988, Paris, France.

[52]K.R. Polenske, "Relevance of U.S. Regional Statistics," paper presented at the American Association for the Advancement of Science, Jan. 19,1989, p. 7.

[53]"Gross Product by Industry: Comments on Recent Criticisms," op. cit., footnote 31, p. 132.

[54]National Academy of Sciences, Committee on National Statistics, *Measurement and Interpretation of Productivity*, (Washington, DC: National Academy of Sciences, 1979), p. 65.

Box E—Japan's International Input/Output Model Project

In an effort to build an analytical capability for analyzing "bilateral and multilateral economic issues and conflicts,"" analyzing the economic impact of international economic activities," and "clarifying the magnitude of international interdependence," the Japanese are engaged in creating an international input/output table.

At the cost of a million dollars a year for 6 years, the Ministry of International Trade and Industry (MITI) directed project will construct a series of I/O tables that connect the economies of Japan, the United States, the United Kingdom, France, the Federal Republic of Germany, South Korea, Malaysia, Singapore, Thailand, the Philippines, Indonesia, China and Taiwan.[1]

It's scheduled to be completed in 1992. Because the model is based on 1985 data, data for the United States had to be estimated by a private contractor. Similarly, since the United States does not have data on the use of imports by industry-an important characteristic of the model-the Japanese had to estimate it by surveying Japanese firms about which U.S. industries buy which type of goods from them. In the case of the developing Pacific Rim countries who in some cases lack a strong statistical system, the Japanese are collecting and organizing the data as a part of Japan's foreign aid to those countries.

The Japanese have stated that they will use the input/output tables to:

. make international comparisons of industrial structures,
• evaluate the results of a given country's protectionism,
. determine the economic effects of direct overseas investment,
. analyze the impact of changing crude oil prices, and
. evaluate the effect of fostering the development of new industries in specific countries.[2]

Obviously, the data could bean important competitive tool in identifying and targeting key industries. As the world gets increasingly carved up into large trading-blocks (i.e., U.S. and Canada and Europe's 1992 agreement), the input/output tables could also be used to evaluate the costs and benefits of a Pacific Rim trading agreement.

[1]It is worth noting that as Japan spends $1 million a year on this international effort which is a supplement to their main domestic effort, the 1989 fiscal year budget for the entire U.S. input/output effort (BEA's Interindustry Division) was $1.4 million.

[2]M. Sate, Japan's Ministry of International Trade and Industry, "Compilation of an International Input-output Table," paper presented at the OECD workshop on International I-O Tables and Performance Analysis of Structural Adjustment, Dec. 14, 1988, Pans, France, p. 2,3.

could remain unchanged while its domestic value-added and employment declines. (In fact, about 70 percent of the value of the components of Chrysler's vehicles are manufactured by outside suppliers.[55]) Similarly, the company could decide to purchase advertising, payroll accounting, software development, and other services from specialty firms instead of doing this work with internal staff. This could also leave total auto sales unchanged while reducing value-added and employment in the automobile industry.

Value-added in constant dollars can be computed by subtracting an industry's intermediate inputs from its output after both have been adjusted for inflation. Doing this with precision obviously requires an enormous amount of data. It also requires high quality data for the entire economy since businesses depend on each other through "intermediate inputs" in complex ways. On close examination, there are deficiencies in much of the data that are currently used. The largest of these include problems with:

- data showing the links connecting different kinds of businesses (including data showing what businesses purchase from other businesses)
- the way products and services are adjusted for inflation (many of these problems have already been discussed)
- the way imported intermediate inputs are treated (this issue is treated in greater detail in the next section on international trade).

Data limitations in these areas make it extremely difficult to trace national output to specific businesses with much precision--particularly when it is

[55]Kevin Flaherty, "Foreign Sourcing by the U.S. Automobile Industry," report prepared for the Congressional Research Service, Washington, DC, Nov. *8, 1985,* p. *2.*

important to remove the effects of inflation. In many cases it is necessary to use "gross output" or sales instead of value-added in analysis of specific industries; this is the case with estimates of industrial productivity. [56]

Adjusting for Inflation —In principle, the value--added in each type of business can be computed using input/output tables. The inputs purchased by each business are deflated separately and the total deflated value of intermediate inputs is subtracted from a deflated level of industry sales (or gross output). This technique, called "double-deflation," is recognized as a preferred method by the Department of Commerce because of its use of a consistent set of price indexes.[57] The problem of adjusting total GNP accounts for inflation were discussed earlier. Developing deflators for value-added by industry (also referred to as gross product originating) compounds the problem since much more detailed and extensive information is needed. Services are a major problem since about two-thirds of all services are purchased by businesses as intermediate inputs and not by households or the government as a final product. [58]

In practice, however, incomplete data mean this technique can only be used in 29 percent of the 1986 GNP—the manufacturing, farm, and construction sectors. [59] A variety of scaling techniques and other methods are used for the rest of the economy. [60] Again, services are the most difficult area. The intermediate inputs of service industries are very poorly documented from survey-based series. [61] For many kinds of services, no direct data on intermediate inputs are available.

Even after the current dollar data are compiled, adjusting for inflation is difficult because of the lack of adequate price series for services. BEA calculates deflators for several service sectors by extrapolation using jobs as a proxy for increases in quantity. By definition, this means that no labor productivity growth can occur, resulting in an overstatement of the rise of prices in this industry and a subsequent underestimate of the quantity of services purchased as inputs. [62] The underestimate of inputs means that the value-added is overstated. [63]

Estimates of value-added in construction suffer both from poor estimates of total industry output in constant dollars (for reasons discussed earlier) and from poor estimates of inputs. Since there is no detail on prefabrication by construction suppliers, inputs are double counted. For example, inputs such as wood are counted once when they are purchased by a business making prefabricated (pre-hung) doors and are counted again for a second time when the prefabricated doors are purchased as an input by a construction firm building a house. [64] This results in an over counting of inputs and subsequently an underestimate of construction's value-added.

BLS has a deflator series for the gross output of a number of service businesses (some not completely incorporated into the BEA accounts) and has research projects underway in a number of areas (communications, semiconductors, computer programming services, medical services, and banking).

Double-deflation is also limited by the fact that deflators for gross output are available only for 72 percent of the GNP (table 3). BLS computes deflators for a number of service industries not presently used by BEA. The services for which precise deflator series are available, however, are primarily those where output is comparatively easy to quantify (e.g., electricity). In other service sectors attempts are made to count or quantify output using measures such as the number of checks processed or

[56] *Measurement and Interpretation of Productivity,* op. cit., footnote 54, p. 67.

[57] Milo Peterson, "Gross Product by Industry," *Survey of Current Business, vol. 67, No. 4,* April 1987, p. 27.

[58] U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business.* 1984. "The Input-Output Structure of the U.S. Economy: *1977,"* vol. 64, No. 5 (May), pp. *42-84.*

[59] Calculated from National Income and Product Accounts, op. cit., footnote 15, table *6.1.*

[60] Peterson, op. cit., foomote 57, p. 27,

[61] To some extent this is a recent and growing problem since a good portion of intermediate service input data used to come from records kept on regulated industries that have been or are being deregulated.

[62] Denison, op. cit., footnote *29, p. 52.*

[63] "Gross Product by Industry: Comments on Recent Criticisms," op. cit., footnote 31, p. 133.

[64] Baily and Gordon, op. cit., footnote 11, p. 404.

Table 3—BLS Deflator Series for Gross Output

	Percent of GNP covered
Gross output deflators based on price indices	72
Manufacturing	
Mining	
Some Services	
Gross output deflated by an index based on hours or cost indexes	6
Nonresidential structures etc.	
No BLS deflator series.	
General government	(10)
Owner-occupied housing	
Rest of the world	(1)
Households and institutions	(4)

NOTE: Total may not be 100 percent due to rounding.
SOURCE: J.A. Mark, "Problems Encountered in Measuring Single- and Multifactor Productivity," *Monthly Labor Review*, December 1986, p. 5.

the number of operations performed.[65] But these techniques have clear limitations in times of rapid technical change.[66]

Adjusting for Trade—Another difficulty in assigning value-added to different industries is the fact that the current input/output tables do not distinguish between imported and domestically produced products used as intermediate inputs. Imported inputs are recorded as a category of final demand.

This accounting convention is adequate for aggregate measures of GNP. But without additional information the data cannot be used to track many important effects of international trade on the U.S. economy-such as the way trade affects the output of different kinds of businesses.

First, BEA uses the deflator for domestic industries to adjust intermediate inputs purchased even though some of these inputs are imported.[67] This had the effect of underestimating the value of intermediate inputs when the dollar was strong in the mid- 1980s and underestimating their value when the dollar weakened. During the mid 1980s, using faster rising domestic price series on imported inputs, the level of intermediate inputs was overstated and the level of value-added or output was understated.[68] BEA estimates that correcting for this problem would drop the growth rate of manufacturing by half a percent or more per year from 1979 to 1985.[69] That correction is nearly equivalent to eliminating the increase in output of the electrical equipment industry—the second largest contributor to manufacturing's growth over the period.[70]

Second, some products purchased "intermediate inputs" by businesses are in fact products produced by foreign subsidiaries. In many cases U.S. components are shipped abroad for assembly and then reimported for final testing and sales. This kind of production is encouraged by Items 806 and 807 of the U.S. Tariff Code requiring duties only on the *difference* between the value of components exported and products imported by a multinational firm. The Census Bureau reports that many firms fail to report inputs received from overseas affiliates as costs of business.[71] As a result, the value of the input gets credited as value that was added domestically, overstating the true amount of U.S. production in that industry .72 Although this problem has always existed, the upsurge in intermediate inputs coming from foreign sources makes this a growing problem. And potentially it is a large problem. In 1985, nearly a third of all U.S. exports were exports from U.S. companies to overseas affiliates. Over a fifth of all imports to the United States came from these overseas U.S. affiliates.[73] For some industries like

[65] Jerome A. Mark, "Measuring Productivity in Service Industries: The BLS Experience," paper presented at the Symposium on Technology and the services Industries Hanover, NH, August 1987, p. 25.

[66] For example, the number of transactions processed fails to include developments such as increases in branch banking made possible through the widespread uae of automatic teller machines (ATMS). Baily and Gordon, op. cit., footnote 11, pp. 399-400.

[67] An exception to this occurs in the deflation of petroleum Where the imported price is used.

[68] The decline in the value of the dollar since 1985 should have the reverse effect of underestimating the change in manufacturing's output.

[69] "Gross Product by Industry: Comments on Recent Criticisms," op. cit., footnote *31,* p. 132.

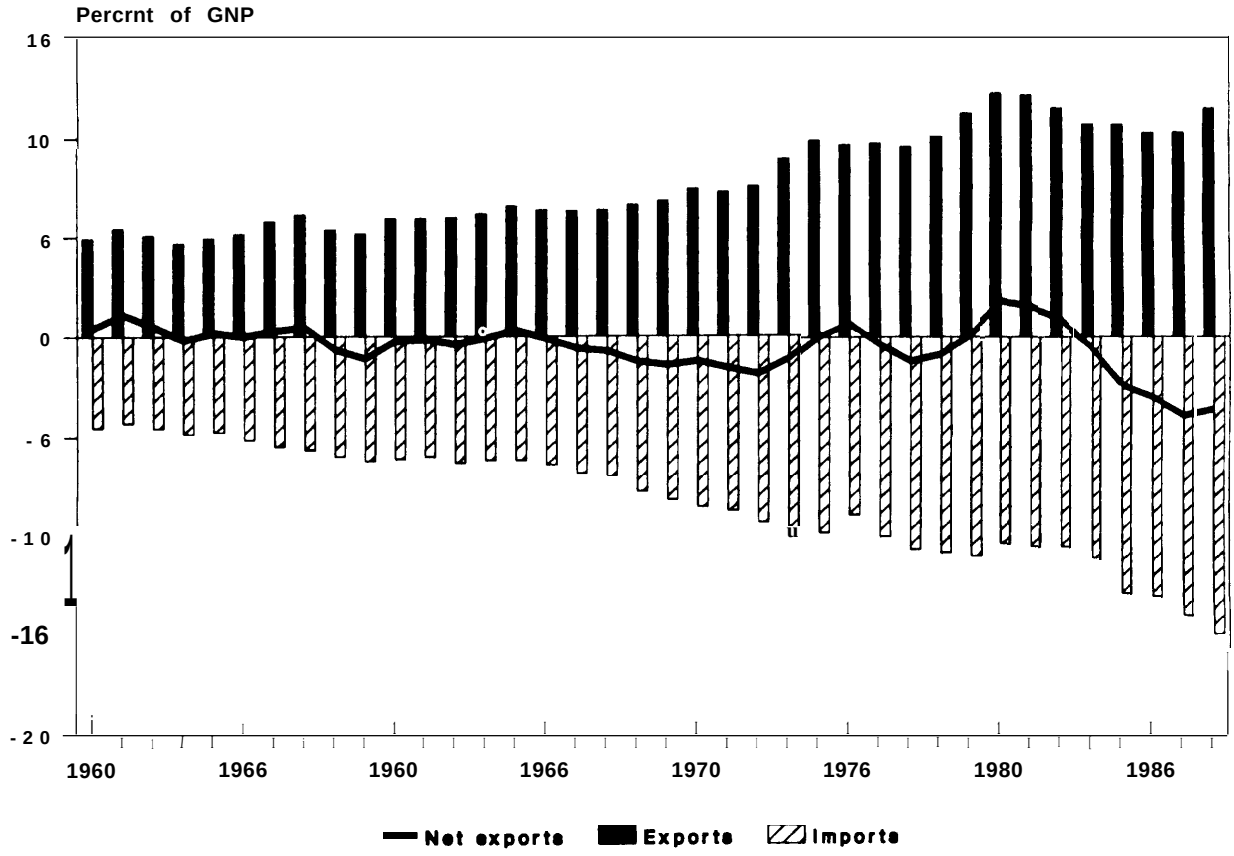
[70] Nonelectrical machinery, which includes the computer industry, was the largest contributor. National Income and Product Accounts, op. cit., footnote 15, table 6.2.

[71] The data being referred to is the Census of Manufacturers. See John P. Govoni, " Possible Improvements in Industrial Statistics for 1987," paper presented to the Census Advisory Committee of the American Economic Association and the American Marketing Association at the Joint Advisory committee, Oct. 9-1o, 1986, p. 5.

[72] Ibid.

[73] John Hein, "What the Trade Numbers Hide," *Across the Board*, October 1987, p. 12.

Figure 4-Exports and Imports (percent of GNP in constant 1982 dollars)



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, tables 1.2 and 4.4.

semiconductors where potentially half of the value of the chip is added overseas in the assembly process, this could be an especially important problem.[74]

C. What Is the Impact of International Trade on Domestic Producers and Consumers?

The speed by which the U.S. economy has become immersed in international trade and accumulated a huge trade deficit is a striking example of an economy in transition. The share of GNP held by exports has grown by almost a third from 1970 to 1986; import penetration increased by 76 percent. (See figure 4.) From the end of World War II to 1983 the amount of imports purchased on a per capita basis (real 1982 dollars) slowly crept from $300 to $1,500. By 1987, the amount was $2,300----a 50 percent increase in 4 years. This phenomenon is not limited to a few select products but now affects virtually every industry.

Global production networks have redefined the nature of trade. Direct foreign investment[75] by the U.S. investors overseas increased by 43 percent between 1980 and 1987; foreign investment in the United States tripled during the same time.[76] There has been particularly sharp growth of worldwide production associated with direct investment leading to an upsurge in "intrafirm" trade where a

[74]Govoni, op. cit., footnote 7 1, p. 3.

[75]Defined as owning 10 percent or more of an enterprise.

[76]Unfortunately, this data are available only in current dollars, a shortcoming discussed below. See James K. Jackson, "American Direct Investment Abroad," Congressional Research Service, Aug. 8, 1988, p. 2.

division of a multinational corporation trades with another affiliate.[77]

It is obviously important that we understand how foreign trade influences the performance of the domestic economy. For example, the effects of trade on jobs, inflation, and our dependence on foreign sources, are the root of many policy decisions. While data about international trade have improved significantly in recent years with the development of improved reporting and good deflator series, more improvement is possible. The absence of any detail about trade in the input/output accounts, for example, means that an uncomfortable number of assumptions must be made to see which industries are affected directly and indirectly by changes in the U.S. trade position.[78] The explosive growth in the volume and complexity of trade makes this a major challenge. And there is reason to believe the quality of trade statistics may decline in the next few years.

Trade data are largely a by-product of data collected for administrative or regulatory purposes .79 The administrative need associated with trade data is the assignment of duties, tariffs, or quotas on particular products from particular countries. But increasingly, trade between countries have become more free, undermining the motivation of Customs to collect data on those products.[80] From 1970 to 1986, the share of imports (based on value) subject to duties has fallen by 50 percent.[81] Data on U.S. trade with Canada (about 20 percent of all U.S. trade) may become very unreliable when tariff barriers between the two nations are removed. Data on trade with individual members of the European Economic Community (EEC) may be difficult to obtain once internal EEC tariff barriers are removed at the end of 1992.[82] New mechanisms for collecting trade data must then be found to prevent the quality of trade statistics from declining. Some form of international cooperation on trade statistics is likely to be desirable (possibly essential) to prevent a major deterioration in the quality of data.

Tracking Trade Volume

When the number of export and import documents more than doubles over a decade, reaching 15 million in 1987, just reporting the level of exports and imports becomes a daunting task.[83] This huge jump in the volume of transactions has contributed to deficiencies in the data. For instance, in the mid-1980s the dramatic increase in imports made it impossible for the government to collect accurate monthly trade statistics. So much time was required to process trade data that in 1985 anywhere from 35 to 53 percent of the official import statistics in any single month actually represented a "carryover" from previous months.[84]

Monthly trade data are, of course, also needed to measure GNP accurately. The discovery of one carryover forced the estimate of growth in the gross national product (GNP) during the last quarter of 1984 to be revised downward-from 4.3 to 0.6 percent.[85] Another revision of GNP tied to trade data occurred in the second quarter of 1986 where the new estimate reversed the direction of growth from a positive rate to a negative one, resulting in the first quarter of negative growth in the current economic expansion-a fact that went largely unnoticed.[86] Obviously, revisions of such magnitude can send a

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[77] Jane Sneddon Little, "Intra-Firm Trade: An Update," *The New England Economic Review*, May-June 1987, p. 47.

[78] See K. Young, Ann Lawson, and Jennifer Duncan, "Trade Ripples Across U.S. Industries," working paper, U.S. Department of Commerce, Office of Business Analysis, January 1986, pp. 57-61, or the appendix of *Technology and the American Economic Transition*, op. cit., footnote 1, for examples of assumptions employed to circumvent this problem, pp. 469470.

[79] National Academy of Sciences, Committee on National Statistics, "proposal for a Panel Study on Foreign Trade Statistics," July 1987, p. 6.

[80] Report on "The Working Group on the Quality of Economic Statistics," op. cit., footnote 6, part 1, p. 10.

[81] U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States, 1989*, p. 778, Table 1351, and @ant W. Gardner and Kent P. Kimbrough, 'The Behavior of U.S. Tariff Rates," *The American Economic Review*, March 1989, vol. 79, No. 1, pp. 212-214.

[82] Joseph W. Duncan, ● 'The Statistics Corner: Statistics and 1992 in Europe," *Business Economics*, July 1989, pp. 52-53.

[83] U.S. Congress, General Accounting Office, Merchandise *Trade Statistics: Some* Observations, GAO/OCE-89-1BR, (Washington, DC: U.S. Government Printing Office, April 1989), p. 40.

[84] Slater, op. cit., footnote 5, part 1, p. 53.

[85] Slater, op. cit., foomote 5, part 1, p. 53.

[86] U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, July 1988 and July 1986, table 1.2.

false signal to policy makers about the strength or weakness of the economy .[87]

The Bureau of the Census is aware of these shortcomings and improvements are gradually being made by automating reporting and reducing "carryovers" by releasing trade figures 45 days after the close of the month. By July of 1988, import and export carryovers had been reduced to 5 percent of the value of imports and exports.[88] But nagging problems remain.

An illustration is provided by looking at the gaps in data between the world's two largest bilateral trading partners: Canada and the United States. U.S. exports to Canada are consistently underestimated.[89] In 1986 the U.S. trade deficit with Canada was revised downward by 42 percent from $22.9 to$13.3 billion.[90] Since June 1987, U.S. exports to Canada are based on the more relaible Canadian reports of imports from the United States.[91] These data are likely to become less accurate if, as is likely, Canadian interest in precise tracking declines in a free-trade regime.

A report by the General Accounting Office (GAO) on Merchandise Trade Statistics pointed out many other discrepancies in trade data. Over the last 13 years GAO found that U.S. export data consistently fell short of foreign import data.[92] Overall, the shortfalls rose from $5.7 billion in 1975 to $18.7 billion in 1986, falling to 13 billion in 1987 after the use of Canadian data was implemented.[93] The report concluded that: " . . . there is a strong possibility that U.S. exports are not fully counted; as a result, the U.S. merchandise trade deficit possibly has been overstated for the past several years. '94

Trade in Production Networks

The growth in investments around the globe is indicative of the emergence of worldwide production networks. For example, the assembly of the Ford Escort involves glass from Canada, fan belts from Denmark, radiators from Spain, steering wheels from England, and tires from Norway. In all, parts are made or assembled in 16 countries on three different continents.[95] In 1985, more than a quarter of all Digital Equipment Corporation's (DEC) sales were sales to its overseas affiliates.[96] These global production networks transcend the idea of the sovereign state, obscuring the notion of what is

[87] Supposedly, the overly optimistic early estimate of 1984 GNP fooled *the* Federal Reserve Bank into limiting the expansion of the money supply, helping to push the value of the dollar to its 1985 high mark. Testimony of Courtenay Slater before the Joint Economic Committee. Slater, op. cit., footnote 5, part 1, p. 94.

[88] *Merchandise Trade* Statistics: Some *Observations*, *op.* cit., footnote 83, p. 22.

[89] Slater, op. cit., footnote 5, part 1, p. 56.

[90] National Academy of Sciences, Committee on National Statistics, "Proposal for a Panel Study on Foreign Trade Statistics," p. 6.

[91] *Merchandise Trade Statistics: Some Observations*, op. cit., footnote 83, p. 42.

[92] The study included the United States' major trading partners: Canada, Japan, West Germany, France, The United Kingdom, and the Netherlands. The Netherlands was the only country where U.S. exports were not consistently short of recorded imports from the United States. See *Merchandise Trade Statistics: Some Observations*, op. cit., footnote 83, p. 30.

[93] *Merchandise Trade Statistics: Some Observations*, op. cit., footnote *3, pp. 30-32.

[94] *Merchandise Trade* Statistics: Some *Observations*, op. cit., footnote 83, p. 2.

[95] Barry Bluestone and Bennett Harrison, *The Deindustrialization of America (New* York, NY: Basic Books), 1982, p. 177.

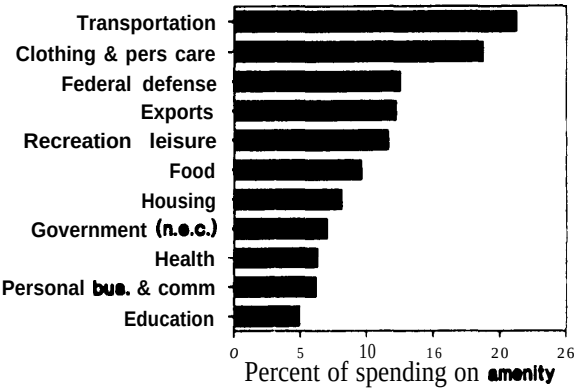
[96] Hein, op. cit., footnote 73, p. 12.

meant by *foreign trade.*[97] It is as if GM's sourcing of parts from a division *in New* York to an assembly plant in Michigan was considered international trade. Certainly, international, intrafirm transactions are a much different variety of trade than what is connoted by the traditional meaning of trade. This changing nature of trade requires a reexamination of how the statistics are collected, presented, and interpreted.

For example, when the International Trade Commission (ITC) tries to calculate the import penetration rate of the computer industry, how should it treat the large intrafirm imports from DEC's Scotland plant to its Maynard, Massachusetts plant? Is this a threat to the U.S. industry? Should the sale price of a Chrysler Mini Van complete with a Mitsubishi engine (24 percent of Mitsubishi is owned by Chrysler) be counted as domestic production?[98] Tied to this is the question of whether or not these intrafirm transactions are being priced at the "arms-length" market rates or at internal, "transfer" prices? The Internal Revenue Service under section 482 of the Internal Revenue Code requires that these transactions be valued at market rates, but in many cases the product being sold is a unique component that does not have a corollary in the market. This problem is even more vexing in the cases of intangible, intermediate service sector products. The BLS does not include intracompany transfer prices in its international price series, preferring instead to include only a subset of intrafirrn prices designated as being arms-length. In any case, if in fact these intrafirm transactions are not priced at market rates then our knowledge about the "true" level of imports and exports is diminished further.

Existing data makes it difficult to trace the effects of imports or exports through the economy. Making some reasonable assumptions about how trade is used as an intermediate input, it is possible to see that imported commodities affect businesses throughout the economy (figure 5).[99] Without more precise data, however, it is impossible to make firm estimates of the problems that might be created by a sudden change in trade--such as a change in the import quotas of steel on the U.S. auto industry, a disruption of the oil supply because of a war in the middle east, or the effect low-priced or "dumped" semiconductors would have on the U.S. computer industry. It is even difficult to determine the vulnerability of the Department of Defense (DoD) to import disruptions since DoD purchases products are at the end of long and complex production networks.[100]

Figure 5-imports Used to Produce Amenity (directly and indirectly)



SOURCE: U.S. Congress, Office of Technology Assessment, *Technology and the American Economic Transition:* Choices *for the Future,* OTA-TET-283 (Washington, DC: U.S. Government Printing Office, May 1968), p. 296.

The Census Bureau is attempting to ask more detailed questions about imports used in production, but in many cases the establishments simply do not know the national origin of the products they purchase since the products have passed through many middlemen.

Direct Investment

Shifts in the Capital Account— the value of U.S. assets owned overseas net of foreign owned assets in the United States—are also distorted by a failure to

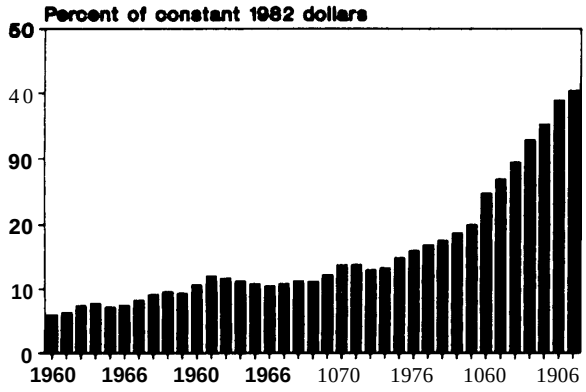
[97] See Robert *B. Reich,* "Members Only," *The New Republic,* June 26, 1989, pp. 14-18.

[98] Automotive News, 1987 Market Data Book as cited in Office of Technology Assessment, *Technology and the American Economic Transition,* Op. cit., footnote 1, part 1, p. 326.

[99] See *Technology and* the *American Economic Transition,* op. cit., footnote 1, part 1, p. 469.

[100] See U.S. Congress, Office of Technology Assessment, *Holding* the Edge, OTA-ISC-421, April 1989.

Figure 6—Investment In Information Equipment (percent of all producer's durable equipment)



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, table 5.7.

adjust for changes in value over time.[101] Direct investments by the United States overseas and by foreigners in the United States[102] are valued at book value-the price paid for at the time of purchase. No attempt is made to adjust for inflation. Since 70 percent of U.S. direct investments owned overseas were purchased by 1980 at relatively low prices while over two-thirds of foreign direct investments in the United States were acquired after 1980 at higher prices, the net position of the United States is greatly underestimated.[103] Estimates indicate that the failure to adjust for inflation undervalues U.S. overseas investments by $200 billion to $400 billion.[104] In terms of policy, this undervaluation means that the rate of return associated with those foreign assets has been grossly overestimated and the alarm over the United States becoming the largest net debtor in the world might be misplaced.[105] In addition to a more accurate valuation process, researchers argue that more detailed data on inputs, type of labor employed, and layoffs are needed for a more complete analysis of the effect of foreign direct investment on the U.S. economy.[106]

D. What Capital and Labor Inputs Are Purchased by Domestic Producers?

Up to this point this discussion has focused almost entirely on different ways of measuring the output of the economy and how to assign this output to the activities of different kinds of domestic products. It is important, however, to determine the extent to which the economy is growing only because of increases in the amounts of labor and capital and the extent to which growth which can be traced to better management or use of technology. Measuring the productivity of the economy, or output per unit of input, requires good information about both inputs and outputs.

Rapid economic changes have always been associated with major changes in capital investment. While investment in steam engines, railroads, telephones, and electric generating facilities dominated earlier periods of economic change, the most critical investments in the present period seem to involve information and intelligence—both human and artificial. It proves difficult to measure either kind of input.

A sharp growth in purchases of information equipment is documented in the income and product accounts. Over 40 percent of all business investment in durable equipment is now in "information processing" equipment—double the 1979 share and four times the 1972 share (see figure 6). '07 It is difficult to know how precise these measures are. The

101 See Norman J. Glickman and Douglas p. Woodward, *The New Competitors (New* York, NY: Basic Books), 1989, Appendix A; Robert E. Lipsey, "Changing Patterns of International Investment In and By the United States," National Bureau of Economic Research Working Paper No. 2240, May 1987, p. 47; and "Measuring the U.S. International Investment Position," Survey of *Current Business,* June 1989, p. 40.

102 Direct investment is defined as " · · · the ownership, acquisition, or establishment directly or indirectly by a person-individual association, corporation, government, etc.— of 10 percent or more of the voting securities of a foreign enterprise." See James K. Jackson, "American Direct Investments Abroad: How Much are 'hey Worth?" Congressional Research Service, July 25, 1988, p. 1.

'mJames K. Jackson, "American Direct Investments Abroad: How Much are They Worth?" Congressional Research Service, July 25, 1988, p. 2.

104 Jackson, op. cit., footnote 103, p. 10.

105 Jackson, op. cit., footnote 103, p. 1 and p. 6. When forms of international investment other than direct investment such as gold, bank loans, and securities—each of which have valuation problems—are reviewed for measurement problems, the Department of Commerce contends that *it is likely that the* aggregate international investment position has shown a substantial decline" . . . reflecting the large cumulative U.S. current account deficit." See "Measuring the U.S. International Investment Position," Survey *of Current Business,* June 1989, p. 40.

106 Glickman and Woodward, op. cit., footnote 101, p. 280.

107 National Income and Product Accounts, op. cit., footnote 15, table 5.7.

difficulty of measuring the constant dollar value of computer purchases, however, has already been discussed.

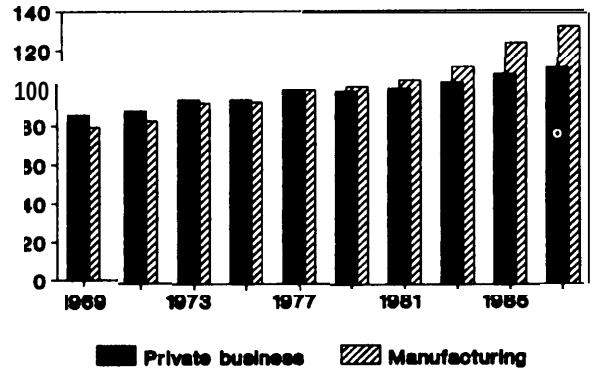
While the inflation adjusted value of the capital equipment purchased may be difficult to measure with precision, it seems likely that a significant change in the composition of what is bought has occurred. Such a large shift over such a short time period means that not only has the composition of capital investment undergone a dramatic change, but also the nature of the firms that are buying the equipment. Increasingly, industries not typically associated with capital equipment, like insurance, banking, and retailing, are becoming large users. In 1982, department and grocery stores bought more computers and peripheral equipment than the aircraft and guided missile industry .*" These large investments in information processing equipment, all along the chain of production, are indicative of an economy becoming more responsive to the needs of customers and the challenges of competitors.[109]

Accounting Conventions

Changes in the economy have reopened an ancient debate about whether to count investment in the education and training of people in the same way that physical capital is treated. Workers with good educations, and skilled in adapting to new tasks, are the most important inputs for most businesses. The traditional national income and product accounts, however, continue to treat education as a form of consumption even though economists have long understood it as a form ofinvestment.11°

Similar problems are encountered in government spending. Unlike accounting conventions used for private businesses, government purchases of capital goods—roads, airports, public buildings, and other facilities—continue to be treated as current government expenditures (current accounts) and not investments (capital accounts), even though many of these facilities obviously provide a critical infrastructure

Figur87-ProductMty (output per hour)



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics*, Bulletin 2217, June 19S5, table 91.

for economic growth. Since government investments are excluded by definition, figures on net investment, the stock of capital, and government's role as an investor in the economy's infrastructure and a holder of assets is obscured. This limits analysis that attempts to understand the links between types of government investment and economic growth. The United States is the only major advanced economy that doesn't separate its government expenditures into current and capital accounts. [111]

Although these accounting conventions are not new, their existence has drawn more attention in an era of large budget deficits. According to one estimate, the amount of useful capital investment made by the government is roughly equal to half of the $155 billion annual Federal deficit.[112] The role of Federal Government investment in promoting economic growth also takes on increased importance as international competitors explicitly base economic policies on government investment strategies.

Industry Purchases of New Capital Equipment

Statistical problems are encountered even using the most conventional definitions of capital. The

108 U.S. Department of Commerce, Bureau of Census, *General Report on Industrial Organization*, October 1986, table 8, p. 294.

109 Russell Johnston and Paul R. Lawrence, "Beyond Vertical Integration—The Rise of the Value-Adding Partnership," *The Harvard Business* Review, July-August 1988, pp. 94-101.

110 H~ Levin, "Mapping the Economics of Education," *Educational Researcher*, May 1989, pp. 13-16.

111 Michael J. Boskin, "Theoretical and Empirical Issues in the Measurement, Evaluation, and Interpretation of postwar U.S. Saving," in *Savings and Capital Formation*, Gerard Adams and Susan Watcher, eds. (Lexington, MA: Lexington Books, 1986), p. 19.

112 Robert Eisner, '*Divergences of Measurement and Theory and Some Implications for Economic Policy," *The American Economic Review*, March 1989, p. 5; see Charles L. Schultze, "Of Wolves, Termites, and Pussycats," *The Brookings Review*, Summer 1989, for an opposing view, pp. *26-33.*

most recent statistics providing a comprehensive estimate of which businesses purchased which types of capital equipment (the capital flows tables) date to 1977.113 Sometime in 1990, the 1982 capital flows tables will be released, but given the peculiarity of that recession year, the usefulness of the data on capital investment will be limited. Even if 1982 were not a recession year, the fast pace of change in capital investments that has occurred since 1982 leaves a poor understanding of how the economy has evolved. For example, from private sources we know that the number of personal computers in the workplace has jumped from 1.2 million units in 1981 to nearly 13 million in 1986, but we don't know which industries are using them or how[114] Recent criticisms that U.S. industry has not concentrated on the process side of production [115] and has "hollowed-out" [116] need to be analyzed using data that reflect which industries are purchasing what type of capital goods and how this equipment is being applied.

Recently, the Bureau of the Census has produced a report that attempts to rectify this situation for the manufacturing sector and goes further by breaking the data down by size and age of the firm, but there is no provision to make this an ongoing survey or to extend it to other sectors. [117] Interestingly, the main funding source for this survey was the Defense Logistics Agency of the Department of Defense. A one-time snapshot is useful, but it is static and it does not begin to answer questions about how investments in capital goods change in an economy that is increasingly dynamic.

Capital Stock

These issues deal with accounting for new purchases of capital equipment; another, possibly more fundamental issue, involves accounting for the existing stock and vintage of *existing* capital. Currently, estimates of capital stock are derived from a perpetual inventory system that assumes an average useful life, a set retirement distribution, and a particular efficiency rate.[118] Estimates of the existing stock can be calculated by knowing what was purchased, when, and how fast it depreciates. By and large, service lives and discard rates are based on educated guesses and tax law provisions. [119] Except for nuclear fuel, railroad equipment, and autos, the service lives for private equipment were estimated from industry studies conducted during the 1970s.[120] These estimates work reasonably well in periods of economic tranquility. But unexpected events like the two oil shocks,[121] the severe recession of the early 80s, [122] the advent of fierce foreign competition, and the arrival of new types of capital equipment, like computers, have undoubtedly changed the efficiency, depreciation, and discard rate of equipment and have caused a radical realignment of relative prices from what prevailed in the early seventies. [123] The rapid obsolescence of capital equipment used in the design and creation of semi-conductors is an example of an important industry that barely even existed in the early seventies. A periodic rebenchmarking of the exiting capital stock would reanchor the perpetual inventory system and allow a fine tuning of the perpetual

[113] Jerry Silverstein, "New Structures and Equipment by Using Industry, 1977," Survey *of Current Business,* November 1985, pp. 26-35.

[114] Future Computing Inc. cited in the U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States: 1988,* table 1286, p. 726.

[115] Michael L. Dertouzos and Richard K. Lester, Robert M. Solow and the MIT Commission on Industrial productivity, Made *in* America." *Regaining the Productive Edge,* (Cambridge, MA: The MIT press), 1989.

[116] The term "hollowed-out" refers to the practice of contracting out for finished goods and services that used to be produced internally, reducing the function of the company to primarily marketing and distribution. "The Hollow Corporation," *Business Week,* Mar. *3, 1986,* pp. 57-85.

[117] U.S. Department of Commerce, Bureau of Census, *Manufacturing Technology 1988,* SMT(88)-1, May 1989.

[118] Charles R. Hulten, "The Measurement of Capital," forthcoming in the proceedings from the Conference on Research in Income and Wealth, Washington, DC, May 12-14, 1988, edited by Ernst Berndt and Jack Triplett, July 1988, p. 44.

[119] Edwin Dean, Masako Darrough, and Arthur Neef, "Alternative Measures of Capital Inputs in Japanese Manufacturing," forthcoming in *A* Comparison *of Productivity in Japan and the United States,* National Bureau of Economic Research, (University of Chicago Press), p. 3.

[120] U.S. Department of Commerce, Bureau of Economic Analysis, *Fixed Preproducible Tangible Wealth in the United States, 1925-88,* (Washington, DC: Government Printing Office, 1987), p. xxi.

[121] See Martin N. Baily, "Productivity and the Services of Capital and Labor," *The Brookings Papers on Economic Activity,* vol. 1, 1981.

[122] See Susan G. Powers, "The Role of Capital Discards in Multifactor Productivity Measurement," *Monthly Labor Review,* June *1988,* pp. *27-31.*

[123] The significance of Some of these factors on estimates of capital are discounted by Huten *et. al.* See Charles R. Hulten, James W. Robertson, and Frank C. Wykoff, "Energy Obsolescence, and the Productivity Slowdown," in *Technology and Capital Formation,* edited by Date W. Jorgenson and Ralph Landau (MIT Press 1989), pp. 225-258.

inventory estimation process.[124] Canada has recently begun an effort to measure capital stock for exactly this purpose.[125]

Education as Investment

Traditional accounting conventions do not treat expenditures on education or training as a form of investment.[126] This is not a trivial exclusion because total education expenditures are nearly 10 percent of the GNP. Currently, data suggest that a company is investing if it purchases a new machine, but not if it pays for the employee training needed to use that machine efficiently. Indeed, the total national investment in education probably exceeds net private purchases of equipment like machine tools and computers. Even if we decided to treat education as an investment, however, we don't have any clear idea of how much we are investing. Estimates of corporate investment in education and training range from $66 billion to $210 billion.[127] GM boasts that it has the largest, private educational program in the world. 'n Federal data on training are very incomplete. Estimates of private investment in education are based primarily on private surveys, which are acknowledged to be inadequate. [129]

If education outlays are to be included in capital accounting, a number of problems must be overcome. Perhaps most difficult is measuring the value of education. However, even the most conservative estimates would more accurately reflect the new realities of an education-based economy.

Labor Inputs

Data on the actual number of hours worked by Americans are available from BLS. But all hours are not equal. Several attempts have been made to adjust for the "quality" of labor by examining changes in skills and levels of education.[130] BLS is introducing a new indicator of labor quality.

It is particularly difficult to adjust for the quality of education delivered. Declines in standardized test scores during the 1970s and early 1980s seemed to indicate that an adjustment should be made. Estimates show that growth in "quality adjusted labor inputs" may be 0.1 to 0.25 percent per year lower than unadjusted labor inputs during the 1980s.[131] It is important to measure changes in the real education assets available in the American workforce since competitiveness of U.S. industry appears to depend critically on changes in labor quality.

Adjustments for labor quality depend on techniques linking wages to education, age, sex, work experience, and other factors. Few, if any of the measures take into account training received on the job (except to the extent that training is measured by years of "work experience"). It is difficult to determine whether higher wages are paid for education because the education was needed on the job or simply because education was needed to get the job in the first place. Planned improvements to the Survey of Income and Program participation (SIPP) survey (discussed later) may help.

E. How Productively Do Domestic Producers Use Inputs?

Given accurate information about outputs and inputs, it is possible to compute changes in the productivity growth rate (output per unit of labor input) of the economy. In the absence of productivity

[124] Hulten, op. cit., footnote 118, p. 50.

[125] Peter Koumanakos, "The Capital Stock Survey Project," *Survey of Current Business*, May 1985, vol. 64, No. 5, p. 31.

[126] A similar point could also be made about expenditures on health care. See Eisner, op. cit., footnote 112, p. 10.

[127] Roger J. Vaughan and Sue E. Berryman, "Employer-Sponsored Training: Current Status, Future Responsibilities," prepared for the Conference on Employer-Sponsored Training, Alexandria, VA, Dec. 1-2, 1988, p. 3.

[128] Advertisement, *The Atlantic*, May 1989, p. 105.

[129] A.P. Carnevale and H. Goldstein, "Employee Training: Its Changing Role and An Analysis of *New* Data," American Society fOr Training and Development Press, Washington, DC, 1983 and A.P. Carnevale, testimony before the Subcommittee on Taxation and Debt Management of the U.S. Senate Finance Committee, Washington, DC, Nov. 30, 1987.

[130] Edward F. Denison, *Trends in American Economic Growth*, 1929-1982 (Washington, DC: The Brookings Institution), 1985; D. Jorgenson, F. Gollop, and B. Fraumeni, *Productivity and U.S. Economic Growth* (Harvard University Press, 1987), E. Dean, K. Kunze, and L. Rosenblum, "Productivity Change and the Measurement of Heterogeneous Labor Inputs," paper presented at the Conference on New Measurement procedures for U.S. Agricultural Productivity (Mar. 31-Apr. 1, 1988, Washington DC).

[131] Martin N. Baily, "Productivity and the Services of Capital and Labor," *Brookings Papers on Economic Activity*, vol. 1, 1981, p. 49; J. Bishop, "Is the Test Score Decline Responsible for the Productivity Growth Decline?" working paper 87-05 (Cornell University, Jan. 6, 1988).

growth, economic output per person and therefore living standards can only increase over the long term by increasing inputs—e.g. by having each person work more hours or by putting more people to work. Productivity is a key measure of progress in the economy.[132] The output per hour worked in the business sector of the U.S. economy in 1986 was 60 percent higher than it was in 1960.[133] Each hour worked therefore produced 60 percent more to be paid as wages or profits.

Tracking changes in productivity, and helping explain changes in productivity, is clearly one of the central goals of the national statistical effort. It has been very difficult to explain the striking changes in rates of growth in labor productivity that have occurred during the past few years. Labor productivity grew an average of 2.9 percent per year between 1948 and 1973, fell to 0.6 percent per year between 1973 and 1979, and increased to 1.4 percent per year from 1979 to 1986.[134] The challenge of explaining the changes is made more difficult by the fact that the post 1979 increases in productivity show a very peculiar feature. Unlike previous periods of productivity growth, the post 1979 growth was dominated by increases in manufacturing productivity (it averaged 3.5 percent per year between 1979 and 1986) while productivity growth in other business sector activities (primarily services) was very slow (0.6 percent per year).[135]

A variety of explanations have been offered to explain the change. Martin Baily and Robert Gordon suggest that as much as 30 percent of the productivity decline after 1973 is the result of errors in measuring both outputs and inputs.[136] Even after granting some errors in measurement, however, a real decline has clearly occurred. Explanations for this decline include a surge of less experienced workers from the baby boom, a decline in spending for research and development, dramatic shifts in oil prices that required increased inputs of capital and labor, and new government regulations that increased labor inputs without increasing sales.[137]

The Bureau of Labor Statistics (BLS) provides three kinds of productivity statistics:

- *Business Sector Productivity* that measures the value-added in the business sector per hour worked.[138]
- *Industry Productivity Series* that measures gross output (or sales) produced per unit of labor for each major industry.[139]
- *Multi-factor Productivity Series* that separates changes in Business Sector output due to changes in capital and labor inputs from changes that result from new technologies or other practices that can increase output without increased use of capital and labor. A new series (the KLEMS) provides a more detailed analysis of the effect of different types of inputs (capital, labor, energy, materials, and services) on productivity at an industry (2-digit SIC) detail for the manufacturing sector.

In addition to these productivity series, the BLS produces a number of "unpublished" series that cover industries such as construction which are not

[132] Robert E. Litan, Robert Z. Lawrence, and Charles L. Schultze (eds.), *American Living Standards*, (Washington, DC: The Brookings Institution, 1988), p. 178.

[133] *Statistical Abstract of the United States, 1989*, op. cit., table 659, P. 403.

[134] Denison, op. cit., footnote 29, p. 3.

[135] Denison, op. cit., footnote 29, p. 3.

[136] Baily and Gordon, op. cit., footnote 11, p. 418.

[137] See Edward F. Denison, "The Interruption of Productivity Growth in the United States," *The Economic Journal*, vol. 93, March 1983; Herbert Giersch and Frank Welter, "Towards an Explanation of the Productivity Slowdown: An Acceleration-Deceleration Hypotheses," *The Economic Journal*, vol. 93, March 1983; Wayne B. Gray, 'The Impact of OSHA and EPA Regulation on productivity," working paper, National Bureau of Economic Research, Cambridge, MA, July 1984; Assar Lindbeck, "The Recent Slowdown of Productivity Growth," *The Economic Journal*, *vol. 93*, March 1983; Zvi Griliches, "R&D and the Productivity Slowdown," *The American Economic Review, vol. 70, No. 2*, May 1980; Martin N. Baily and Alok K. Chakrabarti, "Innovation and Productivity in U.S. Industry," *Brookings Papers on Economic Activity, No. 2, 1985;* Richard J. Murname, "Education and the Productivity of the Workforce: Looking Ahead," in *American Living Standards*, Robert E. Litan, et. at., (eds.) (Washington, DC: The Brookings Institution, 1988), pp. 215-245.

[138] The business sector includes roughly three-quarters of GNP. It excludes output from the rest-of-the-world, general government, output from paid employees of household help, nonprofit institutions, the rental values of owner-occupied buildings, and the statisti-cal discrepancy in *computing* NIPA. See U.S. Department of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics*, Bulletin 2217, June 1985, p. 226,

[139] U.S. Department of Labor, Bureau of Labor Statistics, *Productivity* Measures *for Selected Industries and Government* Services, Bulletin 2296, February 1988.

covered in the published series because of weaknesses associated with the data.

Business Sector Productivity

The broadest and most widely followed measure of productivity is called business sector productivity.[140] The business sector is chosen to include only the parts of the economy for which BLS has reasonably good price deflators (e.g., it does not include any government activities) and is highly aggregated. Business sector productivity is published only for a few not mutually exclusive sectors: private non-farm business, manufacturing, durable and nondurable manufacturing, and nonfinancial corporations. This high level of aggregation avoids many of the difficulties encountered when attempts are made to assign economic output to specific businesses.

Business sector labor productivity is calculated using constant dollar estimates of value-added generated by the "business sector" and estimates of the total value-added in manufacturing provided by BEA in its Gross Product Originating series.[141] But there are problems even at this high-level of aggregation. The difficulty BEA encounters in estimating value-added in constant dollars was discussed at length earlier in this paper. A number of researchers including Baily and Gordon,[142] Denison,[143] John Kendrick,[144] Lawrence Mishel,[145] and OTA[146] think that manufacturing's productivity rate has been overestimated because manufacturing's constant dollar value-added is improperly measured.[147] If this is true, non-manufacturing's productivity has been underestimated.

Industry Productivity

The problem of computing value-added can be avoided if labor productivity is defined to be ***gross*** business output (or sales) divided by hours worked. In this case it is only necessary to develop a deflator for the products sold by an industry. The difficulty with using gross output as a measure of a business' contribution to economic activity has already been discussed in the section on "Computing Business Output by Sector." A potential problem with gross output is that it includes the value of intermediate inputs produced by suppliers and the value-added by the firm. Thus artificial boosts in labor productivity could occur if a firm kept gross output steady while increasing suppliers' products and decreasing labor that used to be used to make those products internally. BLS claims that it does not publish series for industries where the intermediate inputs have changed so significantly that they would distort the results.

The industry labor productivity series covers mining and manufacturing industries in extensive 3 and 4 digit SIC (Standard Industrial Classification) detail, but does not have any published productivity data on any segment of the construction industry and the published data covers less than half of the jobs in private sector service industries.[148] The services that are included tend to be industries whose output can be quantified, such as ton miles in the railroad transportation industry.[149] This means that impor-

[140] The business sector includes roughly three-quarters of GNP. It excludes output from the rest-of-the-world, general government, output from paid employees of household help, nonprofit institutions, the rental values of owner-occupied buildings, and the statistical discrepancy in computing NIPA. see Us. Department of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics,* Bulletin 2217, June 1985, p. 226.

[141] U.S. Department of Labor, Bureau of Labor Statistics, *Handbook of Methods*, Bulletin *2134-1,* (Washington, DC: *U.S.* Government Printing Office 1982), p. 94.

[142] Baily and Gordon, op. cit., footnote 11, p. 420.

[143] Edward F. Denison, *Estimates of Productivity Change by Industry* (Washington, DC: The Brookings Institution, 1989), p. 58.

[144] John W. Kendrick, "Service Sector Productivity, *Business Economics,* April 1987, p, 23.

[145] Lawrence R. Mishel, "Manufacturing Numbers: How Inaccurate Statistics Conceal U.S. Industrial Decline" (Washington, DC: Economic Policy Institute, April 1988), p. 57.

[146] U.S. congress, Office of Technology Assessment, *Paying the Bill: Manufacturing and America's Trade Deficit,* OTA-ITE-390 (Washington DC: U.S. Government Printing Office, June 1988), p. 46.

[147] See the section on "Computing Business Output by Sector" for a more complete discussion of this mismeasurement.

[148] Derived from table 1 of *Productivity Measures for Selected Industries and Government Services*, Bulletin 2296, February 1988 and U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, op. cit., footnote 15, table 6.1OB.

[149] Jerome A. Mark, ''Measuring Productivity in Service Industries: The BLS Experience, ''Resented at the Symposium on Technology and the Services Industries, Hanover, NH, August 1987.

tant and quickly growing service industries whose output is difficult to measure, such as business services, health care, and private education, do not have published productivity estimates.

Left with this gap, researchers either calculate their own productivity estimates using BEA's National Income and Product Accounts data (value--added divided by persons or hours) or unofficial, unpublished BLS estimates. In sectors like business services and banking, inflation adjusted gross product originating (value-added by industry) is estimated using changes in employee hours as an indicator of how the quantity of output in this sector has changed.[150] Because labor productivity is calculated by dividing an industry's total output by the total number of hours needed to generate the output, this process of estimating output through the use of hours essentially puts hours in both the numerator and the denominator of the ratio, canceling each other out. The result is that labor productivity increases are practically eliminated by definition algebraically. *s* This might help explain why this sector's productivity has been flat even though the service sector has made substantial investments in productivity enhancing capital equipment, like computers. It is because of these limitations that the BLS publishes detailed productivity indexes only for selected industries.

Nevertheless, the widely followed business sector productivity series does indirectly make use of this limited, extrapolated data because many of the constant-productivity services like business services are large and growing inputs into other sectors, particularly manufacturing.[152] Because of this and other factors, Denisen estimates that the productivity of farms and manufacturing has not only been overstated, but has been increasingly overstated over time.[153]

Multifactor Productivity

The third measure of productivity produced by the Bureau of Labor Statistics is the multifactor series. Favored by most economists, the multifactor series does not ascribe all changes in output to one factor such as labor, but rather breaks it down into broad categories of inputs. The series published on a regular schedule traces changes in business sector productivity to changes in multifactor, labor, and capital productivity. A new series (KLEMS) add energy, materials, and purchased services productivity for all manufacturing industries. Whatever growth that can not be attributed to these factors reflects a more qualitative change such as a shift in technology or different management. Although, this series is conceptually a large improvement, it suffers from some of the same problems that plague the other productivity and output measures; particularly the lack of detailed data on purchased services.

F. How Has the Corporate Structure of the U.S. Economy Changed?

Sophisticated technology, regulatory changes, an active merger wave, a severe recession and the need to participate in intricate marketing and financial networks, have led to a realignment of the structure of America's enterprises.

While it is difficult to provide precise documentation, there is clear evidence that the growth of large firms is increasingly built around the aggregation of large numbers of comparatively specialized small establishments.[154] Many large firms,[155] including AT&T, DuPont, General Motors, Hewlett-Packard, IBM, Martin Marietta, NCR, 3M, and Xerox claim that they are reorganizing operations to encourage more entrepreneurial behavior on the part of individuals and establishments.[156]

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[150] Milo Peterson, "Gross Product *by* Industry," *Survey of Current Business*, April 1987, p. 27.

[151] Kendrick op. cit., footnote 144, p. 20 and Baily and Gordon, op. cit., footnote 11, pp. 394 and 397.

[152] Tschetter, op. cit., footnote 34, p. 34.

[153] Edward F. Denison, *Estimates of Productivity Change by Industry* (Washington, DC: The Brookings Institution), 1989, p. 55.

[154] An establishment is the smallest unit in which business activity is conducted. It can represent the entirety of the business activity within a business, making that business a sole-establishment enterprise, or it can be one of hundreds of establishments (branches, subsidiaries, and corporate headquarters) that make up a multi-establishment enterprise.

[155] The term firm refers to the entire corporate family or enterprise which can be made up of numerous establishments.

[156] James Brian Quinn, "Managing Innovation: Controlled Chaos," *Harvard Business Review*, May/June, 1985, p. 80 and R.M. Kanter, "The Attack on Pay," *The Harvard Business Review, vol. 65, No. 2,* March-April 1987, pp. 60-67; and Michael Piore and Charles Sable, *The Second industrial Divide (New York, NY:* Basic Books), *1984.*

Small firms traditionally flourish during periods of rapid transition, since the bureaucratic inertia of large firms may blind them to opportunities in places where none were expected. Computers and communications technology are providing opportunities for small enterprises to hook into larger networks of production. Sophisticated production technologies capable of tailoring products to specialized markets without a significant sacrifice in productivity or increase in cost can vastly diminish the values of economies of scale-benefiting small businesses.

When the trends are combined there appears to be a convergence in structure as firms in sectors that are traditionally fragmented (farming, physicians, and home construction firms) become amalgamated into larger firms while sectors that are traditionally highly concentrated, like automobile production, bear less resemblance to Ford's enormous Rouge River Plant (where wood and iron went in one end and cars rolled out the other) and more like the craft-based production that preceded heavy automation. This observation parallels the popular notion that advances in production technologies have reduced the need for large production units, but have simultaneously made it possible to connect and manage many different units under one corporate structure. [157]

The data needed to track these changes and their impacts are spotty at best. Even answering more mundane industrial organization questions, such as how mergers and acquisitions have changed the makeup of the U.S. economy, whether small firms are the source of a disproportionate amount of new jobs, or what the levels of new business startups and closures are, requires elaborate methodological contortions. A complete data base of U.S. business establishments organized into their corporate families that researchers can study to observe some of the dynamics discussed above does not exist. The constant churning of the economy makes this a difficult task.

Currently, there are two primary data sets that show the corporate structure of the U.S. economy over time: the Small Business Administration's (SBA) Small Business Data Base (SBDB)[158] and the Enterprise Statistics file compiled by the Bureau of the Census. [159] Both of these data sources suffer from limitations that restrict their usefulness.

The Enterprise Statistics data series is a file built from establishment level data collected from the economic censuses (e.g., Census of Manufacturing). The data are converted from the establishment level to the enterprise level through use of another Census data file, (The Report of Organizations), which takes a snap-shot of the enterprise at a specific time.[160] Because the data are cross-sectional and not longitudinal, it is impossible to understand the dynamics underlying changes in employment or sales. Questions such as whether the employment growth was due to the birth of new firms or the expansion of old firms cannot be answered. Collected in five-year increments, the Enterprise Statistics currently available dates back to 1982. In addition, the data do not provide links that allow longitudinal tracking and lack coverage in some of the fastest growing segments of the economy, such as transportation, communication, finance, insurance, and real estate.[161]

[157] See Russell Johnston and Paul R, Lawrence, op. cit., footnote 109, pp. 94-101.

[158] The SBDB consists of several interrelated files. Two are implicitly referred to here: USEEM (U.S. Establishment and Enterprise Microdata) and USELM (United States Establishment Longitudinal Microdata). See U.S Small Business Administration, *Handbook of Small Business Data, 1988,* (Washington, DC: U.S. Governmental Printing Office), 1988.

[159] Several other data sources for business level data do exist, such as Unemployment Insurance (UI) records, Longitudinal Employee-Employer Data (LEED), Statistics of income, the Longitudinal Research Database (LRD), and the Standard Statistical Establishment list (SSEL). These data sources are not included as primary data sets because they have either been discontinued, are subject to disclosure provisions, cover only one sector such as manufacturing, or lack fundamental data of interest to researchers such as employment or the enterprise structure. See *Handbook of Small Business Data, 1988*, op. cit., footnote 158, *pp. 10-17.*

[160] U.S. Department of Commerce, Bureau of the Census,]982 *Enterprise Statistics: General Report on Industrial Organization*, October 1986, p. 31 1.

[161] The failure to cover some portions of the service industry should be alleviated when the Census Bureau expands its industrial censuses in 1992. In prior years, the Census Bureau could not include these sectors because they were in regulated industries. For a comparison of the two data sources, see U.S. Small Business Administration, *Handbook of Small Business Data, 1988,* (Washington, DC: U.S. Government Printing Office), op. cit., footnote 158, pp. 26-79, and Candee S. Harris, "Handbook of Small Business Data," report to the Small Business Administration, January 1983, p. 8.

Under a mandate from Congress,[162] the Small Business Administration started in 1979 to develop a database built from private Dun & Bradstreet Dun's Market Identifier (DMI) data that roughly cover all private businesses with employees.[163] A private data source was used so that individual firms could be analyzed without violating confidentiality restrictions associated with public data. Organized into their respective corporate enterprises, the firms are linked over time for the even years from 1976 to 1986, exposing the evolution of the business as it gains and loses jobs and establishments, shifts lines of business, and relocates geographically. The births of new businesses appear alongside deaths. The problem is that the Dun & Bradstreet (D&B) data were collected for the purpose of assigning credit ratings and creating other business products, not for academic economic analysis. Nor was it ever intended to be organized on a longitudinal enterprise basis. As a result, the data underreport branches of multiestablishment firms since most credit decisions are made at the corporate headquarters or subsidiary level.[164] Thus the true corporate structure from an establishment viewpoint is obscured. The database does not include firms without employees, such as the self-employed, who represent about 9 percent of the labor force and roughly 60 percent of all businesses.[165] Other problems include the fact that it can take several years for D&B to include new firms (especially smaller ones) in its file—possibly missing a large number of firms that go in and out of business during that time.[166] Likewise, firms, especially smaller ones, are not consistently updated, creating possible distortions in calculations of growth.[167] When these problems are added to clerical errors that were found, nearly half of the establishments in the full SBA USEEM database were deemed inadequate for tracking employment over time. To correct for this, editing, imputing, and weighting schemes had to be devised.[168]

Depending on how one adjusts for these deficiencies, researchers using Dun & Bradstreet data can get significantly different results. One of the early users of D&B data, David Birch, states in his new book, *Job Creation in America,* that firms with less than 20 employees created 88 percent of all the new jobs between 1981 and 1985.[169] But Mr. Birch, whose work has attracted a lot of criticism, asserts that: "Anybody can make it come out any way they want. ''[170]

SBA analyses using a database built on Dun & Bradstreet data conclude that only 36,5 percent of new jobs came from firms with less than 20 employees between 1982 and 1986.[171]

The lack of a comprehensive longitudinal database on corporate structure means that questions concerning the roles of small versus large business in generating economic growth are answered with great imprecision-if they are answered at all. Studies about the source of job growth, as discussed above, are controversial. Research that looks at the correlation between productivity and firm size yield ambiguous results.[172] The amount of business start-ups and closures—a seemingly basic indicator of the direction of the economy-is unavailable with any

[162] The Small Business Economic Policy Act of 1980, Public Law %- 302.

[163] Confidentiality restrictions prevented the SBA from using detailed Census data.

[164] In 1978, there was a 15 million employee difference between the total employment reported by the corporate tops of the firms and the sum of the firms establishment employment. Dun & Bradstreet says that it has recently improved its coverage of branch establishments. See A.L. Walton, "How Small Businesses Contribute to Job Generation—The Pitfalls of a Seemingly Simple Question," National Science Foundation, prepared for the 1983 Conference on Industrial Science and Technological Innovation, Evanston, IL, May 2-4, 1983 and *The State of Small Business,* March 1983, p. 290.

[165] *Handbook of Small Business,* 1988, op. cit., footnote 158, p. 7.

[166] Bruce D. Phillips and Bruce A. Kirchhoff, "Formation, Growth and Survival: Small Firm Dynamics in the U.S. Economy," *Small Business Economics, vol.* 1, 1989, pp. 66-67; Sue Birley, "Finding the New Firm," *Academy of Management Proceedings '84, 44th* Annual Meeting, Boston, MA., Aug. 12-15, 1984, p. 67; Douglas P. Handler, "Business Demographics," a study by Dun & Bradstreet, p. 7.

[167] A.L. Walton, "How Small Businesses Contribute to Job Generation---The Pitfalls of a Seemingly Simple Question," National Science Foundation, paper prepared for the 1983 Conference on Industrial Science and Technological Innovation, Evanston, IL, May 2-4, 1983, pp. 10-14.

[168] See *Handbook of Small Business Data, 1988,* op. cit., footnote 158, p. 2 and *The State of Small Business* (Washington, DC: U.S. Government printing Office) May 1985, p. 425.

[169] David Birch, *Job Creation in America (New* York, NY: The Free Press, 1987), p. 16.

[170] David Wessel and Buck Brown, "The Hyping of Small-Firm Job Growth," *The Wall Street Journal,* Nov. 8, 1988, section B, p. 1.

[171] "The Hyping of Small-Firm Job Growth," *The Wall Street Journal, Nov.* 8, 1988, p. B7.

[172] Steven Lustgarten, *Final Report to the Small Business Administration on Firm Size and Productivity,* (Washington, DC: U.S. *Government printing* Office), September 1982 and Stahrl W. Edmunds, 'Organizational Size and Efficiency in the U.S.," *The Antitrust Bulletin,* Fall 1981, pp. 507-519.

sort of precision.[173] More abstract, but crucial questions, such as the role of organizational structure in promoting innovation, cannot be definitively answered.[174] This uncertainty hinders and possibly misleads the development of economic growth policies.

The difficulty associated with developing a complete list of businesses cannot be understated. Dun& Bradstreet estimates that " . . . several hundred thousand businesses see a change in their status through starting or discontinuing operations or through M&A [mergers and acquisitions] activity. "[175] A potential solution to this problem exists through use of the Standard Statistical Establishment List (SSEL) that is used by the Census Bureau or the unemployment insurance data collected by the BLS. Currently both databases provide a sampling frame for the agencies' surveys which could possibly be used for other purposes such as examining changes in corporate structure. Consisting of the address, SIC code, sales, and employment of nearly every business establishment in the country, the SSEL provides fairly complete data on the way business organize to form the economy; although efforts would be required to organize the file into a corporate structure. But the use of detailed Census data trigger confidentiality limitations that restrict their use by outsiders and even by other statistical agencies like BLS. [176] Because of these restrictions BLS has developed its own business list from unemployment-insurance administrative lists that have extensive coverage of small businesses.[177] External use might be possible if the data are aggregated in a way that protects the confidentiality of respondents.

G. How Does Growth Affect Incomes and Income Distribution?

All the discussion thus far has been directed at national averages. Aggregate data on growth of national income and wealth say nothing about who benefits from this growth. There are clear indications that the benefits of growth have been enjoyed primarily by the wealthiest families in the United States since 1979.[178] The gap separating those able to benefit from the transformation of the American economy (primarily people with good educations) and those left behind (primarily those with poor educations and families headed by single women) is growing.[179] This trend has a direct effect on theU.S. labor force because it means that about a fifth of all children now live in poverty and may enter the work force disadvantaged by this experience.

Information about the effects of economic change on income distribution are important for policies ranging from changes in the personal income tax to changes in welfare policies to identifying who are the poor. The bipartisan welfare reform program recently enacted drew heavily on data showing how many people remained in welfare programs for long periods of time.

Data linking incomes to individuals and households come primarily from four sources: the Statistics of Income, the Current Population Survey, the Survey of Income and Program Participation, and the Consumer Expenditure Survey. Of the four, the most widely used for studying patterns of income distribution is the Census Bureau's Current Population Survey (CPS) because of its rich demographic detail on households. While most wage income is reported in the CPS, income from dividends, inter-

[173] *Handbook of Small Business Data, 1988*, op. *cit.*, footnote 158, pp. 21-22.

[174] See C. Freeman, J. Clarck, and L.G. Soete, *Unemployment and Technical Innovation* (Westport, CT: Greenwood Press, 1982); W.M. Cohen, R.C. Levin, and D.C. Mowery, "Firm Size and R&D Intensity: A Re-examination, "National Bureau of Economic Research (Cambridge, MA), working paper No. 2205; and L. Tornatzky, et. al., *The Process of Technological Innovation: Reviewing the Literature* (Washington, DC: U.S. Government Printing Office, 1983).

175 Handler, op. cit., footnote 166, p. 10.

[176] Efforts to legislatively ease these confidentiality limitations have met with opposition. See National Association of Business Economi sts, "Report of the Statistics Committee of the National Association of Business Economists," February 1988, p. 18.

[177] Slater, op. cit., footnote 5, part 1, p. 84.

[178] S. Danziger, P. Gottschalk, and Eugene Smolensky, "How the Rich Have Fared, 1973-87," *The American Economic Review*, vol. 79, No.2, May 1989, pp. 310-314. US. Congress, Congressional Budget Off@, *The Changing Distribution of Federal Taxes: 1975-1990*, October 1987.

[179] See U.S. Congress, Congressional Budget Office, *Trends in Family Income: 1970-1986* (Washington, D, C,: U.S. Government Printing office), February 1988, p. xviii; U.S. House of Representatives, Committee on Ways and Means, *Children in Poverty*, May 22, 1985, p. 601; and U.S. Congress, Congressional Rcsearch Service, "Economic Benefits of Education," Dec. 13, 1988.

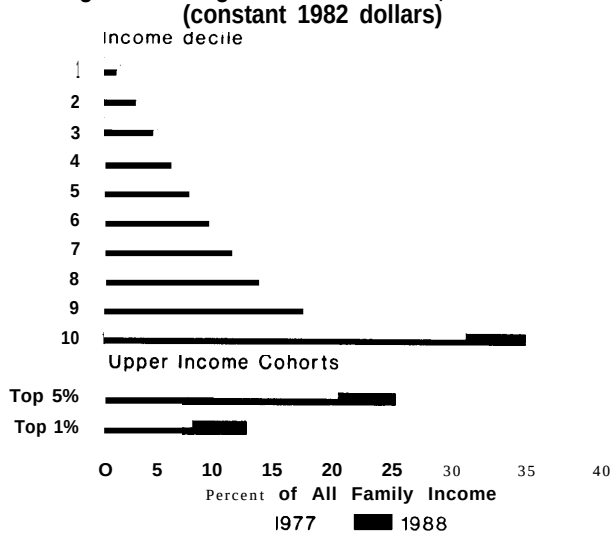
est, rents and other types of property-type income are very poorly reported. Estimates indicate that even after some imputations are made, only half of some categories of income (e.g., interest and dividend) may be reported. The survey also does not fully capture the income of the very wealthy.

In an effort to improve the accuracy and the response rates, the survey does not ask the wealthy to report their exact income, but instead simply to state whether their income exceeds a certain threshold such as "$300 thousand or above" giving no information about how much is earned in excess of the threshold.[180] The data available to the public has an even more restrictive threshold of $100 thousand. This not only leads to a significant underestimate of the income of high income households which appear to be a growing segment of the population, but also frustrates accurate comparisons of the income distribution over time since the threshold level has been increased erratically over the past 15 years.[181] Because this level changes over time, researchers trying to analyze expenditure patterns on the basis of income and estimates of household income growth and inequality, particularly for this upper group, are constrained. To get around the problem researchers usually throw out the top group, leading to an underestimate of the inequality in income.[182]

Some of the confusion surrounding the so-called "Missing Middle" income distribution question, where it is alleged that the middle class is shrinking as the lower and upper classes grow, involves limitations with the CPS. A report from the Congressional Budget Offie, which made creative use of IRS records to correct for this upper-income problem, found that *all* of the inflation-adjusted, after-tax income growth between 1977 to 1988 occurred in the upper 10 percent of all families (see figure 8).183 Efforts to track growth that exclude this upper income group are obviously severely hampered.

A potential solution would be for the Census Bureau to assign a mean or median **income** level for this top group rather than the threshold level. This estimate could be derived through matching the CPS to another data source (e.g., IRS Statistics of Income

Figure 8—Mergers and Takeovers, 1972-1986 (constant 1982 dollars)



NOTE: Assumes Corporate Tax Allocated to Capital Income,
SOURCE: Julius Allen, 'Corporate Takeovers: A Survey of Recent Developments," U.S. Congressional Research Service report No 87-726-E, Washington, DC, Aug. 6, 1987.

data) that does not suffer the same limitations. The characteristics of the data used to accomplish this task and necessary confidentiality restrictions require that it be done at a very aggregated level.

The other sources for income data include:

- The Statistics of Income (SOI) published by the Internal Revenue Service consists primarily of income data, providing good detail on the source of income (wages, interest, dividends, etc.), but lacks explanatory demographic data and information on people who do not file tax returns.
- The Survey of Income and Program participation (SIPP) is designed to provide 'more detailed information about the income households receive from all sources—particularly noncash transfer benefits. Unlike the CPS, the SIPP monitors changes in the income of individual families over a number of years and data are available on a monthly basis. It also attempts to provide a measure of the wealth of households, not just current income.

[180]This setting of an income threshold is commonly referred to as "top-coding."

[181]U.S. House of Representatives, Committee on Ways and Means, *Children in Poverty*, *op. Cit.*, footnote 179, p. 599.

[182]Ibid., p. 599.

[183]U.S. Congress, The Congressional Budget Office, *The Changing Distribution of Federal Taxes: 1975-1990*, October 1987, table A-2, p. 85,

- The Consumer Expenditure Survey provides information about household purchases and income for a small sample of families each year (see the next section for more details).
- A small sample of households has been followed by the-University of Michigan since the mid 1970s. Known as the Panel Study of Income Dynamics, the series is a rich longitudinal database but suffers from a small sample size and data inconsistencies.

While the data available from these sources can be used to outline basic changes in income distribution, the limitations noted greatly limit the analysis possible. Changes in the wealth and income of wealthy households is not well reported. Sample sizes in SIPP and other longitudinal studies are so small that many small but important demographic groups are not represented in large enough numbers to be statistically significant (e.g., nonwhite welfare mothers, or the very old). Information about employer benefits is not well reported either by employers or by individuals. What is reported is of uneven quality. Efforts to link total employer contributions to benefits enjoyed by different kinds of households, are only in the experimental stages. [184]

As mentioned before, a potential solution to some of these shortcomings involves matching these data files to other data sources. This process could compensate for some data deficiencies, but suffers from the fact that much of this data was collected from respondents with an assurance of confidentiality. Conforming to these confidentiality restrictions can limit the usefulness of the matching technique.[185]

Other Problem Areas

This report has only touched on data designed to address gross measures of economic change. A number of *other areas* clearly deserve attention. These include:

- The redundancy of two business directory lists for sampling purposes should be eliminated. Currently, two nonfarm business lists exist as sampling frames for establishment censuses and surveys. The Bureau of the Census uses the Standard Statistical List (SSEL) and BLS uses its business directory list compiled from Unemployment Insurance (UI) data. The existence of two lists means that data is not strictly comparable and that an expensive duplication of effort occurs. Although the President's Economic Policy Group recommended that BLS serve as the agency in charge of compiling a common list,[186] efforts have been stymied by a lack of legislation that amends the confidentiality law allowing BLS access to the Census data.
- Data on scientific and engineering manpower also suffer from weaknesses. BLS surveys report only half of the scientists and engineers reported by NSF while NSF reports only 60 percent of the engineers counted by the Bureau of the Census.[187]
- While extensive data are available on regional economic activity, comparatively little work is done to analyze or present the data in ways that would allow states or regions to reproduce national analyses. Regional input/output data are constructed with painful deliberation.[188]

  BEA has long published personal income estimates by state and county and has recently introduced an "experimental" data series on Gross State Product. As businesses focus on niche markets and as economic development issues increasingly fall into the hands of the states, there is a need to add to databases of regional economic statistics. Significant economies seem to exist by having the Federal government undertake this task rather than having the individual states do their own data collection.
- The two standard measures of net savings—BEA's NIPA measure and the Federal Reserve

[184] The Census Bureau has experimented with collecting data from employers of respondents of SIPP and hopes to do so on a larger scale in the future.

[185] See Roger Herroit, Chester Bowie, Daniel Kasprzyk, and Sheldon Haber, "Enhanced Demographic-Economic Data Sets," Survey *of Current Business,* November 1988, pp.44-48 and Walter Y. Oi, "How Valuable Are Matched Data Files," Survey*of Current Business,* November 1988, pp. 49-50.

[186] "Report of the Working Group on the Quality of Economic Statistics to the Economic Policy Council," April 1987 and "Implementation of the Working Group on the Quality of Economic Statistics Recommendations," March 1987.

[187] See National Academy of Science, *Surveying the Nation's Scientists and Engineers: A Data System for the 1990s,* 1989 and U.S. Congress, Office of Technology Assessment, *Preparing for Science and Engineering Careers: Field-Level Profiles,* Staff Paper, Jan. 21, 1987.

[188] Polenske, op. cit., footnote 43, p. 3.

Board's flow-of-funds saving measure-lead to conflicting estimates.[189] The NIPA "income-less-outlays" method faces the problem of subtracting two large numbers.[190] Thus errors in either end up as errors in the residual which is the estimate of savings. Flow-of-funds savings estimates are actually built up from data on assets and liabilities which face new problems because of the many new savings instruments made possible by a deregulated financial indus-
Q .

- Nagging problems remain in treatment of the "underground economy" and possible under count of inner-city residents in the decennial census.[191]
- Time-Use Accounting needs to be improved. The way Americans spend their time is becoming a critical part of economic analysis since major changes are occurring in the things formally counted as a part of the economy. Many activities formerly done with unpaid household time (child care, cooking, care for the elderly) are now purchased while capital equipment in the home (microwaves, VCRs) substitutes for services that might otherwise have been purchased. Changes in time use provide a sensitive way to measure changes in the overall performance of the national economy. It is clear, for example, that Americans have purchased economic growth in recent years by sacrificing free time. The National Science Foundation funded small time-use surveys in 1965 and 1975, but budget cuts made a 1985 survey impossible. Fortunately, a private corporation, AT&T, provided the bulk of funding for a similar time-use study that year based on many of the same categories as the earlier research, and has recently agreed to make most of the data available to the public.[192]
- Timely data are needed on the bridge used to convert consumer spending to business output.[193] A critical link between the world familiar to consumers (where things like pizza and automobiles are bought in retail stores) and the world of economic statistics comes in the form of an obscure table called the bridge table in the jargon of input/output accounting. These tables are used to translate a dollar spent (say on a pizza) into economic output in standard business categories (e.g., $10 in pizza purchases might result in $2 for the grocery store, $0.50 for the trucking and warehousing company, ***$0.50*** for insurance, $5 for food manufacturing companies and the rest for farmers). Since it was assumed that the ratios in these tables would change only slowly (retailing was never considered a progressive industry) there was little point in devoting a lot of attention to updating them. Our work convinces us, however, that the new production networks necessarily alter the chain of production that includes transportation and retail operations. This is precisely where the inventory reductions occur when information equipment is used to improve the flow of products.
- Research and Development data by industry and product type have not been reported in much detail. The National Science Foundation has attempted to correct many of the deficiencies (e.g. no summary data are published for construction, services, and some manufacturing) and will shortly publish much more complete data. Many problems remain, however, because of incomplete reporting and because research and development conducted at the corporate level is difficult to assign to activities by individual establishments that may be owned by the corporation.
- One of the weakest links in the chain of statistics occurs between the highly detailed demographic statistics on household spending patterns contained in the Consumer Expenditure Survey (CSX) and consumer spending information available in other data series like those that appear in NIPA (the first item in the right-hand column of table 1). Administered to

[189] Boskin, op. Cit., footnote 111, pp. 15-20, and F. & Leeuw "Conflicting Measures of Private Savings, "Survey *of Current Business,* November 1984.

[190] Outlays include consumer expenditures, taxes, and interest payments made to businesses.

[191] Joel F. Houston, "The Underground Economy: A Troubling Issue fOr Policymakers," *Business Review,* September-October 1987, pp. 3-12; and Barbara A. Bailar, "Finding Those the Census Missed," *Technology Review,* May/June 1988, pp. 22-24.

[192] The National Science Foundation provided some funding for the 1985 time-use survey.

[193] See, U.S. Department of Commerce, Bureau of Economic Analysis, "The Input-Output Structure of the U.S. Economy, 1977," Survey *of Current Business,* May 1984, table B.

5,000 household (consumer units) a year, the CSX has since 1980 been conducted on an ongoing (annual and quarterly) basis-prior to that time it was done about every 10 years. The primary purpose of the CSX is to provide weights for the Consumer Price Index. The relatively small sample size limits any detailed attempt to figure out how ***or*** why different *type* of consumers buy what they do; by the time you slice the data by expenditure category, type of household, and income level, the divisions have become so fine that further attempts to analyze the data by variables such as age, sex, or region are impossible because the results quickly become unreliable or "statistically insignificant." This is frustrating when advances in information technology have allowed a much finer targeting of products to consumers and have in-turn allowed consumers much more flexibility in tailoring products to their needs. This so-called "niching" phenomenon is difficult to track given the limits to public data.

In a broader sense, many surveys linking spending to consumer amenity are not well coordinated with the national accounts. It is all but impossible to link spending patterns to measures of the quality of the amenities that are the ultimate result of the spending. A number of surveys are taken that could, in principle, be coordinated with the consumer expenditure surveys to help make some of these connections. They could also be designed with a more comprehensive view to documenting changes in the quality of American life and understanding the nature of economic change instead of focusing narrowly on the programmatic issues for which they were initially designed.