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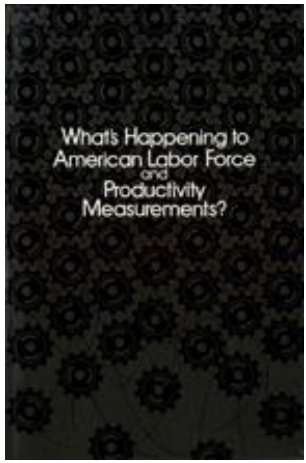

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Establishment Data and Productivity Measurements

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In the specific area of productivity data and analysis, simple labor productivity measures for the economy (or even for the major sectors) are no longer sufficient with the changing patterns of availability and cost of various inputs—and especially in an economy which has moved away from a century-long dependence upon industrial equipment driven by cheap energy. Measures which relate output patterns to the inputs of labor, materials, energy and capital are deemed essential. These must be coupled with sound analyses of the realities of "tradeoffs" of the input factors which have (or could) contribute to improved efficiency and/or lowered cost—of production and of the finished product.

Productivity measures must reflect today's realities of doing business. Most of the great strides in productivity gains over the past century have come from technological improvements and discoveries—the path to greater output per hour (labor productivity) is through new technologies to investment in new plant and machinery and on to more effi-

cient labor. While it is true that improvements in industrial organization and behavior, as well as enlightened management-labor relationships, also contribute to gains in productivity, the main engine of productivity improvement is through capital.

People are said to be "inquisitive, acquisitive, and lazy." They are "inquisitive" and search out how to do their work better and more efficiently. They are "acquisitive" as they like to acquire the tools to do their jobs better. And, they are "lazy" in the sense that they would rather have machines sweat and toil than themselves. Productivity gains are not achieved by people working harder, but by giving them the tools to work more efficiently and by giving them the incentives to do so.

Labor productivity is a partial productivity measure and, as such, does not reflect the role of capital and the interaction between labor and capital. To quote the Bureau of Labor Statistics (BLS) in the boxed-item of their periodic "Productivity and Costs" report,

> Although the productivity measures relate output to the hours of all persons engaged in each sector, they do not measure the specific contributions of labor, capital, or any single factor of production. Rather, they reflect the joint effects of many influences, including new technology, capital investment, the level of output, capacity utilization, energy use, and managerial skill, as well as the skills and efforts of the work force.

The use of partial productivity measures is appropriate, depending upon the circumstances and their use. For gauging the efficiency of use of all resources, be it at the national level or at a company, productivity measures which include all inputs are the appropriate ones to use.

The making of policy, be it employment, inflation or output, requires empirical measures which correctly reflect our

economic conditions. Such measures will always include some degree of error, but the critical factor is that their *trends* should be as free from *systematic biases* as possible. This study will review several aspects of productivity measurement since such measures represent one of the main economic indicators of our economic well-being: the need for total factor productivity measures; the impact of our changing economic structure; the divergence between hours worked and hours paid; and the undermeasurement of labor in the real estate sector. Before embarking on the analytical sections, it is useful to review why productivity is so important.

1. The "Big Picture"

The United States—and the entire free-world community of nations—is presently in a revolutionary situation. Unfortunately, too few leaders of industry, academia or the government recognize this fact and its significance for the future. Specifically, in the late 1960s the U.S. was still the world's leader in world trade, in standard of living, in science and technology, in the world financial community, and in productivity. By the end of the decade of the 70s, due to a variety of errors of omission and commission together with events outside control of our national leaders, we were in the unenviable position of:

—Suffering three recessions in a single decade, with the terminal one (1980), in the judgment of some experts, continuing through 1981 and the first half of 1982.

—A complete catastrophe in productivity growth, with a slowdown followed by actual declines in output per hour in 1978, 1979 and 1980 (and only about 1 percent rise in 1981).

—Rampant inflation, throughout the decade, with an increase in the late 70s to levels higher than in any former peacetime period.

—Unprecedentedly high interest rates, which stubbornly refuse conventional "cures"; and these rates in turn virtually assuring the collapse of the major construction sector and catastrophic declines in the sale and production of other major consumer durables, particularly automobiles.

—Rates of unemployment higher than in any span since the "Great Depression" of the 30s.

—Tremendous loss of our "normal" international markets for manufactured goods, accompanied by a major—and growing—invasion of the U.S. domestic market by imported manufactures, thus contributing to unemployment and the virtual collapse (present or almost certainly assured for the near future) of major mature U.S. industries.

—Persistent, very large adverse balance of payments.

As a result, the U.S. has lost its former lead in the export of manufactured goods, and its role as the financial bellwether or leader of the Western industrial world's financial community.

Due to the above combination of factors (not the least of which was our extremely weak comparative productivity growth performance) and including the apparent inability of U.S. leaders (of industry, labor and government) to work together to maximize exports, many of our basic industries were either already moribund or very ill indeed; and the U.S. living standard had already fallen to a measurable degree.

2. Total Factor Productivity Measures

The need for productivity measures that include the role of capital as well as labor has long been recognized by the economic community, especially Professors Kendrick, Jorgenson, Denison, and Griliches, among other productivity researchers.[1] Until recently, only labor productivity measures have been compiled and published on a regular basis by the Bureau of Labor Statistics for the private

business economy and six sectors. Since 1980, the American Productivity Center (APC) has been maintaining and publishing total factor productivity using Professor Kendrick's approach.[2] The APC "Multiple Input Productivity Index" program covers the private business economy, six sectors, and thirty segments. Further, the APC measures of output and labor hours are consistent with the BLS measures.

Total factor productivity measures have been periodically published since the late 1950s. Yet, it wasn't until 1979 that the Rees Commission, under the auspices of the National Academy of Sciences,[3] recommended the continuous availability of productivity measures which also include the role of capital:

> Measures of multifactor productivity show changes in the use of all measured inputs per unit of output. Measures of output per worker hour may increase only because inputs of capital or intermediate goods have been substituted for labor inputs. Thus, measures of productivity, which are more complete measures of changes in productive efficiency, generally rise less rapidly than measures of labor productivity.
>
> In any measure of multifactor productivity, weights are needed to determine the shares of the various inputs in the aggregate input measure. These are ordinarily determined by the share of total input value in some base period. The panel recommended that BLS experiment with combining labor and other inputs into alternative measures of multifactor productivity.[4]

The BLS has taken up this recommendation and is planning to publish total factor productivity measures for the private business and other major sectors by the end of 1982.

It is understood that their measure of capital and their approach to adding up the inputs will differ from that used by the APC.

It should also be recognized that by including capital in productivity measures adds to the problems of measuring output and labor, (see Table I). The measurement of capital stock presents more difficulties than measuring output or labor hours, yet the approaches taken to measure capital are consistent and theoretically sound. Such measures, then, are appropriate in capturing broad trends in total and partial productivity.[5]

Labor productivity measures have been telling a rather gloomy story of the progress of the U.S. economy since 1965. Before 1965, labor productivity for the private business economy had been rising at an average annual rate of 3.2 percent. Between 1965 and 1973, the growth rate fell to 2.4 percent; labor productivity dropped even further through 1979 to only a 0.8 percent rate. During the recession years of 1979 through 1981, its rate again fell to 0.5 percent rate, (see Table II).

As dismal as past economic performance is, measured by labor productivity, the total factor measure is even gloomier. Its pre-1965 rate is some 19 percent *lower* than when only the role of labor is measured. Total factor productivity (TFP) grew at an average 2.6 percent rate, as compared to 3.2 percent for labor productivity; over the 1965-73 period, the TFP rate was 1.8 percent. Between 1973 and 1979, TFP was only one-half the labor productivity rate, 0.4 percent, and since 1979 TFP has been declining at a 0.4 percent rate while labor productivity has been increasing. Thus, when capital is included in our measure of productivity, the performance of the U.S. economy is worse.

It is expected that TFP measures should show slower growth than labor productivity. When capital is substituted

Table I
Share of Private Business Economy
Output and Inputs
Selected Periods
(Percent)

	1950	1965	1975	1981
A. Output				
Private business economy	100.0	100.0	100.0	100.0
Farm	5.7	3.8	3.3	3.1
Nonfarm nonmanufacturing	63.6	63.7	66.2	66.1
Manufacturing	30.7	32.5	30.5	30.8
Goods-producing sector	45.8	45.9	40.9	40.6
Service-producing sector	54.2	54.1	59.1	59.4
B. Labor Hours				
Private business economy	100.0	100.0	100.0	100.0
Farm	17.2	8.2	5.4	4.2
Nonfarm nonmanufacturing	53.7	60.0	65.7	68.1
Manufacturing	29.2	31.8	28.9	27.7
Goods-producing sector	55.3	47.6	41.8	40.3
Service-producing sector	46.7	52.4	58.2	59.7
C. Total Capital Input				
Private business economy	100.0	100.0	100.0	100.0
Farm	18.7	14.5	11.4	10.2
Nonfarm nonmanufacturing	68.7	67.5	70.5	71.4
Manufacturing	17.3	17.9	18.1	18.5
Goods-producing sector	40.4	38.1	34.4	33.6
Service-producing sector	59.6	61.9	65.6	66.4

SOURCES: American Productivity Center; Pace University.

NOTE: Goods producing includes manufacturing, farm, mining, and contract construction segments.

Service producing includes transportation, communications, public utilities, trade, finance and insurance, real estate, and services segment as defined by the American Productivity Center's Multiple Input Productivity approach.

for labor, output may rise, leading to an increase in labor productivity. However, measured TFP would not rise as much since the increase in capital is also included in this measure. In this case, the rise in productive efficiency measured by labor productivity is overstated.

Table II
Labor and Total Factor Productivity
Private Business Economy
(Annual Percent Change, Selected Periods)

	Labor Productivity		Total Factor Productivity	
Period	Rate	Percent Decline	Rate	Percent Decline
1948-81	2.4%	—	1.8%	—
1948-65	3.2	—	2.6	—
1965-73	2.4	25%	1.8	31%
1973-79	0.8	67	0.4	78
1979-81	0.5	38	-0.4	200

SOURCES: American Productivity Center; Pace University.

The Post-1965 Slowdown. The falloff in productivity growth rates since 1965, as well as some likely causes, has been well-documented elsewhere.[6] As exhibited by Table II, both the partial labor productivity and TFP rates have consistently declined in each of the post-war subperiods: in this case too, labor productivity understates the slowdown. Between the 1948-65 and 1965-73 subperiods, labor productivity growth rates dropped 0.8 percentage points, or declined 25 percent. In contrast, total factor productivity growth rates fell 31 percent. The 1973-79 subperiod exhibited an even more severe falloff in its productivity performance from the previous period, declining 67 percent. Again, the TFP rate slowed down even more, 78 percent.

The moderation in productivity rates continued after 1979, but much of this poor performance can be associated with the two (or possibly one) recessions, the last of which we are still experiencing at the time of this writing. It should be noted, however, that the recent year-to-year performance of productivity is slightly encouraging. In 1981, labor productivity reversed its decline of the previous years, and rose at a 1 percent rate. Total factor productivity also increased after several years of declines, at a somewhat milder rate of 0.4 percent. In measuring the post-1965 slowdown of productivity, we again see that it has been much more severe when gauged by the more inclusive total factor productivity measure than when looking at labor productivity only.

3. The Changing Economic Structure

The structure of the U.S. economy has been changing over the post-World War II period, reflecting changing tastes and preferences, new technologies and products, altered resource availability and costs, the impact of taxes and other government economic and social policies, as well as increasing foreign competition. As the economy shifts from a goods-producing to a more service-producing economy, these shifts alone would affect measured productivity.

For example, in 1950 over 17 percent of all hours worked were in the farm sector; by 1965 the farm sector contributed only 8 percent to total private business labor input. Much of this shift in labor was to the service-producing sector. Such a shift would affect measured productivity even if within each sector productivity did not change.

Table II presents the shifts in the U.S. private business economy over the past 33 years. In terms of output, there was hardly any change in the economy's structure between 1950 and 1965; about 46 percent of output was from the goods-producing sector and 54 percent from service-

producing industries. (There was a slight shift from the farm sector to manufacturing.) Between 1965 and 1975, the economy incurred a substantial change in its structure. During this tumultuous 10-year period, the goods-producing sector's share of output dropped to 41 percent, a decline of 5 percentage points. The U.S. economy became more service-oriented, currently producing about 59 percent of output. Further, the manufacturing industries' contribution dropped back to its 1950 share of 31 percent.

Examination of the changing proportions of labor and capital inputs among the major sectors of the private business economy tells the same story: the U.S. is an increasingly service-oriented economy. As of 1981, 60 percent of labor's efforts and over 66 percent of the capital stock is devoted to service-oriented activities including transportation, communications, public utilities, wholesale and retail trade, finance, insurance, real estate, and business services. The farm sector's claim on resources dropped dramatically between 1950 and 1975, but has now stabilized. (The shift from farm to other activities is now over and has been for many years.) Manufacturing continues to claim resources very much in the same proportions in 1981 as it did in 1950.

The Impact of Services. The question then is how this shift from goods- to service-producing industries has affected measured productivity. Many of the more serious problems in measuring real output and capital inputs are associated with the service-producing sector: defining and measuring real output, and defining and measuring real capital stock; even measuring labor inputs for the service-oriented industries is more difficult. We will see that the real estate sector is a case in point. Basically, most of services deal with intangible types of outputs: financial advice, the sale of a house, accounting services, even economic consulting. It is very difficult to define what is the output of a particular ser-

vice. It is even more difficult to measure price changes in order to deflate the output data.

Some analysts have attributed a proportion of the slowdown in productivity growth to the shift from the "more productive" goods-producing to the "less productive" service-producing industries. One reason many analysts consider service industries to be less productive is that output measures may be underestimated, leading to downward biased productivity measures. In order to examine this question, our measure of total factor productivity for private business economy was recalculated, holding the proportion of output, labor and capital inputs at their 1965 levels (see Tables I and III).

The impact of the changing economic structure on total factor productivity is exhibited by Chart I. Between 1948 and 1965 there is a marked difference in the trends of the variable structure total factor productivity (VS-TFP) and the constant structure total factor productivity (CS-TFP). After that period, there is very little difference in their respective trends. The growth rates of TFP bear this fact out (see Table IV); between 1948 and 1965, VS-TFP grew at an average rate of 2.6 percent, some 12 percent lower than the 2.9 percent rate of TFP when the structure is held constant. Over the post-1965 subperiods, the rates of growth of both VS-TFP and CS-TFP are almost exactly the same.

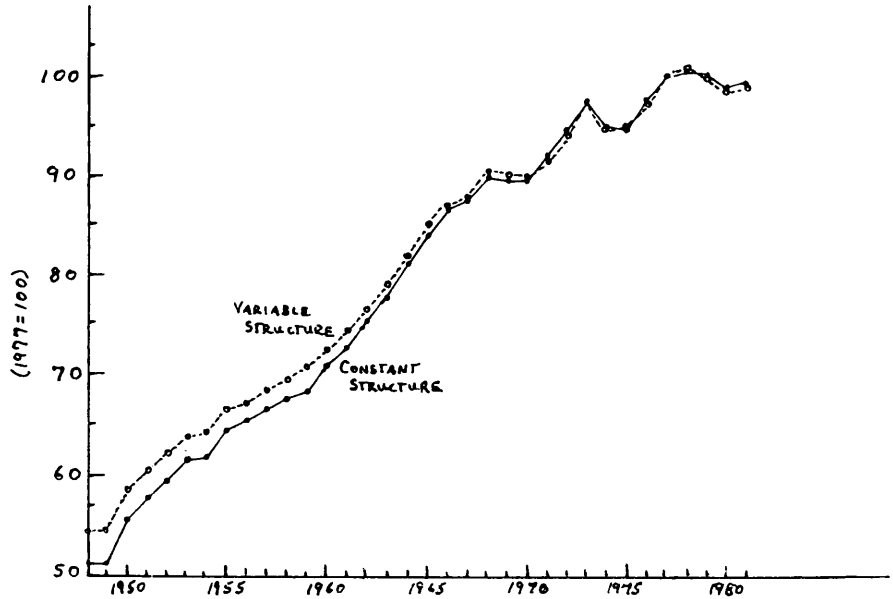
During this earlier 1948-65 period, the proportion of output changed but little (see Table I); the same is true in regard to capital input. The significant changes occurred in the proportion of labor hours; labor hours in the goods-producing sector declined almost 8 percentage points, from 55.3 percent in 1950 to 47.6 percent in 1965. Of course, the service-producing sector gained this amount. Between 1965 and 1975 the goods-producing sector again lost share, about 6 percent, dropping to 41.8 percent.

Table III
Proportion of Private Business Economy
Output and Inputs
as of 1965

	Output	Labor	Capital
Manufacturing	.325	.318	.179
Food	.032	.031	.017
Tobacco	.005	.001	.002
Textiles	.010	.016	.007
Apparel	.011	.021	.003
Lumber	.011	.012	.003
Furniture	.005	.007	.002
Paper	.011	.012	.011
Printing and publishing	.018	.017	.005
Chemicals	.020	.016	.020
Petroleum	.008	.003	.011
Rubber	.009	.009	.004
Leather	.003	.006	.001
Stone, clay and glass	.012	.011	.008
Primary metals	.030	.022	.029
Fabricated metals	.024	.025	.010
Machinery excluding electric	.034	.032	.016
Electrical machinery	.025	.028	.009
Transportation equipment	.044	.034	.017
Instruments	.008	.008	.003
Miscellaneous manufacturers	.005	.007	.002
Nonfarm nonmanufacturing	.541	.524	.619
Mining	.022	.012	.043
Contract construction	.075	.064	.012
Transportation	.051	.050	.070
Communications	.023	.015	.027
Public utilities	.027	.011	.061
Trade	.203	.255	.077
Finance and insurance	.049	.041	.015
Real estate	.061	.012	.193
Services	.127	.140	.176

SOURCES: American Productivity Center; Pace University.

Chart I
Total Factor Productivity
Variable Structure Versus Constant 1965 Structure
1948-1981
(1977 = 100)



SOURCE: American Productivity Center.

Table IV
Total Factor Productivity and Related Indexes by Major Sector (Selected Periods, 1948-1981)

	Average Annual Rates of Change				
	1948-79	1948-65	1965-73	1973-79	1979-81
A. Total Factor Productivity					
1. Variable Structure					
Private business economy	1.8	2.6	1.8	0.4	-0.4
Goods-producing sector	2.2	3.1	2.2	0.4	-0.2
Service-producing sector	1.3	1.8	1.4	0.5	-0.4
Manufacturing industry	2.0	2.6	2.3	0.8	-0.4
2. Constant Structure					
Private business economy	2.0	2.9	1.9	0.4	-0.4
Goods-producing sector	2.5	3.8	2.4	0.4	-0.4
Service-producing sector	1.4	1.9	1.4	0.6	-0.2
Manufacturing	1.8	2.4	2.2	0.6	-0.5
B. Labor Productivity					
1. Variable Structure					
Private business economy	2.4	3.2	2.4	0.8	0.5
Goods-producing sector	2.8	3.8	2.6	0.9	1.0
Service-producing sector	1.9	2.3	2.2	0.7	0.3
Manufacturing	2.6	3.0	2.8	1.5	1.0
2. Constant Structure, 1965					
Private business economy	2.0	2.9	1.9	0.4	-0.4
Goods-producing sector	3.1	4.4	2.9	0.9	0.7
Service-producing sector	1.9	2.4	2.2	0.7	0.3
Manufacturing	1.8	2.4	2.2	0.6	-0.5
C. Capital Productivity					
1. Variable Structure					
Private business economy	0.2	0.8	0.1	-0.5	-2.3
Goods-producing sector	0.3	1.0	0.7	-1.1	-3.1
Service-producing sector	0.2	0.5	-0. 1	0.1	-1.5
Manufacturing	0.0	0.9	0.3	-1.5	-4.2
2. Constant Structure, 1965					
Private business economy	0.3	0.9	0.2	-0.5	-2.3
Goods-producing sector	0.3	1.1	0.7	-1.3	-3.6
Service-producing sector	0.4	0.7	0.1	0.3	-1.2
Manufacturing	-0.2	0.7	0.2	-1.7	-4.3

Table IV (continued)
Total Factor Productivity and Related Indexes by Major Sector (Selected Periods, 1948-1981)

	Average Annual Rates of Change				
	1948-79	1948-65	1965-73	1973-79	1979-81
		D. Real Output			
		1. Variable Structure			
Private business economy	3.3	3.6	3.9	2.7	0.6
Goods-producing sector	2.8	3.5	3.2	1.7	-0.9
Service-producing sector	3.6	3.6	4.3	3.4	1.7
Manufacturing	3.3	4.0	4.1	2.1	-1.3
		2. Constant Structure, 1965			
Private business economy	3.1	3.5	3.6	2.4	0.2
Goods-producing sector	2.7	3.4	3.0	1.4	-1.3
Service-producing sector	3.5	3.5	4.2	3.3	1.5
Manufacturing	3.1	3.7	3.8	1.8	-1.5
		E. Labor Input			
		1. Variable Structure			
Private business economy	0.9	0.4	1.4	1.9	0.1
Goods-producing sector	0.0	-0.4	0.6	0.8	-1.8
Service-producing sector	1.7	1.2	2.1	2.7	1.4
Manufacturing	0.8	1.0	1.2	0.6	-2.3
		2. Constant Structure, 1965			
Private business economy	0.5	-0.1	1.0	1.6	-0.3
Goods-producing sector	-0.5	-0.9	0.1	0.5	-1.9
Service-producing sector	1.6	1.1	2.0	2.6	1.1
Manufacturing	0.6	0.9	1.1	0.4	-2.5
		F. Capital Input			
		1. Variable Structure			
Private business economy	3.1	2.8	3.7	3.1	3.0
Goods-producing sector	2.5	2.4	2.5	2.9	2.3
Service-producing sector	3.5	3.1	4.5	3.3	3.3
Manufacturing	3.3	3.1	3.7	3.6	3.0
		2. Constant Structure, 1965			
Private business economy	2.8	2.6	3.4	2.8	2.6
Goods-producing sector	2.4	2.3	2.2	2.7	2.4
Service-producing sector	3.1	2.8	4.1	2.9	2.7
Manufacturing	3.3	3.1	3.6	3.5	2.9

SOURCES: American Productivity Center; Pace University.

This significant gain in the service-producing sector's share of labor hours is reflected in the differing growth rates of variable structure labor productivity and constant structure labor productivity. During each of the four post-war subperiods examined, when the structure of output and labor input are held constant, the rates of growth of labor productivity are significantly lower. And the divergence in their respective growth rates increases as we approach the 1980s. Thus, the shift from a goods- to a service-oriented economy has had a significant impact on labor productivity throughout the 1948-81 period, but not significant after 1965 when productivity is measured using the total factor approach.

Again, we see the importance of including capital in the measure of productivity. Interestingly, there is little difference in capital productivity growth rates between the variable and constant structure measures.

Output and Inputs. Table IV also presents the impact on output and labor and capital input growth rates for all three series; and for each subperiod, when the structure is held constant, the growth rates are lower than in the variable structure case. This result is expected since an economy normally shifts output and resources to industries which are experiencing greater growth in demand. Further, higher productivity growth industries tend to have slower rising prices, which encourages increasing demand and output, and higher profit margins, which also encourages and attracts more resources.

Translating these increases in output, labor and capital into faster-rising productivity depends upon their *relative* growth rates. As we saw, the major divergence was in regard to labor productivity, the difference in output growth rates (1948-65) was only 0.1 percentage points, yet labor input declined at a 0.1 percentage rate when when the structure

was held constant, as compared to an actual (variable structure) use of 0.4 percent per annum. The divergence in capital input growth rates over this same period was also minimal, 0.1 percentage points. Here, too, we see that the strong shift in labor explains the divergence in labor productivity growth rates.

Within-Sector Shifts. Shifts of output and inputs within a sector will also impact its measured productivity growth rates. Apparently shifts within the goods-producing sector had a substantial impact on total factor productivity growth rates over the 1948-65 subperiod, 3.1 percent versus 3.8 percent for the variable and constant structures, respectively. After that period, the differences are much smaller. Much of this difference in the early period can be attributed to shifts in labor among the goods-producing sectors. Since there is only a small difference in manufacturing VS-TFP and CS-TFP growth rates, most of the divergence within the goods-producing sector must be due to the shift from farm to nonfarm labor in the early post-war period.

Within the service-producing sector, there is very little difference in growth rates of VS-TFP and CS-TFP. Apparently, there have been only small shifts of labor, and output and capital, within this sector.

Rate, Level and Interaction Effects. Gains in productivity can be separated into rate, level and interaction effects. The rate effect is the growth in productivity due to within-industry productivity gains. The level effect is due to shifts in the composition or structure of the economy, holding within-industry productivity constant. The interaction effect is a result of the interaction between the rate and level effects.

The estimates of constant structure growth rates presented above are approximations of the rate effect. Unfortunately, there is no approach available to decompose total factor pro-

ductivity into rate, level and interaction effects. However, it is possible to do so for labor productivity.[7] Using a 60-sector disaggregation, Beebe and Haltmaier estimate the rate and level effects for selected subperiods:[8]

	Decomposition of labor productivity (Annual rates of change)		
	1948-65	1965-73	1973-78
Private domestic economy			
Total	3.24	2.54	1.00
Rate	2.79	2.22	0.93
Level	0.45	0.33	0.10

This table indicates that the level effect accounted for 13.9 percent of the rate of productivity growth between 1948 and 1965, 13 percent over the 1965-73 period, and 10 percent over the 1973-78 period. In order to isolate which sectors account for the level effect, Beebe and Haltmaier use a two-sector approach, isolating each sector in a separate calculation. Their findings are that farming accounts for most of the level effect, especially in the earliest subperiod, 0.41, 0.18, and 0.05, for the three subperiods, respectively. Our constant-structure approach agrees with their findings.

4. The Hours Paid Bias

The BLS establishment survey known as the Current Employment Statistics Survey (709), has three major problems in regards to productivity measurement:

1. Self-employed and unpaid family workers are excluded. In the BLS sector estimates and the APC sector/industry estimates of productivity, self-employed and unpaid family workers are included, albeit using indirect methods. In contrast, direct industry estimates would be based on imputations by sector of self-employed and unpaid family worker

employment, using estimates from the Current Population Survey. At least this source of bias is addressed.

2. Average hours estimates cover only production workers in mining and manufacturing, and all nonsupervisory workers in other industries. Generally, in calculating total hours worked, average hours of supervisory (nonproduction) are assumed to be the same as nonsupervisory (production) workers. As of 1977, about 18 percent of total workers in nonagricultural industries, and about 28 percent of mining and manufacturing workers had their hours estimated under this assumption. It is not clear what direction this assumption would bias our productivity measures, if any. The trend has been towards working less hours per week, at least until the early 1960s. This trend applies to both supervisory and nonsupervisory workers. More likely, these estimates lead to a cyclical bias in that production workers' hours are lowered during business downturns, but nonproduction personnel hours generally stay the same.

3. The major problem is that the establishment survey measures hours paid instead of hours worked. Hours paid includes vacations, sick-leave, holidays, coffee breaks, and the like. If the difference between hours paid and worked had stayed the same since 1948, productivity *trends* would not be affected, and only productivity *levels* would be biased downwards.

But in reality the trend has been towards more hours that are paid but do not represent work. Evidence on this trend is sketchy but very convincing. In 1966, 83 percent of total compensation was for working time (all nonagricultural industries, see Table V). By 1970 this figure dropped to 81.9 percent, and to 76.7 percent by 1977, the last year such information was published. During this same period, pay for leave excluding sick went from 5.2 percent of total compensation to 6.1 percent. Other evidence indicates that between

1965 and 1976, the maximum allowable vacation of plant workers rose from 3.3 weeks per annum to 3.9 weeks, and from 3.6 weeks to 4.1 weeks for office workers.[9]

This problem was addressed as early as 1976 by the Bureau of Labor Statistics.[10] They recognized the impact this bias has on productivity measures and they attempted to rectify for the lack of hours worked data. After reviewing the several employment surveys conducted by the federal government, they recommended that the Current Employment Statistics Survey be expanded to include hours worked information.[11]

Table V
Percent of Total Compensation
by Type of Activity
All Industries
Selected Years
(Percent)

Activity	1966	1970	1974	1977
Total	100.0	100.0	100.0	100.0
Pay for working time	83.0	81.9	78.2	76.7
Pay for leave (excluding sick)	5.2	5.6	6.0	6.1
Vacation	3.1	3.3	3.4	3.4
Holidays	1.9	2.1	2.3	2.3
Employer expenditures Sick leave	0.6	0.7	0.7	0.8
Wages and salaries (Gross pay)	89.9	89.0	86.3	84.6
Supplements to W&S	10.1	11.0	13.7	15.4
W&S less pay for working	6.9	7.1	8.1	7.9

SOURCE: *Handbook of Labor Statistics,* Bulletin 2070, U.S. Department of Labor, Table 132, "Employee Compensation, Private Nonagricultural Economy, Selected Years, 1966-77," December 1980, pp. 308-318.

In their approach to defining what comprised hours worked, they had several somewhat competing uses in mind, including labor negotiations and productivity measurement. They finally recommended the use of the concept "hours at work," which they defined as "all time during which an employee is necessarily required to be on the employer's premises, on duty, or at a prescribed work place."[12]

> In addition to regular working time where the employee is engaged in productive activity, hours at work thus include short rest periods and coffee breaks, standby or ready time, downtime, portal to portal pay only if paid, washup time only if paid, travel time from job site to job site within the working day, travel away from home if it cuts across the working day, and paid training periods during working hours. Hours at work exclude normal travel time from home to work, unpaid wash time, and lunch time . . . the major items excluded from hours at work are vacations, holidays, and absences due to sickness or personal or civic reasons.[13]

About 90 percent of paid but not at-work time is due to vacations. This definition does include some nonwork time which would be better excluded for productivity measurement purposes, but these items represent a very small proportion of nonwork time.

For illustrative purposes, estimated total hours paid for the nonfarm sector were adjusted to an hours worked basis. The adjustment is based on the evidence given in the BLS Report.[14] This table indicates that hours worked were 95.2 percent of hours paid in 1952, and declined an average of 0.1 percentage points per annum through 1966, the same annual percentage point decline as presented in Table V. Taking the 1952 figure of 95.2 percent as a benchmark, we assumed

through extrapolation that hours worked were 95.6 percent of hours paid in 1948, and 92.3 percent in 1981. (All intervening years were linearly interpolated.)

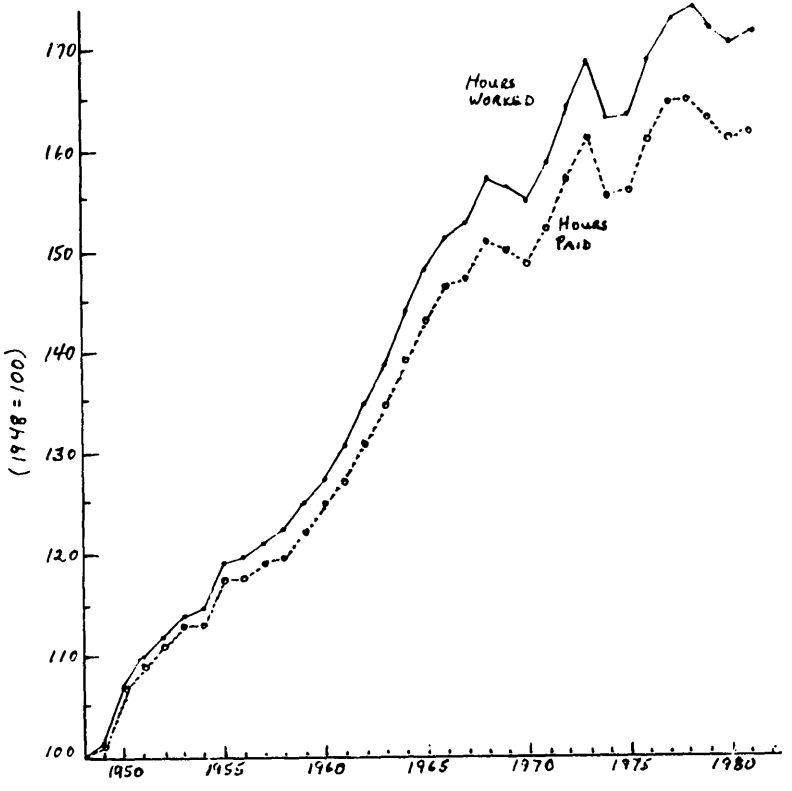
Labor productivity and total factor productivity were calculated using adjusted hours worked labor input. Chart II shows the trends in the hours worked and hours paid measures of total factor productivity (assuming both measures are equal to 100 in 1948). It is clear that the hours paid measures are an underestimate of TFP, and that this bias increases over time.

The differences in rates of growth for the *nonfarm sector* are not very large, no more than 2 percentage points (see Table VI). But over long periods of time, small percentage differences in growth rates lead to substantial differences in *levels.* For example, if it is assumed that total factor productivity using hours worked and hours paid measures were equal in 1948—as was done for Chart II—hours paid TFP would rise 61.8 percent by 1981 (at a 1.5 percent rate) and hours worked TFP, 71.2 percent (at a 1.6 percent rate). The gap between these two measures widens steadily over time and reaches 5.8 percent by 1981.

Using hours paid rather than hours worked leads to an understatement of both the *level* and the *rate of growth* of total factor productivity and labor productivity. While this conclusion implies that the productivity problem facing the U.S. economy is not as bad as has been measured by currently available data, we still must conclude that since 1965 productivity gains have slowed down substantially and that since 1973 they have been nonexistent.

Stafford and Duncan report that their survey "shows that the divergence between hours worked and hours paid accounts for as much as one-third of the productivity slowdown."[15] Further, Norsworthy *et al.* report that the rate of change in the ratio of hours worked to hours paid for the

Chart II
Total Factor Productivity
Hours Paid Versus Hours Worked
Nonfarm Business Economy
1948-1981
(1948 = 100)



SOURCE: American Productivity Center.

private nonfarm business sector was -0.06 percent from 1952 to 1965, -0.21 for 1965 to 1973, and -0.12 from 1973 to 1975.[16]

They conclude that the results are "not striking" but that there "is a small, persistent but variable decline in the ratio of hours worked to hours paid."[17] Neither we nor Norsworthy attribute a significant proportion of the decline in productivity to the divergence between hours worked and hours paid. However, we are in agreement that the BLS should continue with their plans to expand their survey to include hours worked.

Table VI
Total Factor Productivity
Nonfarm Sector

A. Growth Rates, Selected Periods

Subperiod	Hours Paid	Hours Worked*
1948-81	1.5%	1.6%
1948-65	2.1	2.3
1965-73	1.5	1.6
1973-79	0.2	0.4
1979-81	-0.6	-0.4

B. Percent Difference in Hours Worked and Hours Paid**

Year	Total Factor Productivity	Labor Productivity
1965	3.3%	3.3%
1973	4.5	5.7
1979	5.5	7.0
1981	5.8	7.5

SOURCES: The American Productivity Center; Pace University.

*For illustrative purposes only.

**Assumes that both measures equal each other in 1948.

5. Underestimate of Labor in the Real Estate Sector

There is evidence that the Current Employment Statistics program underestimates labor hours in the real estate sector. Traditionally, much of the effort in this sector is by individuals working on a commission basis and on their own time. The establishment survey apparently underestimates the amount of labor effort by nonpayroll personnel and, as such, undercounts the number of employees.

Information provided by the National Association of Realtors (NAR)[18] indicates that the BLS survey is only capturing approximately 16 percent of the total labor force in this sector, which implies that a more correct estimate of real estate labor is about six times the published figure. Another source of underestimation is the average hours paid (worked) per week. Currently, only nonsupervisory workers are covered, and real estate is *not* broken out from the broader finance, insurance, and real estate sector. Therefore, this estimate of average hours must be used in calculating total real estate labor hours.

Table VII presents employee information provided by the NAR.[19] About 84 percent of the total workforce is made up of salespersons, and only 16 percent are in-office personnel. This number appears to be fairly stable over the 1976-81 period. Unfortunately, no data is available prior to 1976 so no trend can reasonably be inferred.

The BLS estimates that nonsupervisory workers are paid for an average of 36 hours per week. Real estate salespersons average over 40 hours according to NAR surveys, and brokers over 50 hours per week. Here, too, we have a rather significant understatement of employee activity in this sector.

Finally, the distribution of gross income indicates that some 13 percent goes to cover payroll-type costs, and 45 per-

cent to commissions, adding up to total labor costs of 58 percent. This proportion is way below estimates of labor's share of total factor costs as compiled from the Bureau of Economic Analysis. In 1978 the APC has calculated that labor compensation, after an imputation for self-employed is added on, was only 8 percent of total factor costs, way below the figure implied by NAR data.

The data provided by the NAR are compelling. Two factors ar highlighted which signal likely labor measurement problems for the real estate sector:

1. The level of real output per hour for the real estate sector is almost 40 percent higher than any other nonfarm nonmanufacturing sector. (In 1979, output per hour was $27.42—in 1972 dollars—as compared to $19.76 for public utilities.)

2. Labor's share of factor income is the lowest of all nonfarm nonmanufacturing sectors. (In 1978, real estate's labor share was 8 percent, about one-fourth the 36.5 percent labor share of the public utility sector.)

Unfortunately, the data provided by the NAR survey would lead to hour and employee estimates which are unrealistically high. Using their data and adjusting BLS estimates of the number of employees and average hours for real estate, we would derive estimates of aggregate hours of 13.6 billion and employment of 6.4 million workers. Even though these estimates are not acceptable, the NAR survey results do indicate that there is a substantial underestimate of labor effort in the real estate sector.

Table VII
Real Estate Sector
Labor Characteristics
Selected Years

1. Employment by Type
(Percent of workforce)

	1976	1978	1981
Salespersons	82.2%	84.0%	84.6%
In-office nonsales personnel	17.8	16.0	15.4
Total	100.0	100.0	100.0

2. Distribution of Hours per Week

	1975[a]		1978	
	Percent under 40	Percent 40 & over	Percent under 40	Percent 40 & over
Salespersons	29.8	70.2	39.2	60.8
Brokers	-	-	17.9	82.1

	1981	
	Percent under 40	Percent 40 & over
Salespersons	45.9	54.1
Brokers	23.3	76.7

3. Average Hours per Week

	1975	1978	1981
Salespersons	47	45	41
Brokers	-	50	51
BLS FIRE[b]	36.5	36.4	36.3

4. Distribution of Gross Income
(Percent)

	1975	1978	1981
Payroll-type costs	14.1%	13.3%	13.2%
Commissions	44.0	45.0	46.0
Total labor costs	58.1	58.3	59.2
Other costs (occupancy, communications, advertising, sales promotion, etc.)	41.9	41.7	40.8
Total all costs	100.0	100.0	100.0

SOURCES: National Association of Realtors; The American Productivity Center; Pace University.

a. Realtor associates, salespersons and brokers.

b. Nonsupervisory worker, Finance, Insurance, and Real Estate.

6. Conclusion and Recommendations

In the specific field of employment and hours data, as generated by the Bureau of Labor Statistics, several conclusions are apparent:

1. To properly capture gains in productive efficiency, the role of capital must be included at the sector level, and intermediate materials and energy inputs should be added if measuring productivity at more detailed levels. Because of substitution among the various inputs, labor productivity measures are biased upwards.

2. The shift from a goods-producing to a service-oriented economy had a significant effect on measured productivity in the early part of the post-World War II era, but has not affected productivity growth rates since 1965. If productivity is measured by labor productivity, there appear to have been labor-shift effects since 1965, but these effects are incorrect. The shift to more services has not contributed significantly to the post-1965 productivity slowdown.

3. The current practice of estimating hours paid rather than hours worked by the Bureau of Labor Statistics significantly biases productivity growth rates downwards. While the bias is significant, it does not account for the post-1965 productivity slowdown.

4. For some sectors—especially the real estate sector—the true aggregate of hours devoted to gainful endeavor *and* the number of persons involved in generating the value-added "output" for the sector is seriously understated by the BLS exclusion of "non-office sales personnel." This exclusion undoubtedly exerts some effect in a number of the service industries, but is especially serious for real estate. According to the National Association of Realtors data, not less than three-fourths of the total number of persons gainfully employed by the industry (and probably an even larger

percentage of the hours actually worked) are non-office sales personnel, paid for either entirely or very largely on a commission basis. With this exclusion, the computation of a meaningful productivity *level* (output per hour) is not possible; and with an output per hour *trend* based on perhaps 20 to 25 percent of the total human resources input, the validity is indeed questionable.

The technical problems reviewed here are important but should not detract us from some basic economic problems facing the U.S. economy. Our declining productivity performance, which is clearly evident regardless of any biases in estimation, continues to erode our national vitality and international competitiveness. While the technical recommendations are clear—measure total factor productivity and measure hours at work—how we can revive our economy's efficiency of operation is more difficult to fathom.

As matters stand, it is obvious that the U.S. industrial community of the future will inevitably be altogether different from that of the past. If we are to avoid the fate of nations in the past who fell from the position of world leadership to the status of third-rate or fourth-rate powers, we must:

*Develop new—and high-technology—industries and expand them rapidly;

*Carry out wide-ranging actions to maximize productivity, flexibility and general acceptance of change and new approaches in existing, mature industry;

*Substantially increase diffusion throughout every segment of the industrial community of "best practice";

*Encourage development of the requisite new skills required for new high-tech industries and for the more automated, robotized plants of the future in extant industries;

*Direct improvements in productivity and general operational efficiency in the growing service industry segment of the economy.

In addition to industrial restructuring toward services and technology-oriented industries and improvements in its overall effectiveness, it appears essential that new and imaginative approaches be shaped for on-going collaboration of the government, industry and labor to expand U.S. fabricated goods exports in the world marketplace, plus effective action in exporting efficient, flexible U.S. "services," including transportation, communications, finance and professional services.

Further, it appears likely that the U.S. will also be able—as it must—to expand further its still-extant lead in the production and export of agricultural products. Here, again, new technologies (including hydroponics, photosynthesis and bioregulators) will be required to meet the needs of the twenty-first century and to help assure retention by the U.S. of at least a relatively high standard of living.

NOTES

1. See John W. Kendrick and Elliot Grossman, *Productivity in the United States: Trends and Cycles,* Johns Hopkins University Press, 1980; Edward Denison, *Accounting for U.S. Economic Growth, 1929-1959,* Brookings Institution, 1974; Dale Jorgenson and Laurits Christensen, "Measuring Economic Performance in the Private Sector," in *Measurement of Economic and Social Performances,* M. Moss, ed. Studies in Income and Wealth, vol. 38, Columbia University Press, 1973; John Kendrick, *Understanding Productivity: An Introduction to the Dynamics of Productivity Change,* Johns Hopkins University Press, 1977; Zvi Griliches, "Returns to Research and Development Expenditures in the Private Sector," in *New Developments in Productivity Measurement and Analysis,* Kendrick and Vaccara, eds. NBER Studies in Income and Wealth, vol. 44, University of Chicago Press, 1980; and from the same volume, Frank Gollop and Dale Jorgenson, "U.S. Productivity Growth by Industry."

2. "Multiple Input Productivity Indexes," various issues, American Productivity Center, Houston.

3. Panel to Review Productivity Statistics, National Academy of Sciences; see also, Albert Rees, "The Measurement and Interpretation of Productivity," National Academy of Sciences, 1979; and Albert Rees, "Improving the Concepts and Techniques of Productivity Measurement," *Monthly Labor Review,* September 1979, pp. 23-27.

4. Rees, "Improving the Concepts," p. 25.

5. For a discussion of problems in measuring capital and productivity, see Peter K. Clark, "Issues in the Analysis of Capital Formation and Productivity Growth," *Brookings Papers on Economic Activity,* 2:1979, pp. 423-445.

6. See Kendrick and Grossman, *Productivity in the United States* and Kendrick, "Productivity Trends and the Recent Slowdown: Historical Perspective, Causal Factors, and Policy Options" in *Contemporary Economic Problems, 1979,* W. Fellner, ed., American Enterprise Institute, 1979.

7. J.H. Beebe and Jane Haltmaier, "Disaggregation and the Labor Productivity Index," Working Paper No. 106, Federal Reserve Bank of San Francisco, November 4, 1981, updated April 19, 1982.

8. *Ibid.,* p. 6.

9. *Handbook of Labor Statistics,* Table 110, U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2000, 1978.

10. U.S. Department of Labor, Bureau of Labor Statistics, "Report of the BLS Task Force on Hours Worked," processed, March 1976.

11. "The Current Population Survey (CPS) is a household survey which collects and publishes data on hours worked for all persons in the civilian labor force. The other major programs collecting hours data survey establishments. The Current Employment Statistics (790) program collects and publishes data on hours paid for production workers only. The EEC survey collects hours paid and paid leave time for both office and nonoffice employees. The Occupational Safety and Health (OSH) survey collects hours worked for all employees." *Ibid.,* p. 11.

12. *Ibid.,* p. 12.

13. *Ibid.,* p. 13.

14. *Ibid.,* Table IX, p. 95. This report also presents evidence that the divergence between hours paid and hours worked differs among industries and type of workers.

15. F.P. Stafford and G.I. Duncan, "The Use of Time and Technology by Households in the United States," in R.G. Ehrenberg, Orley Ashenfelter and R.L. Oaxaca, *Research in Labor Economics,* Vol. 3, JAI Press, 1979.

16. J.R. Norsworthy, M.L. Harper, K. Kunze, "The Slowdown in Productivity Growth: Analysis of Some Contributing Factors," *Brookings Papers on Economic Activity,* 2:1979, pp. 387-422.

17. *Ibid.,* Table 9, p. 411.

18. National Association of Realtors, "Real Estate Brokerage, Income, Expenses, Profits," Department of Economics and Research, 1976, 1978 and 1981.

19. *Ibid.*

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