Is the U.S. Economy Really Growing Too Slowly? Maybe We're Measuring Growth Wrong

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The central paradox of the American economy today is that we are apparently in an era of extremely rapid technological progress in which economic progress has slowed dramatically — and according to some measures stopped. In an article in the *Wall Street Journal* for June 8, 1995, G. Paschal Zachary quotes Robert M. White, head of the National Academy of Engineering: "The pace and intensity of technological advance are without historical precedent." By contrast, government data say that U.S. aggregate economic growth, after correcting for inflation, has been very slow for the past 20 years, compared with past trends. The apparent consequence is that measured economic rewards have stagnated. In particular, current measurements show real average hourly earnings are lower now than they were 20 years ago. While total real earnings per person (counting all residents of all ages) in the United States have increased, it is only because a larger proportion of us are working and because the quality of the workforce has increased: we are better educated and more experienced at our jobs. What these and other official statistics plainly assert is that changes in the tech-

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nology of production no longer lead to improvements in economic well-being.

An alternative view is that the statistics are wrong: the U.S. economy has been experiencing strong growth, but our official measures fail to reflect it. In an article in the November/December 1995 issue of the *Business Review*, I argued this *mismeasurement* view — our price statistics are biased upward, thereby artificially reducing measured U.S. growth.

The policy differences implied by the two alternative economic descriptions are profound. For better or worse, we live in a society in which national economic policy is both formulated and evaluated based on national statistics. Should we stress fairness and support for the unfortunate, or should we stress efficiency and incentives for savings and investment? Should we tax all incomes equally, or should the rich bear a disproportionate burden, even though this reduces their incentives to earn? A prerequisite for answering these kinds of questions is good data. If our economy is stagnating, generosity to those currently in unfortunate circumstances may be misplaced because it may make us less able to be generous in the future. On the other hand, if the economy is growing robustly, we may be able to afford more generous policies today.

In this article, we will explore how economic progress is measured and some policy implications that arise from alternative measures of our rate of growth.

ECONOMIC PROGRESS

What Is It, and How Do We Measure It? Economic progress is best defined as the ability to better meet our needs and desires by increasing the quantity and quality of goods and services at our command. Such progress comes from making better use of existing resources as well as using more resources. Ideally, we would like a measure of economic well-being that takes into account nonmarket activities such as child rearing and home health care. In practice, however, our statistics measure goods and services sold in the marketplace. Thus we measure economic progress by the growth in output of marketed goods and services, not growth in well-being.[1] The advantage in referring only to the marketplace is that we can quantify market activities by the prices paid for marketed goods and services (and as we shall see, even that is no easy task!). Accurate quantitative measurement, in turn, provides common facts about national problems, and such information is important to the success of our policies to overcome them.

For purposes of measurement, there is an important distinction between two kinds of economic progress: progress in our ability to make *existing* goods and services versus our ability to create *new goods and services* that satisfy old needs more efficiently. Economists have long expected existing goods and services to become less important over time because, as wealth rises, we are likely to demand more variety of and higher quality goods: as wealth rises, necessity shrinks in importance and luxury gains.[2]

In all previous eras, necessity was paramount. If we turn back the clock of Western

[1]The market-based measures used in economic analysis, such as gross domestic product (GDP — the broadest measure of domestic output), thus clearly mismeasure growth in well-being. In general, market-based measures are upwardly biased measures of growth in well-being, as nonmarket activities such as child rearing and care for elderly relatives at home become market activities at daycare centers and nursing homes. In earlier times, these types of activities were provided within the household and extended family, not through paid market services, and so were not counted as part of GDP. Thus, even if the amount of these activities hasn't changed, measured GDP has grown, since these activities more frequently take place in the market and thus are counted as part of GDP. This makes the paradox of slow growth in recent years even more marked: GDP shows little growth even though it is intrinsically biased in favor of showing too much growth!

[2]See, for example, H.L. Wold, *Demand Analysis* (John Wiley, 1953).

economic development 400 years, for example, we find that in the Mediterranean world of the Renaissance, food was by far the dominant economic product, representing some four-fifths of all economic output. Of this, fully half was bread grains, primarily wheat.[3] A Spanish or Italian worker might have labored 140 days in a normal year to earn the ton of wheat that meant subsistence for his family; famine was never far away. A drought that doubled the price of grain was ruinous, and such a drought typically recurred three to six times in a worker's average lifetime.

The contrast with the situation facing the American worker is substantial. Today, a ton of wheat costs less than $150 wholesale.[4] Even at the minimum wage of $4.75 an hour this is but a week's work; at the average wage of $12, it is under two days' work. Creating the raw materials necessary for caloric subsistence used to require the preponderance of the working year; now it is a trivial part.

Americans spend more on medicine than on food, beverages, and tobacco (a category that includes restaurants). And the food purchased for home consumption includes an increasing proportion of ready-to-eat or -drink products as the boundary between supermarkets and take-out restaurants disappears. Thus, without question, over these past 400 years, there has been spectacular advance in the standard of living enjoyed by the citizens of economically advanced Western nations like the United States.

A Slower Pace of Measured Growth. In the past 20 years, however, there has been a marked slowdown in measured U.S. economic growth. According to official statistics, real gross domestic product (GDP), a measure of total marketplace economic activity that includes government, business, and consumers, grew at an annual rate of 3.8 percent from 1959 to 1974. But its growth then slowed by one-third, to an annual rate of 2.7 percent, from 1974 to 1994. Population growth slowed too, from 1.3 percent annually to 1.0 percent annually. So on a per-person basis, real GDP slowed from 2.5 percent to 1.7 percent.

This slower pace of growth has been the subject of repeated analysis along the lines that Nobel Laureate Robert Solow advanced: analyzing the sources of growth by measuring the contributions of added capital, added labor, and improved technology. Solow's original work, published in 1957, covered the period 1909 to 1949.[5] During that time, real output in the nonfarm business sector (a convenient grouping that avoids the measurement problems of the agricultural and government sectors) grew at an annual rate of 2.9 percent.[6] Of this rate, 1.1 percentage points were due to an increase in the total number of hours worked (a product, in turn, of more people working a shorter number of hours each year, with the increase in workers outweighing the shortening of the work year). Of the remaining 1.8 percentage points, Solow reckoned that one-fifth (0.4 percent annually) was due to an increase in capital per worker, that is, people having more equipment with which to do their work. The remaining four-fifths (1.4 percent annually) was due to an increase in technological progress, that is,

[3]Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Phillip II,* Vol. 1, Sian Reynolds, transl. (Harper and Row, 1972), pp. 418-61.

[4]The cash price of wheat in December 1996 was $4 per bushel, or roughly $135 a ton.

[5]Robert M. Solow, "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics,* 39 (1957), pp. 312-20. The data on labor hours are from Solow's source, later published as John W. Kendrick, *Productivity Trends in the United States* (Princeton University Press, 1961).

[6]In agriculture, the difficulty is counting the hours of farm owners and their families. In the government sector the outputs — compulsory schooling, criminal justice — are hard to count because they are not priced in the marketplace.

having superior procedures and equipment with which to work. Subsequent work by Edward Denison of the Brookings Institution on the period 1929 to 1969 pushed up the annual contribution of technology to 1.7 percent.[7] The clearcut evidence from these and other studies was that for most of the 20th century, most of American economic growth per person was due to improvements in our technology — *how* we worked — rather than to increases in hours worked or amount of capital per worker. Exactly how technological advance of this type occurs and to what extent the improvements in technology reside in organization of the workforce (working smarter) or equipment (smarter tools) have remained unclear. Indeed, technological advance came to be known as the "black box" of economic growth.[8]

When this same approach is applied to the period of the slowdown in growth that began in the 1970s, however, a new, startling conclusion emerges.[9] The statistics show that the growth of labor and capital accounts for *all* of the increased growth beginning in the mid-1970s and that the contribution of technological advance to economic growth has disappeared! Figure 1 shows what is left over from output growth after accounting for increases in capital and labor.[10] From 1929 to 1974, our productivity advanced at an annual rate of 1.7 percent; afterwards, its growth was nearly zero.

The picture of slowdown in U.S. productivity growth in Figure 1 is at odds with the picture of intensive technological advance that appears in business and science publications. Let's take just one example: electronics. Advances in integrated chips have made electronics ubiquitous in the United States. The number of computers in use today rivals the number of cars. And the United States is at the forefront of the design, manufacture, and utilization of integrated circuits.

Similarly, U.S. universities are at the forefront of practically every discipline, from neuroscience to materials science to computer science, from comparative literature to finance to cinema. And this expertise spills over to technology and engineering, as Intel and Microsoft, Merck and Goldman Sachs, Disney and McDonald's continue to dominate world markets.

To try to reduce the dissonance between these two portraits of America, we can look at other aggregate evidence of American well-being. We have already discussed one candidate: the analysis of expenditure on necessities and luxuries.

MORE LUXURIES AND FEWER NECESSITIES: THE CHANGING COMPOSITION OF EXPENDITURES AS INCOMES RISE

A systematic way of testing for the presence of economic growth is to examine the rate at which basic economic necessities, such as food and clothing and household operations, are shrinking as a proportion of total expenditures.[11] The basic empirical principle in this regard is Engel's Law: As real income per person

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[7]Edward F. Denison, *Accounting for United States Economic Growth, 1929-1969* (Brookings Institution, 1974). The 1.7 percent figure represents Denison's semiresidual, which includes both pure technological advance and economies of scale — productivity gains due to the increased scale of production. Here, I am lumping the two together. It is now generally recognized that technological advance and economies of scale are, in the long run, inseparable. Output per person grew 2.1 percent during this period.

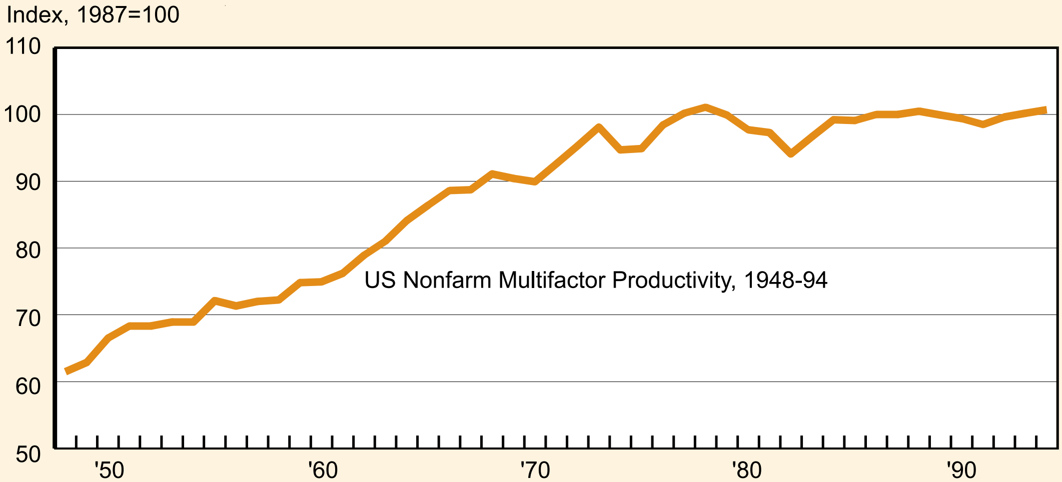
[8]See, for example, the preface to Nathan Rosenberg, *Inside the Black Box: Technology and Economics* (Cambridge University Press, 1982).

[9]Edward F. Denison, *Accounting for Slower Economic Growth: The United States in the 1970s* (Brookings Institution, 1979).

[10]Bureau of Labor Statistics, *Multifactor Productivity Trends, 1994.*

FIGURE 1

U.S. Economic Statistics Appear to Indicate No Technological Progress Since 1977



Source: U.S. Bureau of Labor Statistics, *Multifactor Productivity Trends, 1994.*

rises, the proportion spent on food declines. The eminent Harvard economist Hendrik Houthakker has said, "Of all empirical regularities observed in economic data, Engel's Law is probably the best established; indeed it holds not only in the cross-section data where it was first observed, but has often been confirmed in time-series analysis as well."[12]

Table 1 illustrates the basic idea. Suppose at time 0 real income is 1000, of which 60 percent is spent on food and other necessities, while the other 40 percent is spent on luxuries. Now suppose that real income grew 20 percent, to 1200. Demand for food doesn't increase as much as demand for luxuries, so although food purchases increase, they shrink as a percent of expenditures. Suppose that real income grows another 20 percent. Food purchases continue to rise, but less rapidly than total income and spending. The share spent on food declines over time. Moreover, equal percent increases in real income lead to equal changes in shares of nominal expenditure: in both periods, each share changes 5 percentage points.

This formulation of Engel's Law is based on

[11]This section is based on my paper, "Is U.S. Economic Performance Really That Bad?" Federal Reserve Bank of Philadelphia Working Paper 95-21/R, April 1996.

[12]Hendrik S. Houthakker, "Engel's Law," in John Eatwell, Murray Milgate, and Peter Newman, eds., *The New Palgrave: A Dictionary of Economics.* Volume 2 (Macmillan, 1987), pp.143-44.

TABLE 1

Example of Engel's Law: As Real Incomes Rise, the Share Spent on Necessities Falls

Year	Zero	Ten	Twenty	Change 0 to 10	Change 10 to 20
Spending on food and other necessities	600	825	1080		
Spending on luxuries	400	675	1080		
Nominal expenditures	1000	1500	2160		
Spending on food and other necessities	60%	55%	50%	5%	5%
Spending on luxuries	40%	45%	50%	5%	5%
Nominal income	1000	1500	2160		
Prices	100	125	150		
Real income (dollars)	1000	1200	1440	20%	20%

Note: Deaton and Muellbauer's formulation: Equal percent changes in real incomes in two periods lead to equal percentage point changes in shares of expenditures of necessities and luxuries. All data per person.

work by Angus Deaton and John Muellbauer.[13] It implies that equal percent increases in real income per person should lead to equal percentage point changes in shares of expenditure.

How do we apply their formulation to U.S. data? From 1959 to 1974, according to the official statistics, real income per person grew 45 percent. In the longer period from 1974 to 1994, real income per person grew 39 percent. If these numbers are accurate, one would expect that the share of necessities in total expenditures should have shrunk by about the same amount in the two periods (or perhaps a bit less in the second period). In fact, the proportion of the average budget spent on food fell from 27.3 percent in 1959 to 23.1 percent in 1974, or 4.2 percentage points, but fell substantially more — 7.1 percentage points — from 1974 to 1994.

The proportion of household budgets spent on other necessities, such as clothing and home heating, also almost uniformly contracted by more in the period 1974 to 1994 than in the earlier period 1959 to 1974 (Table 2). In contrast, the share spent on luxuries, such as medical care, personal business services, recreation, education, and foreign travel, generally rose more in the later period than in the earlier one.[14] This

[13]"An Almost-Ideal Demand System," *American Economic Review* 70 (June 1980), pp. 312-16. Their system formally says that holding relative prices constant, equal changes in the logarithm of real income lead to equal changes in shares in nominal expenditures. Here we discuss the system in terms of percent changes as we assume most readers are more familiar with that terminology.

[14]What is a necessity and what is a luxury is not always easy to determine. Food is the clearest example of a necessity. Goods and services whose consumption declines over long periods of time when incomes are rising are defined as necessities here; the consumption of luxuries rises over the same time periods.

TABLE 2

Nominal Spending on Each Category

	Share of Total Spending (in percent)			Change in Spending Shares	
	1959	**1974**	**1994**	**1959-74**	**1974-94**
Total	100	100	100		
Food, Beverages and Tobacco	27.3	23.1	16	-4.2	-7.1
Clothing, Upkeep, and Personal Care	11.7	10.1	7.9	-1.6	-2.2
Housing	14.1	14.3	14.8	0.2	0.5
Household Furnishings, Fuel and Operation	14.1	13.2	11.1	-0.9	-2.1
Medical Care	6.4	10.0	17.5	3.6	7.5
Personal Business Services	4.3	4.9	7.6	0.6	2.7
Transportation	12.7	12.7	11.2	0	-1.5
Recreation	5.5	6.8	7.9	1.3	1.1
Education, Welfare, and Americans' Foreign Travel	3.8	4.9	6.1	1.1	1.2
Average Absolute Change in Shares of Consumption				1.5	2.88
Real GDP per Person, Official Measures, chained 1992 $	$12,494	$18,178	$25,352		

Source: Bureau of Economic Analysis, *Survey of Current Business*, January/February and August, 1996. Population data from *Economic Report of the President*, 1996, U.S. Government Printing Office.

faster shift away from necessities as a proportion of budgets in the second period suggests that real income per person grew more in the second period than in the first, not less as the official statistics say.

How much more? To answer this question, calculate the average absolute change in shares for all consumption categories over each period, that is, take the average without considering whether each change is up or down. In this way, a decline of 2 percent for a necessity like food and a rise of 2 percent for a luxury like travel both correspond to rising real income. The nine consumption categories in Table 2 changed absolutely by 1.50 percentage points, on average, in the period 1959 to 1974, while they changed 2.88 percentage points, on average, from 1974 to 1994. If we use Deaton and Muellbauer's application of Engel's Law, the fact that the average shift in spending shares (away from necessities and toward luxuries) was almost twice as big in the second period as in the first — 2.88 to 1.50 percentage points — implies that the true rise in real income in the second period was about twice as large as that in the first (so long as prices of luxuries did not rise at a substantially different rate than prices of necessities). If real income rose 45 percent from 1959 to 1974 as the official data show, the change in spending shares from 1974 to 1994 suggests that real income rose just over 100 percent during those 20 years, not 39 percent as reported in the official statistics.[15] Over 1974 to 1994, this represents a per-person annual growth rate of 3.7 percent, not 1.7 percent — a difference of 2.0 percentage points per year.

Now let's reexamine the productivity slowdown that began around the mid-1970s. That slowdown is reflected in the official data in Table 2 in that more real growth per person took place from 1959 to 1974 than in the longer period from 1974 to 1994. But the slowdown is *not* consistent with the changes in the consumption expenditure shares. The implication of the calculations reported above is that growth in real income per person was mismeasured by 2.0 percentage points annually from 1974 to 1994 — slightly more than the measured slowdown in productivity growth in the official statistics of 1.7 percentage points annually. That is, it is possible that the entire productivity slowdown of the past two decades revealed by the official statistics is the result of mismeasurement! Put another way, the shifts in composition of expenditures from 1959 to 1974 and from 1974 to 1994 are consistent with the view that productivity growth was the same in both periods. Households are spending in a pattern that is inconsistent with the official statistics on real output and price; that is, the average household has expanded the proportion of luxuries it buys as if its real income had doubled over the last 20 years, while the official data report that its real income rose by less than half.

INCREASING UNCERTAINTY IN OUTPUT MEASUREMENT IN THE AMERICAN ECONOMY

Is it really possible that growth could be mismeasured on this scale? Quantifying economic progress was easier in earlier periods in the industrial revolution. Mass production standardized many goods and thus made their output easier to measure. The more uniform quality of apples and wheat and cars and shoes made for standardized pricing and publication of wholesale and retail prices of these commodities. The most rapid progress took place in the production of goods whose increased quantities we were best able to measure.

Now, an increasing proportion of the economy is devoted to products whose real output we do not attempt to measure. As Zvi Griliches pointed out in his 1993 presidential address to the American Economic Association, the industrial composition of the economy has shifted to service activities that we are not well prepared to measure.[16] And an increasing proportion of goods we do measure is changing more rapidly than in the past, adding to the measurement difficulties.

The clearest example lies in two major components of current consumption expenditures, medical care and personal business services, which are predominately measured by inputs rather than by outputs. Our official data estimate the output of doctors or insurance agents by the number of hours doctors and insurance agents work, rather than the success rate of treatment or number of insurance policies written.[17,18] That is, our statistics assume produc-

[15]To see this, remember that the underlying arithmetic is being done in logs. The change in the log of real income from 1959 to 1974 is 0.375. We multiply this by the ratio between the percent changes, 0.375 x (2.88/1.50) = 0.720. The antilog of .720 is 2.05, suggesting that real per capita income in 1994 was 2.05 times real per capita income in 1974.

[16]Zvi Griliches, "Productivity, R&D, and the Data Constraint," *American Economic Review* 84 (March, 1994), pp. 1-23.

tivity growth in these areas is nonexistent. And these two categories of consumption alone have grown from about 11 percent of consumption expenses in 1959 to over 25 percent of consumption expenses in 1994, so the errors in measurement loom far larger.

IMPROVING U.S. ECONOMIC PERFORMANCE: A PROBLEM IN MEASUREMENT, DIAGNOSIS, AND PRESCRIPTION

We thus are confronted by two possibilities: One, our true economic performance has been quite good, but our measurement of that performance has been faulty. Two, our measures are right, and scientific and technological progress is not being translated into increased economic output. Is this difference important?

The data matter because political disagreements about what our problems are and how to fix them rest on statistics, as does our ability to evaluate the success or failure of our efforts to solve them. Programs that leave in their wake high inflation and low growth are clearly failures, while those that result in low inflation and high growth are successes. If the rate of increase in prices is overestimated, so that growth in output is understated, an economic policy that, in fact, has successfully generated high growth and low inflation will appear to be a failure that has generated low growth and high inflation.

Here are some examples that show why knowing the correct measures of growth is critical to our understanding of the economy. Two other examples are discussed in *Output Mismeasurement in Health and Educational Services.*

Fostering Growth. If we accept the official data at face value and productivity is stagnating, future generations may be worse off. To be generous to those future generations, we may need to decrease constraints on economic growth and increase incentives to economic efficiency, even at the expense of equity in the present. Milton Friedman has argued that government regulations increased dramatically in the 1970s under Presidents Nixon and Carter, declined under President Reagan, and then rebounded to a new high under Presidents Bush and Clinton (Figure 2). If these regulations are associated with programs that have benefited the aged (for example, Medicare and Social Security) and the unfortunate (for example, the Americans with Disabilities Act and Medicaid) at the expense of economic efficiency, perhaps this generosity was misplaced, for, according to the official statistics, our ability to produce with fixed resources is on the verge of deterioration.

Another way to foster growth is to reduce government claims on resources, permitting greater private incentives. A sharp decline in government purchases and cutbacks in the federal safety net are already in progress.

On the other hand, if real output and inflation have been mismeasured, the apparent failure of current policies may be an artifact of bad statistics. Has free trade in the United States been costly? The apparent slow growth of the U.S. economy in the 1980s and 1990s has led some critics to argue that policies too generous to our trading partners have put us on a permanently slower growth path. But are we really on a slower growth path?

[17] Technically, the Bureau of Economic Analysis deflates the nominal revenues of these service providers by a weighted average of input prices. To the extent that any increase in productivity results in higher wages, it will not be measured as increased real output.

[18] The Bureau of Economic Analysis has recently changed the method it uses for deflating medical services. It now uses the Producer Price Index (PPI) for medical services, a series first collected in late 1992, to deflate that segment of personal consumption expenditures. This series measures the costs of treating a disease, a procedure that should be substantially closer to the right measure. However, this measure does not take into consideration improvements in quality of outcomes.

Output Mismeasurement in Health and Educational Services

Measurement problems also apply to policy issues within specific industries, such as health and education. Our efforts in these areas may suffer because we confuse inflation and technical progress.

Health Care in Crisis. We are experiencing a national crisis over health care expenses. This is no wonder: medical care now counts for one-sixth of our consumption. But because we do not measure the output of doctors, nurses, or pharmacists, but rather inputs, some people have the impression that medical providers are absorbing an increasing part of American income out of pure avarice. But what economic evidence there is suggests instead that medical costs are rising entirely because of technological advance — improvements in medical practices cause us to want to buy a lot more medical care.*

As surgery has become less invasive and recoveries more rapid and as the probability of success has risen, patients and doctors have chosen surgical intervention more often. Far more heart attack victims now choose to undergo bypasses and angioplasties because the survival rates are higher and recoveries quicker. Knee surgeries have proliferated as arthroscopic procedures have shortened recovery times to days rather than months. New, expensive drug combinations now offer hope to AIDS victims, when before their cases had been considered hopeless. Thus, the improvement in medical practices has widened demand and, in Cutler's analysis, is the main force that has driven the expansion of medical care.

The Rising Cost of College. A similar issue has been raised about education. Tuition costs at private colleges and universities, for example, have risen more rapidly than the price of medical care. Again, the increased value of the education is not being measured. Unquestionably, the totality of academic information has expanded substantially, as fundamental advances have been made in every physical and social science. As colleges and universities have more to teach, the value of education has risen. This value may be hard to measure precisely, but all available evidence suggests that the rate of return to a college education is increasing rather than falling.

Both of these cases are American success stories in which the producers are at the vanguard of worldwide scientific and technological achievement. But because our statistics treat these achievements as raising prices rather than increasing output, we risk mistaking our achievements and instead seek "reform" of health care and education.

*David Cutler, "Technology, Health Costs, and the NIH," Harvard, mimeo (September 1995).

To take another example, part of the sense of crisis about the U.S. economy is a fear that the Social Security system will be unable to support a rising burden of retirees. Part of this fear may be due to the fact that once a retiree enters the Social Security pool, payments rise with the Consumer Price Index. In theory, this permits retirees to keep up with inflation. But if the Consumer Price Index is overstated, as the Boskin Commission has argued, retirees are enjoying rising real incomes. Indeed, average Social Security benefits have been rising faster than wages — virtually guaranteeing long-run instability.

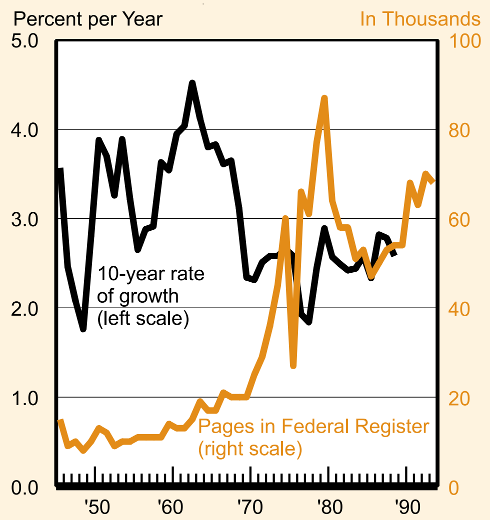
Are We Saving and Investing Too Little? U.S. national income accounts are set up to measure investment in goods — plant and equipment — but not in information: research, education, computer software, data, and on-the-job experience. American investment in formal research and development efforts amounted to $169 billion in 1994, and public and private expenditures on formal education (not counting the value of the time invested by students in acquiring education) were $508 billion in 1994. These expenditures are roughly the same size as our investments in business structures ($180 billion in 1994) and equipment ($487 billion in 1994). Our gross investment rate is far larger than official data show if we consider these informational expenditures to be investments rather than costs of doing business (as our statistics currently treat research and development) or consumption expenditures (as they treat education).[19] Moreover, at an individual level, categorizing our expenditures on education as investments rather than consumption would, by lowering measured consumption, boost savings rates as well, since savings is the difference between consumption and income. Measured personal savings in 1994 was less than $200 billion, so that counting these additional investments in human capital as saving could make a substantial difference. Perhaps we are already saving and investing at unusually high rates! And fostering further saving and investment may not be so crucial after all.

This raises another paradox, however, because if we raise our estimates of capital stock, our estimates of total factor productivity would worsen. With more measured capital, the diagram in Figure 1 would show a clear long-term decline in our technological level. Only if real output growth is shown to be understated can we sensibly argue that investment is understated.

A more difficult, although related, problem is the spreading inequality of incomes. In particular, college-educated workers are increasingly better paid than the less well educated.[20] This disparity is likely related to the rate of technological advance: those who have college educations are better equipped to learn the addi-

FIGURE 2

More Rules, Less Growth?



Note: Decadal rate of real growth of U.S. national income, and annual number of pages in Federal Register, 1946-93

Source: Data courtesy of Milton Friedman. These data appeared in an article written by Dr. Friedman for the *Wall Street Journal*, August 1, 1995.

[19]In 1994, these information investments were about equal to investment in plant and equipment; in 1959, they were 78 percent as large as investment in plant and equipment and in 1974, 86 percent.

[20]Lawrence F. Katz and Kevin M. Murphy investigate the changing supply and demand of college-educated workers in "Changes in Relative Wages, 1963 -1987: Supply and Demand Factors," *Quarterly Journal of Economics* CVII February 1992, pp. 35-78. They find that demand for college-educated workers has been steadily rising, but supply has fluctuated, exceeding demand in the 1970s but falling behind in the 1980s.

tional skills necessary to keep up with a rapidly changing workplace. College graduates, for example, are far more likely than high school graduates to participate in continuing education courses in a given year (52 percent compared with 22 percent).[21] Rapid technological advance and increased economic efficiency may directly exacerbate this inequality, for example, by increasing the return to education. Thus, reducing subsidies to students or spending on education may exacerbate future problems of inequality and deprive future generations rather than help them. It may also be inefficient to shift resources away from high-return investments in education to low-return investments in physical capital.

If we believe the economy is performing poorly, we may try to reduce educational subsidies because we believe that we cannot afford them. Doing so may reduce efficiency and equity if our belief is incorrect.

THE IMPORTANCE OF STATISTICAL INFORMATION

While the fact of statistical mismeasurement may be clear, estimates of the size of statistical mismeasurement differ widely. Estimating these statistics more precisely is crucial to our nation's ability to make effective policy. They provide the yardsticks by which we measure our treatment of the poor, the rich, the elderly, the infirm, and students.

It is widely recognized that the official data underestimate growth and productivity.[22] But the size of the error is unknown. We need further studies, detailed experimental series, and new means of collecting data to obtain better estimates of economic progress. The results of these studies would progressively be incorporated in our data series as the economy evolves.

To improve statistical measurements in the short run and possibly even in the long run, our statistical agencies would need more resources; the experimental collection of information aimed at improving our official statistics is expensive both in terms of economic expertise and electronic hardware and software. While it is true that electronics can improve the efficiency of data collection, the rapid rate of change in the economy means that properly collecting the data will become more and more difficult and will require increasing the amount of intellectual analysis that goes into data collection. But if our statistics are unable to keep up with new economic realities, it will be extremely difficult for government policies to be farsighted.

[21]Data are for 1990-91 and are taken from U.S. Bureau of the Census, *Statistical Abstract of the United States, 1995* (Bernan, 1995), p. 194, which cites the U.S. National Center for Education Statistics, *Adult Education Profile for 1990-91.*

[22]For example, W. Erwin Diewert, "Comment on CPI Biases," *Business Economics* (April 1996), and Matthew D. Shapiro and David W. Wilcox, "Causes and Consequences of Imperfections in the Consumer Price Index," NBER Working Paper No. 5590, May 1996.