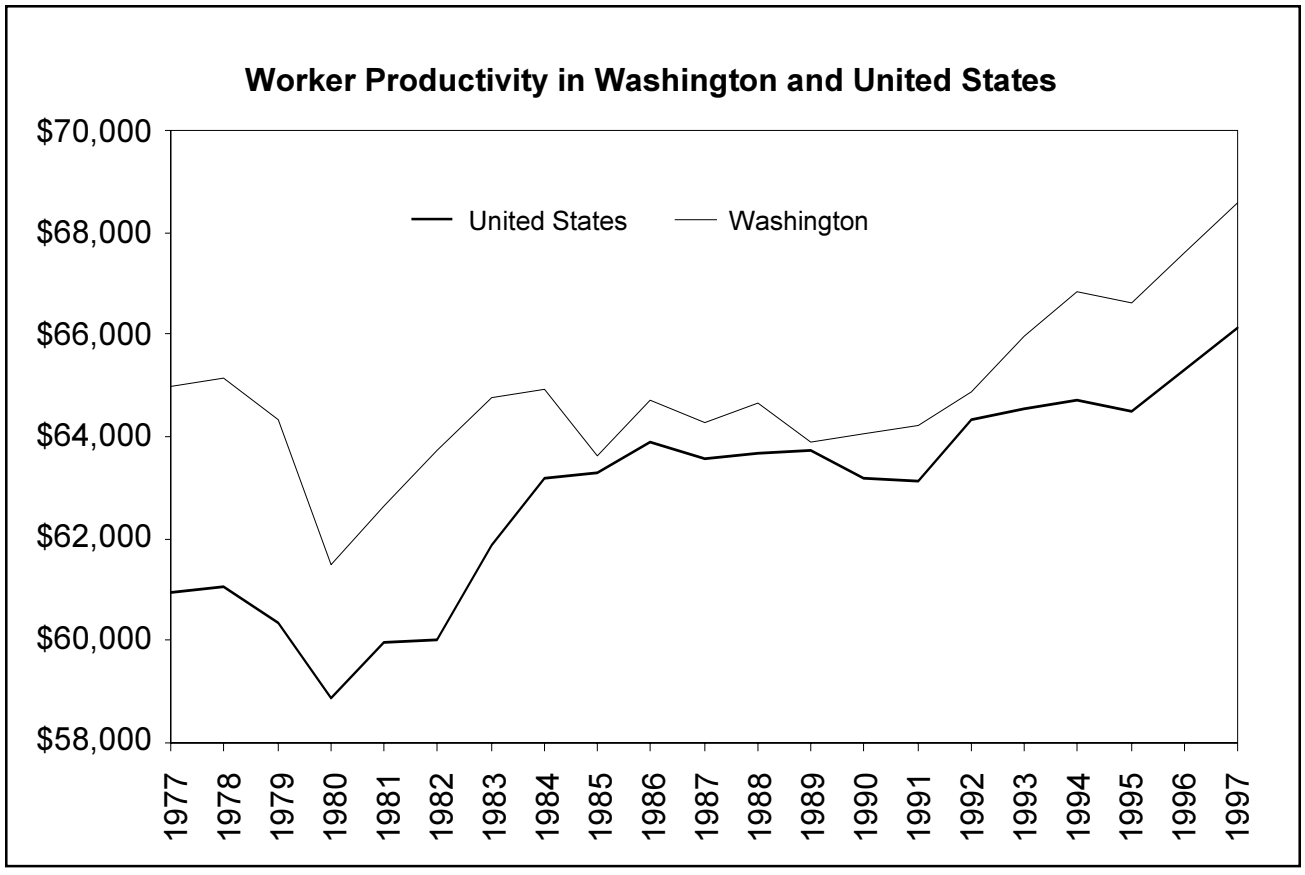
Studies in Industry and Employment

Worker Productivity Trends in Washington, 1977-97



Washington State Employment Security
Labor Market and Economic Analysis Branch
Carver Gayton, *Commissioner*

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Worker Productivity Trends in Washington, 1977-97

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Executive Summary

- Labor productivity is a formal statistical measurement and economic indicator generated by the U.S. Bureau of Labor Statistics and defined as *real output per labor hours worked.*
- Productivity is widely recognized as the broadest measure of growth in the U.S. economy and, as such, is arguably the single most important benchmark of an economy's ability to boost income, sustain competitiveness, and improve the standard of living.
- Labor productivity is not available sub-nationally. Therefore, *worker productivity*—defined as real gross state product per nonfarm worker—was developed for the purpose of state level analysis. Worker productivity and labor productivity were compared nationally with the former and found to be a very good proxy for the latter.
- Worker productivity in Washington was higher than that nationally over the entire 1977-97 period. That gap narrowed during the latter half of the 1980s as the state's resource-dependent and aerospace industries were hit by structural forces, but widened again in the 1990s as the software industry contributed to soaring output.
- Real estate had the highest absolute level of worker productivity in Washington, owing to the nontraditional employment base and the way property is valued. Basic utilities and services also produced exceptionally high worker productivity due to relatively fixed consumption as well as tremendous investment in technology. On the flip side, labor intensive industries in general had the lowest absolute levels of worker productivity whether related to manufacturing, services, or retail trade.
- With the exception of business services (a proxy for prepackaged software), worker productivity in Washington's key industries did not stack up well against similar industries in other states where those industries were equally prominent.
- Extensive research suggests that under-measuring output from technological innovations such as computers and software is not sufficient enough to account for slow productivity growth in the 1990s because they are seldom used to their full capabilities and are such a small share of net business capital stock.
- Corporate downsizing in the 1990s has produced short-term gains in efficiency rather than long-term, sustainable gains in productivity. Downsizing requires making do with less, which is in conflict with long-term productivity's requirement for investment in innovation and human capital to expand labor and capital.
- A pressing measurement problem is underreporting of *hours worked*—a key component in calculating labor productivity as white-collar workers are increasingly "on the job" longer than the data suggest, thanks to the growing amount of work that can be done away from the office via information technology. If true, productivity is overstated. This may further be inhibiting productivity growth because much of this work is being done at the expense of leisure time, which is in conflict with a stated benefit of improved productivity—an increase in one's standard of living.
- Though productivity has been stagnant over the past couple of decades, it has recently demonstrated relatively healthy growth. The jury is still out as to whether these gains were produced by short-term efficiency measures or long-term productivity gains. Whether or not long-term productivity continues to rise at a sustained rate will depend on increased growth in capital investment and human capital—both of which are critical drivers of long-term productivity growth.

In Pursuit of Higher Productivity

Labor productivity measures the relationship between an economy's real output and the labor or work involved in generating that output. It is widely recognized as the broadest measure of growth in the U.S. economy, reflecting the combined effect of many influences, including technological change, capital investment, rate of output, capacity utilization, energy utilization, material utilization, the organization of production, managerial skill, and the characteristics of the work force. As such, it is arguably the single most important economic indicator or benchmark of an economy's ability to boost income, sustain competitiveness, and improve the standard of living. Because continued gains in labor productivity are regarded as critical to avoiding stagnation in any of the aforementioned areas, analysts are constantly trying to improve their understanding of what drives productivity and how that impacts economic growth and prosperity. Against this backdrop, labor productivity figures are among the most eagerly anticipated economic statistics. Among those who eagerly await its release are economists and analysts with the Federal Reserve, federal and state labor departments, higher education institutions, and business and labor organizations, among others.

Labor Productivity Defined

Labor productivity is defined as *real output per labor hours worked.* As the definition suggests, productivity measurement relies on two inputs: *real output* and *labor hours worked*.

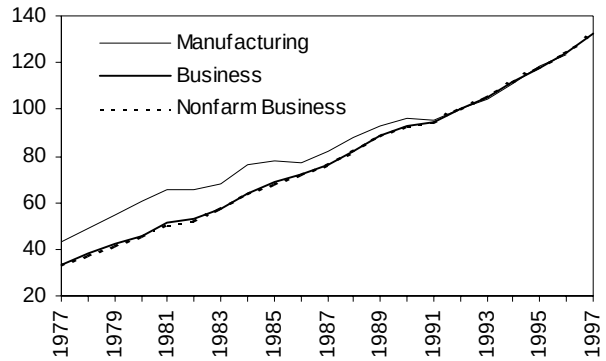
Real output is based on gross domestic product (GDP) generated by the U.S. Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce, which is then adjusted to real terms using the U.S. Implicit Price Deflator.

BEA breaks down real output in terms of business, nonfarm business, manufacturing, and non-financial corporations. *Business* output is an annual-weighted index constructed after excluding from gross domestic product (GDP) the following: general government, nonprofit institutions, paid employees of private households, and the rental value of owner-occupied dwellings. *Nonfarm* output is similarly derived, but also excludes farming output. *Manufacturing* output is a quarterly measure based on the index of industrial production prepared monthly by the Board of Governors of the Federal Reserve System, and which is adjusted to be consistent with annual manufacturing indexes of sectoral output prepared by BLS. Annual manufacturing indexes are constructed by deflating current-dollar industry value of production data from the U.S. Bureau of the Census with deflators from BEA. These deflators are based on data from the BLS producer price program and other sources. The industry shipments are aggregated using annual weights, and intra-sector transactions are removed.

Labor hours worked are derived from data generated by the U.S. Department of Labor, Bureau of Labor Statistics (BLS). This component of the labor productivity formula encompasses hours for wage and salary workers, self-employed, and unpaid family workers. The BLS Current Employment Statistics (CES) program provides monthly survey data on average weekly paid hours of production and non-supervisory workers in these establishments while average weekly paid hours of non-production and supervisory workers are estimated by the Office of Productivity and Technology. Data from the BLS Current Population Survey (CPS) are used for farm labor while the National Income and Product Accounts (NIPA) from BEA and the CPS are used to measure labor input for government enterprises, proprietors, and unpaid family workers.

Figure 1 depicts total business productivity, nonfarm business productivity, and manufacturing productivity

Figure 1
Labor Productivity by Sector
United States, 1977-1997 (Index: 1992=100)
Source: *U.S. Department of Labor, BLS*



on an indexed 1992=100 basis. Nonfarm business productivity is the most widely cited measure in the general press and media.

A Proxy for State Productivity

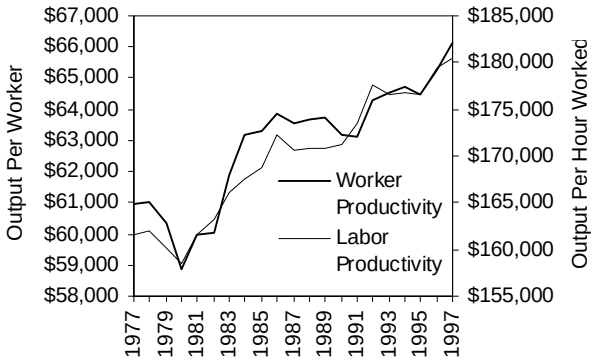
Although labor productivity data are available quarterly and annually for the U.S., no comparable data exist for states or any other sub-national areas. As such, for the purposes of this study, the formal calculation for productivity—real output per labor hours worked—will be replaced by *real output per worker* with real output represented by inflation-adjusted Gross State Product (GSP) and workers represented by nonagricultural wage and salary employment estimates. GSP is generated by the U.S. Department of Commerce, Bureau of Economic Analysis. Nonagricultural wage and salary worker estimates for Washington are generated by the state Employment Security Department. For comparison's sake, a similar approach will be used to calculate real output per worker for the United States. National nonagricultural wage and salary worker estimates are generated by the U.S. Department of Labor, Bureau of Labor Statistics.

To underscore the point, this *is not* precisely the same as labor productivity. As such, the use of the term *labor* productivity will be judiciously avoided, with the term *worker* productivity being used instead. This is an admittedly imperfect approach because data on the number of hours worked, which can vary considerably from industry to industry, are not available. It remains, however, the closest thing we have to a proxy for state labor productivity.

Labor Productivity vs. Worker Productivity

Now that the distinction between labor productivity and worker productivity has been made, the question remains: *Is the latter a reasonable proxy for the former?* If no reasonable fit or relationship can be discerned, it would have to be acknowledged, however reluctantly, that productivity cannot be reasonably measured at the state level. To answer this question,

Figure 2
Real Labor Productivity vs. Real Worker Productivity
United States, 1977-1997
Source: *U.S. DOL, BLS and Employment Security Dept.*

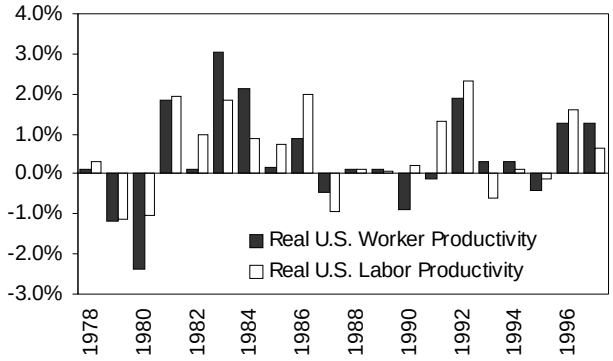


U.S. nonfarm labor productivity was compared to U.S. nonfarm worker productivity.

Figure 2 compares the 20-year trend lines for real nonfarm labor productivity and real nonfarm worker productivity. As can be seen, the fit is more than reasonable; it is virtually right on. The worker productivity trend line, like the labor productivity trend line, reveals an upward pattern over the 20-year period starting in the 1980s. If anything, the worker productivity trend line demonstrated a greater level of activity in the late 1970s and in the mid- to late-1980s than the labor productivity trend line, perhaps owing to the more elastic nature of employment compared to hours. Nevertheless, a more than reasonable fit having been established between labor productivity and worker productivity, the latter can confidently be cited as a proxy for the former.

In terms of annual rates of change over the 1977-97 period, *Figure 3* clearly reveals the period of declining productivity associated with the decade of the 1970s, followed by rising productivity during the expansion periods in the 1980s and 1990s. With respect to the current business expansion, low inflation, low wage pressure, and sustained growth have driven up productivity. Furthermore, though not reflected in *Figure 3*, U.S. labor productivity grew at around 2 percent in 1998 and appears to be on a similar track thus far in 1999.

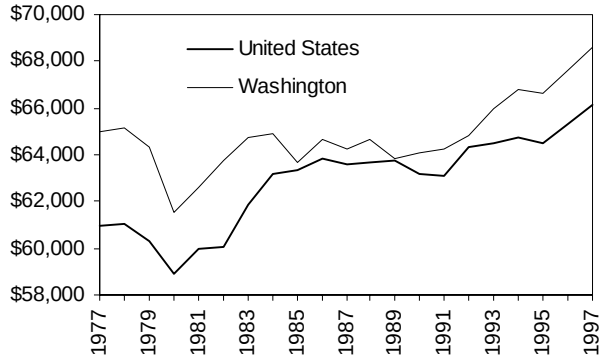
Figure 3
% Real Change in Labor Productivity & Worker Productivity
United States, 1978-1997
Source: *Employment Security Department*



Worker Productivity: Washington vs. U.S.

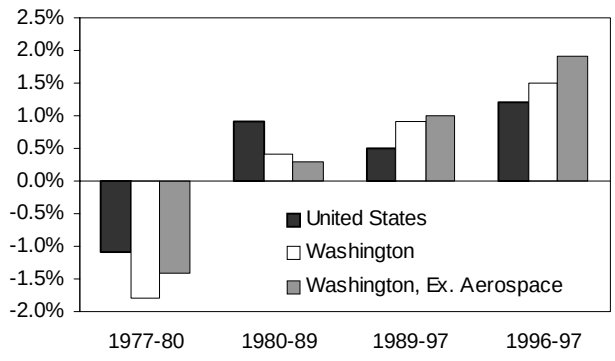
Figure 4 reveals that nonfarm worker productivity in Washington has consistently remained higher than that nationally during the period from 1977-97. That lead narrowed considerably during the latter half of the 1980s as the state's resource-dependent and aerospace industries found themselves caught in the grip of structural forces. The era of restructuring having largely (though by no means completely) played out by the end of the 1980s, nonfarm worker productivity in Washington began a slow but relatively steady upward march in the 1990s, much of that attributable to soaring output in the state's software industry.

Figure 4
Worker Productivity
Washington State and United States, 1977-1997
Source: *Employment Security Department*



A further comparison of worker productivity in Washington and the U.S. was done using annualized rates of change. A further data set created was worker productivity in Washington excluding other transportation equipment (a proxy for aerospace) since the latter is known to operate on a nontraditional business cycle. An initial run was done based on formal business cycles pegged by the National Bureau of Economic Research. These figures proved unrevealing as the results were inconsistent with how one might expect productivity to behave during expansions and contractions, especially in the current business cycle. Then, based on recent research that indicates that business cycles are driven more by changes in rates of productivity growth than by changes in monetary policy (Chatterjee, 1999 and Schweitzer, 1998), the observation periods were shifted to 1977-80, 1980-89, and 1989-97. These time periods also suggest that changes in productivity growth are a leading economic indicator. Consistent with empirical observations, *Figure 5* revealed that worker productivity in Washington is higher than that nationally in the current business cycle. Moreover, it was particularly evident in the most recent data (1997) that hiring inefficiencies in Washington's aerospace sector held worker productivity down by roughly a half a percentage point. Conversely, the data from the earlier business cycles showed that worker productivity in Washington was lower than that nationally even after accounting for the aerospace sector owing largely to the severe restructuring that took place in the state's natural resource-based industries.

Figure 5
Annual % Change in Worker Productivity by Business Cycles
Washington State and United States
Source: *Employment Security Department*



Of course, that is an aggregate picture. *Figure 6* shows that Washington's higher than average level of nonfarm worker productivity compared to the nation did not hold up equally for all of its sectors. Nonfarm worker productivity in Washington's mining and manufacturing sectors lag considerably behind their national counterparts, but was much higher than average in the state's services; retail trade; and finance, insurance, and real estate sectors. *Figures 7-12* provide a more detailed look at the worker productivity trends in each of Washington's major industry divisions over the 20-year observation period.

Figure 6
Worker Productivity by Major Industry Division
Washington State and United States, 1997
Source: *Employment Security Department*

Industry	State	U.S.	% Diff.
Finance, insur., real estate	$244,302	$220,890	10.6%
Transportation & public util.	$111,389	$105,542	5.5%
Mining	$90,571	$202,206	-55.2%
Wholesale trade	$86,321	$84,650	2.0%
Construction	$62,951	$57,776	9.0%
Manufacturing	$58,950	$73,835	-20.2%
Services	$54,976	$45,973	19.6%
Government	$53,670	$52,546	2.1%
Retail trade	$36,222	$32,454	11.6%
Total	$68,572	$66,109	3.7%

Figure 7
Worker Productivity in Services
Washington State, 1977-1997
Source: *Employment Security Department*

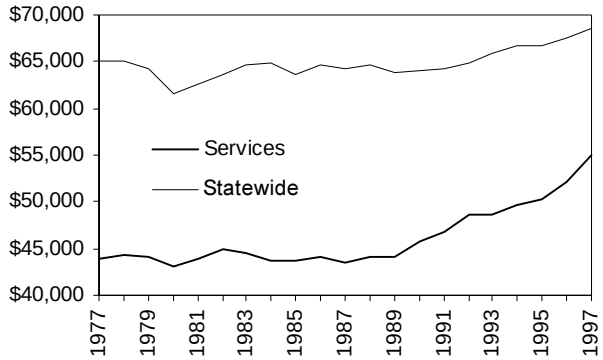


Figure 8
Worker Productivity in Retail Trade
Washington State, 1977-1997
Source: *Employment Security Department*

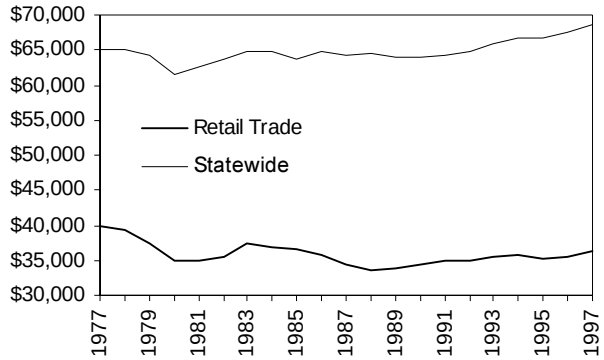


Figure 9
Worker Productivity in Manufacturing
Washington State, 1977-1997
Source: *Employment Security Department*

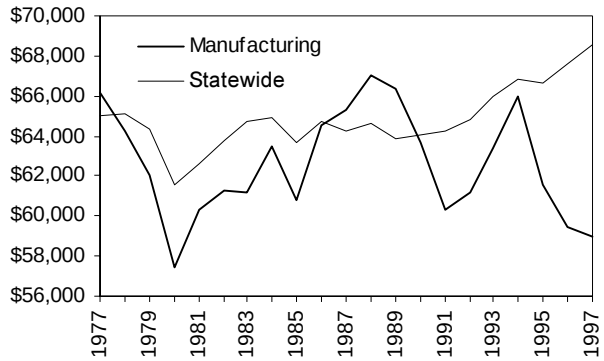


Figure 10
Worker Productivity in Construction
Washington State, 1977-1997
Source: *Employment Security Department*

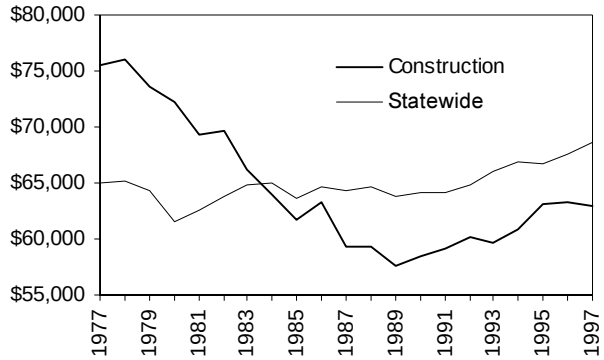


Figure 11
Worker Productivity in FIRE
Washington State, 1977-1997
Source: *Employment Security Department*

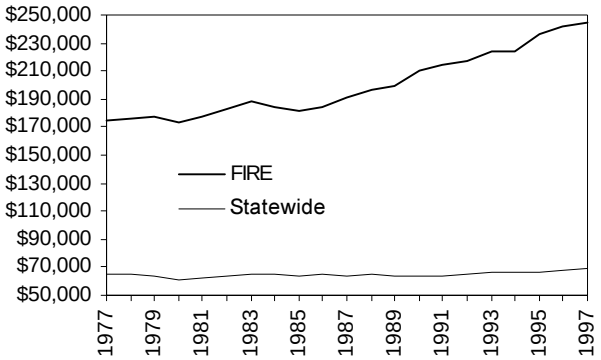
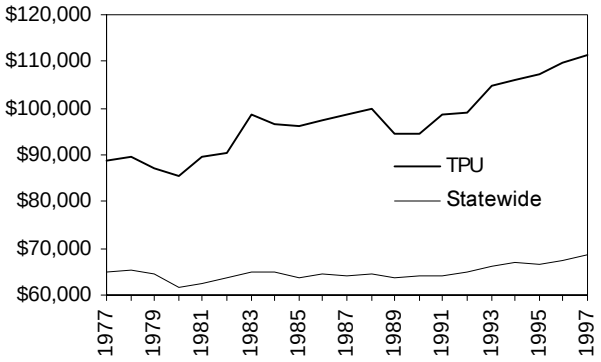


Figure 12
Worker Productivity in TPU
Washington State, 1977-1997
Source: *Employment Security Department*



Washington's Leaders

Ranking real dollar output per worker in absolute terms, *Figure 13* shows that the highest worker productivity in Washington in 1997 was in real estate, which was more than ten times the state average. This incredible figure probably related to the disproportionate number of self-employed individuals in the industry—individuals who are not picked up in the nonfarm employment numbers. It may also be indirectly attributable to the way in which real estate or property is valued as the figure may be further escalated by the inflationary characteristic of property values.

Basic utilities also tend to produce exceptionally high output values due to the relatively constant nature of their consumption. Moreover, utilities in general have led virtually all sectors in information technology investment—investments that have enabled them to reduce labor inputs (Allen, 1997). As such, Washington's electric, gas, and sanitary services industry

Figure 13
Worker Productivity by Industry
Washington State, 1997
Source: *Employment Security Department*

SIC	Industry	Output/ Worker
65	Real estate	$686,342
49	Electric, gas, and sanitary services	$234,852
48	Communications	$191,261
371	Motor vehicles and equipment	$119,955
	Federal government	$119,293
81	Legal services	$106,347
60-2	Finance	$102,486
28	Chemicals and allied products	$98,727
44	Water transportation	$95,773
63-4	Insurance	$93,261
73	Business services	$83,921
27	Paper and allied products	$77,055
33	Primary metal industries	$71,111
45	Transportation by air	$68,185
39	Miscellaneous manufacturing industries	$66,588
24	Lumber and wood products	$63,898
34	Fabricated metal products	$63,310
42	Trucking and warehousing	$61,962
36	Electronic and other electric equipment	$61,882
20	Food and kindred products	$61,542
32	Stone, clay, and glass products	$54,792
29	Petroleum and coal products	$52,679
37	Transportation Equipment	$52,475
80	Health services	$52,032
27	Printing and publishing	$51,564
72	Personal services	$50,937
372-3	Other transportation equipment	$49,318
25	Furniture and fixtures	$45,500
38	Instruments and related products	$45,417
70	Hotels and other lodging places	$42,787
	State and local government	$42,233
82	Educational services	$38,728
35	Industrial machinery and equipment	$35,881
79	Amusement and recreation services	$34,903
23	Apparel and other textile products	$25,248
83	Social services	$19,815
22	Textile mill products	$4,672
	Total	$68,572

also posted exceptionally high real dollar output per worker, followed by the communications industry. Other basic services like finance and insurance also ranked high in real dollar output per worker.

Motor vehicles and equipment, an industry dominated by heavy truck production in Washington, was the highest-ranking manufacturing sector. Chemicals and allied products, paper and allied products, and primary metal industries also posted higher than average worker productivity, though not exceedingly so. Many of the same industries posted among the highest real dollar output per worker at the national level as can be seen in *Figure 14.*

Washington's Laggards

In terms of the lowest real dollar output per worker in absolute terms, *Figure 13* reveals that textile mill products—which is notoriously low tech and labor intensive—had the lowest worker productivity in Washington in 1997. This was less than 7 percent of the statewide average. Apparel and other textile products, a companion to textile mill products, also came in near the bottom of the rankings. Other laggards in Washington's manufacturing sector were key industries like transportation equipment or, more specifically, other transportation equipment, which narrows the sector to aircraft and parts and ship and boat building and repairing. Industrial machinery and equipment (which includes computers and computer-related equipment) posted weak worker productivity numbers with instruments and related products and furniture and fixtures not much better.

In fact, labor intensive industries in general had the lowest levels of worker productivity, particularly those related to services and retail trade. Worker productivity in social services and educational services are examples. Tourism-related industries like amusement and recreation services and hotels and other lodging places also had lower than average worker productivity.

Figure 14 reveals that nationally, many of the same industries posted among the lowest levels of real dollar output per worker.

Figure 14
Worker Productivity by Industry
United States, 1997
Source: *Employment Security Department*

SIC	Industry	Output/ Worker
65	Real estate	$658,010
29	Petroleum and coal products	$249,582
49	Electric, gas, and sanitary services	$241,602
28	Chemicals and allied products	$153,325
372-3	Other transportation equipment	$141,187
60-2	Finance	$125,369
	Federal	$125,261
81	Legal services	$112,878
36	Electric and electronic equipment	$93,105
48	Communications	$92,618
63-4	Insurance	$86,856
371	Motor vehicles and equipment	$86,619
28	Paper and allied products	$80,507
33	Primary metal industries	$74,847
35	Machinery, except electrical	$74,543
37	Transportation Equipment	$73,736
44	Water transportation	$71,791
20	Food and kindred products	$70,295
34	Fabricated metal products	$67,136
45	Transportation by air	$65,640
38	Instruments and related products	$64,555
39	Miscellaneous manufacturing industries	$63,469
27	Printing and publishing	$63,370
	Transportation	$61,970
32	Stone, clay, and glass products	$60,918
42	Trucking and warehousing	$58,411
24	Lumber and wood products	$53,715
80	Health services	$47,420
73	Business services	$45,662
72	Personal services	$43,462
25	Furniture and fixtures	$43,175
79	Amusement and recreation services	$42,977
22	Textile mill products	$41,446
	State and local	$40,904
70	Hotels and other lodging places	$39,538
23	Apparel and other textile products	$34,489
82	Educational services	$29,247
83	Social services	$20,751
	Total	$66,109

State-Nation Disparity

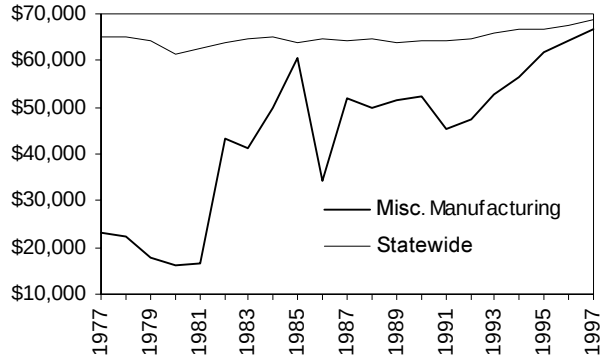
In comparing worker productivity for industries at the state and national levels in 1997 (*see Figures 13 and 14*), a number were polar opposites. Among those within which worker productivity in Washington was much higher than that nationally were water transportation and business services. The explanation is simple: both are key industries in Washington. Water transportation encompasses port and shipping activities, both of which operate at very sophisticated levels in a trade-dependent state like Washington. Business services encompasses software development generally and industry leader Microsoft specifically.

Industries within which worker productivity was much, much lower than nationally were electronic and electrical equipment, petroleum and coal products, and other transportation equipment. The reasons in this case are a little more complex. After all, two of those industries—electronic and electrical equipment and other transportation equipment—are key industries in Washington and should be comparable to their national counterparts. However, electronic and electrical equipment, which includes semiconductors, has been increasingly dominated by the industries in California and Texas. This has forced Washington's sector to hold is own while its counterparts in California and Texas boost output. Meanwhile, other transportation equipment, which includes aircraft and parts and industry leader Boeing, has been beset by weak worker productivity in Washington due to rapid-fire hiring from 1996-97. Petroleum and coal products is a little more straightforward. Energy resources of this type simply are not a major presence in Washington whereas they are key industries in many states (e.g., Texas, California, West Virginia, etc.) and for the nation as a whole.

Growing Productivity in Washington

Nearly 20 two-digit SIC coded industries revealed rising rates of worker productivity over the 1977-97 observation period. For the purposes of this report, however, six have been identified as having the most pronounced and consistent rates of increase: miscellaneous manufacturing, health services, motor vehicles and equipment, business services, insurance, and water transportation.

Figure 15
Worker Productivity in Miscellaneous Manufacturing
Washington State, 1977-1997
Source: *Employment Security Department*



Miscellaneous Manufacturing. This smorgasbord of a sector's overall productivity has yet to match, let alone surpass, the statewide average. Nevertheless, it recorded one of the strongest periods of productivity increase over the past 20 years which, on an annualized basis, averaged 5.4 percent a year (*see Figure 15*). As if to illustrate the many ways in which productivity growth can occur, the defining event behind the productivity gain in the state's miscellaneous manufacturing sector was the exit of a labor-intensive sporting goods manufacturer in 1981, which translated into a 38 percent increase in worker productivity from 1981-85. In other words, the sporting goods manufacturer was inefficient and, by extension, a drag on the sector's overall productivity, which is probably one of the reasons it went out of business. Worker productivity gains have been modest since then. All told, miscellaneous manufacturing has been the most impressive performer among all Washington sectors, thanks largely to elimination of an inefficient player.

Health Services. Worker productivity in Washington's health care sector remains well below the state average. Nevertheless, the sector posted a relatively healthy rate of worker productivity growth, notably during the 8-year period from 1986-94 when it rose 2.7 percent on an annualized basis (*see Figure 16 on the next page*). These gains corresponded with the increasing provision of health care services to the aging post-World War II generation as well as the multitude of Baby Boomers and offspring (Baby Boomlet) they spawned. At the same

Figure 16
Worker Productivity in Health Services
Washington State, 1977-1997
Source: *Employment Security Department*

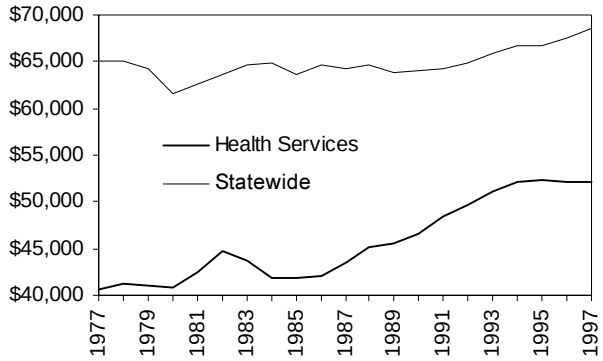
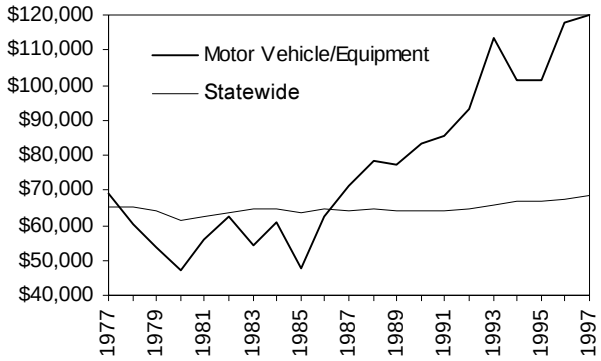


Figure 17
Worker Productivity in Motor Vehicles and Equipment
Washington State, 1977-1997
Source: *Employment Security Department*



time, the industry as a whole was beset by consolidation pressures as federal and state health care reform and the rise of health maintenance organizations (HMOs) and preferred provider organizations (PPOs) led to mergers, acquisitions, and partnership agreements in the mid- to late-1980s. The result of the coupling of these two forces was steady growth in worker productivity.

Though not yet reflected in current data, the federal Balanced Budget Act of 1997 could raise worker productivity over the short term. This is because health care providers are under tremendous pressure to serve a growing population of elderly at a lower rate of federal reimbursement for Medicare-related inpatient, outpatient, home health care, skilled nursing facilities, rehabilitation, psychiatric, and long-term care services. Anticipation of a short-term boost in worker productivity is based on the belief that most health care providers will attempt to serve this growing base while compensating for lower reimbursements by holding down labor costs, which should have the short-term effect of raising worker productivity.

Motor Vehicles and Equipment. Worker productivity in Washington's motor vehicles and equipment sector has risen dramatically since the mid-1980s (*see Figure 17*). During this period, the sector's real dollar output per worker more than doubled from 1985-97—moving from below to nearly twice the state average in the process. Though there are a number of establishments in the state's motor vehicle and equipment sector, the major player is PACCAR, Inc. which builds the Kenworth and Peterbuilt heavy truck line. PACCAR is one of the nation's preeminent manufacturers of tractor-trailers with a solid share of the domestic heavy truck market and a growing share of the foreign market, especially in Mexico and South America. Indeed, it was the global demand for heavy tractor-trailers during the latter half of the 1980s that led to a surge in output as well as employment in Washington's motor vehicle and equipment sector. Nevertheless, PACCAR's modern manufacturing processes enabled output to rise at a faster rate than employment, resulting in a relatively steady increase in worker productivity. This represents a pure form of productivity increase; that is, one driven by expansion in output and employment rather than one driven by employment cuts alone.

Business Services. Business services is comprised of a wide ranging mosaic of activities; everything from advertising to credit reporting and collection to direct mailing to duplicating services to building cleaning and maintenance to equipment rental and leasing to permanent and temporary job placement to software development and data processing to security.

Trends in Washington's business services industry—as elsewhere across the nation—are tied largely to business cycles. This was certainly evident in business services from 1977-97 where employment was essentially flat during the economic doldrums of the late 1970s and early 1980s and subsequently fueled by healthy expansion in virtually all of the state's industry sectors thereafter. This growth has been propelled by

the increasingly common practice of outsourcing work not directly tied to the good or service provided as well as the state's relatively broad-based labor shortage that has forced greater use of temporary help supply agencies. Of course, no assessment of the state's business services sector would be complete without mentioning the rapid growth in prepackaged software employment led by industry leader Microsoft Corporation, a company that did not emerge until the mid-1980s. Its emergence would significantly change the complexion of the business services sector as well as the worker productivity numbers.

The impact of the above mentioned factors can be seen in worker productivity trends for the state's business services sector from 1977-97 (*see Figure 18*). Worker productivity was flat to falling from the late-1970s through the mid-1980s as the state economy slid into severe recession in the pre-software era. The software effect is most evident from 1987-97 when worker productivity in the state's business services sector grew at a tremendous annual rate of 7.3 percent and real dollar output per worker more than doubled. This is not to suggest that growth in other aspects of business services did not contribute. However, only the software sector's output per worker is large enough to account for the much higher than average gains in productivity seen in this industry. Microsoft alone has propelled the sector's output into the stratosphere without a commensurate rate of increase in the number of workers (employment growth has been strong, but not stratospheric). While business services has experienced real worker productivity growth—that is, an expansion of both employment and output—it would be interesting to see what the numbers would look like if software (namely Microsoft) was excluded.

Insurance. Trends in Washington's insurance industry—like that nationally—is tied largely to business cycles. Economic growth and net population migration, for example, tend to translate into residential and commercial building activity which, in turn, heats up insurance activity as developers, homebuyers and businesses require underwriting. This was certainly the case in Washington, which has experienced a prolonged period of economic expansion and strong residential and commercial development since the mid-1980s. During this period, worker productivity grew at 5.5 percent annual rate from 1985-97, rising in the process from well below the state average to considerably above it (*see Figure 19*). The early 1990s ushered in a period of sluggish regional economic performance, but employment in the insurance industry held its own. Additional factors contributing to strong worker productivity are consolidation in the insurance industry, which has wrought what might be efficiency rather than long-term productivity gains, as well as the growing role of health insurance as a major factor.

Water Transportation. Water transportation includes foreign and domestic deep-sea transportation of freight, marine cargo handling, water-borne passenger transportation, barge services, tug services,

Figure 18
Worker Productivity in Business Services
Washington State, 1977-1997
Source: *Employment Security Department*

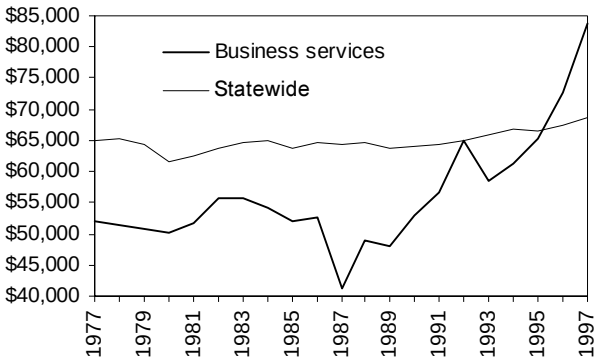
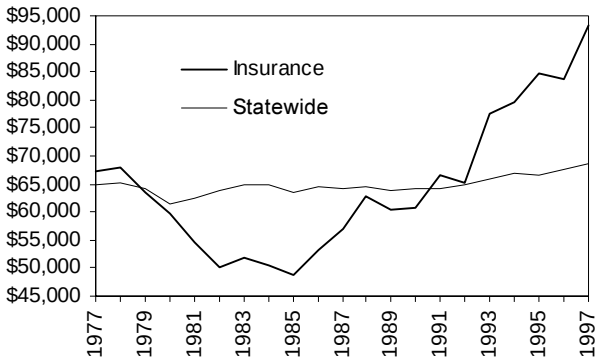


Figure 19
Worker Productivity in Insurance
Washington State, 1977-1997
Source: *Employment Security Department*



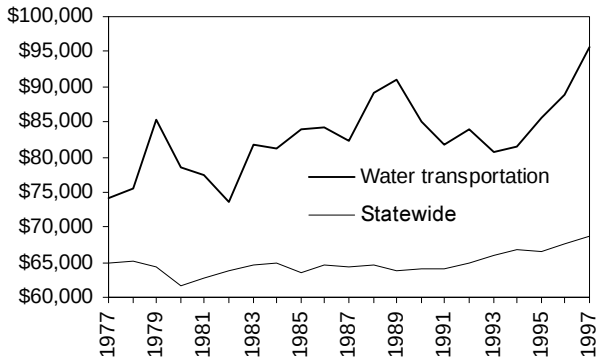
marinas, and other related services. Being situated on the Pacific Rim and having the Columbia-Snake waterway, Washington has a significant presence with respect to water transportation.

Containerization has, of course, made a tremendous difference in productivity. Indirectly, increasing investment in intermodal capacity has enabled ports to boost output while keeping labor costs in line, thus passing some of the savings on to the shipping companies. Newer, bigger ships loaded with modern technology have enabled shipping companies to boost cargo capacity (output) with minimal crew requirements (*see Figure 20*).

The labor required to conduct the entire range of contemporary shipping operations has shrunk phenomenally over the past 20 years. This shift has been particularly evident on both the docks and the high seas. The former has special significance in the greater Puget Sound region where ports are key players in the regional economy.

U.S. ports have been part of the downsizing, rightsizing, and re-engineering movement. The trend was accelerated greatly as port cargo shifted from break bulk to containers and intermodal transportation. The bulk of the impact fell on longshoremen. Gone are the days of manual loading and unloading of ships. The investment in new containers, ships, and technology changed all that. Today's equipment and technology enable longshoremen to handle three to four times the cargo their contemporaries did 20 years ago when loading and unloading required massive work gangs.

Figure 20
Worker Productivity in Water Transportation
Washington State, 1977-1997
Source: *Employment Security Department*



The market for merchant mariners and seamen has changed even more. The U.S. Merchant Marine Academy at Kings Point, NY graduates a class of officers each year, but there are no berths for the graduates. The imbalance is largely blamed on the recent disbanding of the Russian Merchant Navy, which flooded the labor market with highly trained and skilled Russians who were willing to work for considerably less pay than their American counterparts. The same is true with respect to the market for merchant mariners, most hailing from Third World countries. Additionally, today's container ships are longer, wider, deeper, and faster. Consequently, fewer runs are needed even though there is considerably more cargo being transported than in the past. These massive ships are so highly automated and computerized that they require fewer crew. As few as 17 crew are regarded as a full complement and most expect that number to be cut in half in the not too distant future.

Declining Productivity in Washington

More than a dozen two-digit SIC coded industries revealed declining rates of worker productivity over the 1977-97 observation period. For the purposes of this report, however, six have been identified as having the most pronounced and persistent rates of decline: primary metals, instruments and related products, air transportation, construction, other transportation equipment, and lumber and wood products.

Primary Metals. Trends in Washington's primary metals industry are driven by events in its primary aluminum sector—a sector initially drawn to this region by cheap Bonneville Power Administration electricity. The primary aluminum industry operates within a classic economic framework. It produces a single, uniform product (aluminum tested at 99.7 percent purity) whose price is established on the world market based on supply and demand for that product and at the margins by competition or substitute products and externalities.

From the late 1970s through the mid-1980s, the world aluminum market experienced universally weak supply and demand. The supply side, already glutted, was further weakened when Russia, starved for hard currency, further flooded the market with its cheap aluminum. The demand side was weakened by global recession that affected the U.S., Asia, and Europe. Here in the Northwest, externalities appeared in the form of increasing demands on a limited supply of electricity and measures designed to protect endangered salmon. As a result, real aluminum ingot prices went into a free fall from the late 1970s through the mid-1980s. This corresponded with the dramatic decline in worker productivity over the same period in Washington's primary metals industry which saw real dollar output per worker slide at an annual rate of 11 percent from 1977-85 (*see Figure 21*).

The aluminum industry mounted a rebound in the late 1980s on the strength of a global industrial expansion. Worker productivity rebounded as well, with real dollar output per worker rising at a 33 percent annualized clip. By the early 1990s, however, recession intervened and overall worker productivity fell again. The industry attempted yet another recovery after the recession of the early 1990s but that was cut short by the collapse of Asian markets. Worker productivity does not promise to improve so long as the state's primary metals industry remains bogged down by a prolonged labor-management dispute at Kaiser Aluminum Corporation that has idled 2,300 experienced workers and seen them largely replaced by less experienced and presumably less productive replacement workers.

Instruments and Related Products. Washington's instruments and related products industry is concentrated in engineering, scientific, medical, electronic, and aeronautical instruments and devices. This largely reflects the influence of aerospace and medical and biotechnology research on the industry.

In addition to fluctuating significantly over the past 20 years in what resembles a cyclical pattern, worker productivity in the state's instrument sector also lost ground as real dollar output per worker dropped well below the state average (*see Figure 22*). The interesting thing is, one would not necessarily pick that up from the employment data. From the mid-1970s through the late 1980s, instrument employment climbed from 2,800 in 1977 to 15,200 in 1989 at an annual rate of 20 percent, primarily on the strength of aerospace but also from medical and scientific instruments which were lifted by expansions in health care and the rise of medical and biotech research. However, there was a period of slow job growth and modest decline (-300) from 1984-86, to which worker productivity responded by plummeting at an annual rate of 69 percent.

Due to the cyclical downturn generally, and perhaps to aerospace production cuts and deferred medical equipment purchases (health care cost control) more specifically, instruments employment slid to 12,800 in 1994. This translated into declining worker productivity

Figure 21
Worker Productivity in Primary Metals
Washington State, 1977-1997
Source: *Employment Security Department*

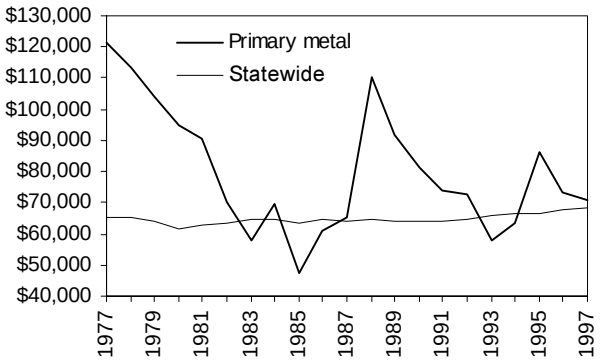
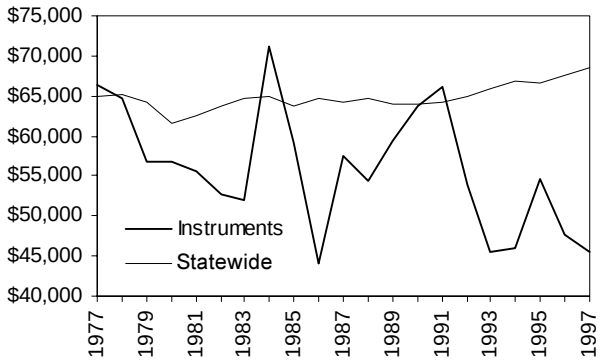


Figure 22
Worker Productivity in Instruments
Washington State, 1977-1997
Source: *Employment Security Department*



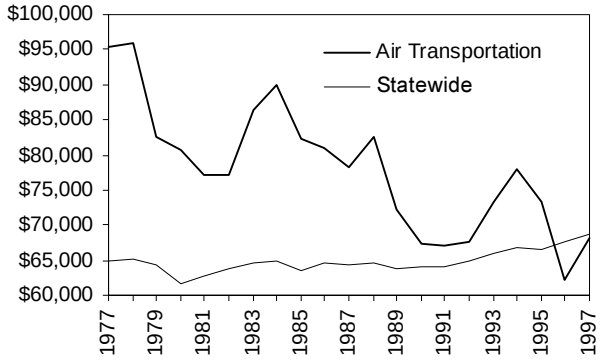
on the order of 11.5 percent from 1991-94. Employment in the sector has since mounted something of a rebound with employment rising to 14,400 in 1997 largely on the strength of its ties to aerospace. Worker productivity, however, did not respond in kind this time around and remained stagnant.

Air Transportation. Not to be confused with Boeing and its manufacturing activities, air transportation is an industry comprised of airlines, airports, cargo and freight companies, and a variety of support services. Here in Washington, the sector's activities revolve primarily around Alaska Airlines and its operations at Seattle-Tacoma International Airport, as well as companies like United Parcel Service, Federal Express, and Airborne Express.

The air transportation industry is cyclical, something readily apparent in the worker productivity trends (*see Figure 23*). As the nation's economy slowed and then fell into severe recession in the early 1980s, the state's air transportation industry saw its worker productivity decline at an annual rate of 7 percent from 1978-81. The latter half of the 1980s brought renewed growth in the air transportation sector as federal deregulation and an atmosphere of "one-ups-man-ship" prompted airlines to rapidly expand their operations. As profits soared, so too did worker productivity levels. Then the bubble burst.

Most domestic airlines, including Alaska Airlines, suffered record-breaking financial losses in the late 1980s and early 1990s as a combination of recession, the Gulf War, and rising fuel prices inflicted the worst operating losses in their history. Worker productivity fell at an annual rate of 4 percent from 1984-91. This was followed, in turn, by record earnings in the mid-1990s as global air travel and air commerce heated up. Washington's air transportation sector benefited inasmuch as the demand was concentrated in Asia, which had established routes to the state. The collapse of Asian markets shortly after put a damper on worker productivity, which by 1996-97 had fallen below the state average.

Figure 23
Worker Productivity in Air Transportation
Washington State, 1977-1997
Source: *Employment Security Department*



Because most of the airlines are now out of the red and profitable, labor expects management to make up the wages and benefit concessions that were granted during earlier fare wars and financial crises. Pilots, flight attendants, machinists and ground crews either have or will come up for contract renegotiations. As such, labor-management issues will likely affect worker productivity in the near term. Seattle-based Alaska Airlines is no exception. In April 1999, Alaska Airlines weathered a sick-out by ticket agents, gate agents and baggage handlers, prompting airline officials to cancel a contract negotiation meeting with the International Association of Machinists and Aerospace Workers, which represents ticket agents, gate attendants, and office workers. On other fronts, Alaska Airline's baggage handlers union has been negotiating unsuccessfully since August 31, 1997 for a new contract, even with the involvement of a federal mediator. Alaska Airlines mechanics joined the Aircraft Mechanics Fraternal Association, but their negotiations have also been unsuccessful, prompting them to request intervention by a federal mediator.

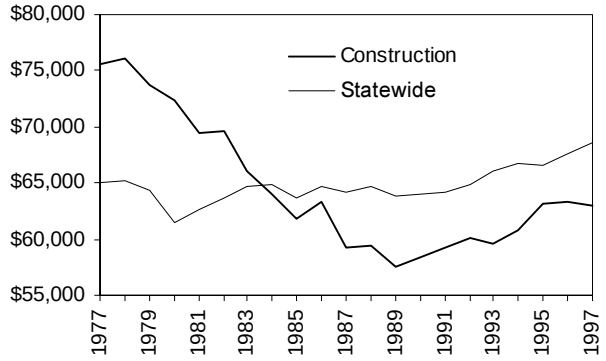
Construction. Truth be told, construction has historically been regarded as one of Washington's key industries in terms of worker productivity. Indeed, worker productivity at the outset of the observation period was well above the state average. This productivity was built on a series of landmark projects from hydroelectric dams (13) to world fairs (Seattle, Spokane) to nuclear sites (Hanford, WPPSS) to interstate highways (I-5, I-90) and more.

That construction can be found among the sectors with the weakest worker productivity trends in Washing-

ton is a consequence of the observation period having begun in 1977, which is coincident with the end of the era of landmark construction projects. Instead, worker productivity in Washington's construction industry fell at an annualized rate of 2.5 percent from 1978-89 to below the state average (*see Figure 24*). Figuring prominently in this period were the collapse of the Washington Public Power Supply System (WPPSS) nuclear construction projects and the severe recessions of the early 1980s, both of which sent productivity plummeting.

The sector's worker productivity slide was halted by a residential and commercial building boom (largely Puget Sound based) that has continued virtually unimpeded through the current period, thanks to a robust state economy coupled with low interest rates and low inflation nationally. This enabled the sector's worker productivity level to gradually climb. Ironically, the pace of construction activity has revealed a down side in terms of worker productivity as this labor-intensive sector's demand for workers rose amidst a regional labor shortage. As a result, the industry has increasingly had to hire workers with little construction experience—assuming it could find workers at all. The result has been low productivity as workers negotiated longer learning curves and as builders with labor shortages had to slow production. Either way, output suffered. Weather has been an added factor as an inordinately long winter and wet spring idled workers and further dampened output.

Figure 24
Worker Productivity in Construction
Washington State, 1977-1997
Source: *Employment Security Department*



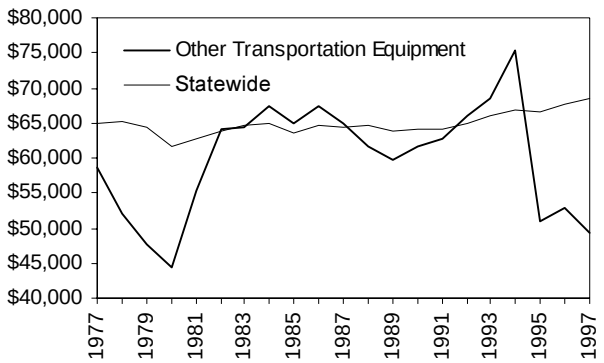
Other Transportation Equipment. Washington's other transportation equipment sector is made up primarily of aircraft and parts and ship and boat building and repairing. It is overwhelmingly dominated by aircraft and parts, however, so this analysis will focus on that sector, namely as represented by The Boeing Company and its subcontractors.

Washington's aircraft and parts industry is driven largely by economic business cycles. Those cyclical influences are evident in the industry's worker productivity trend over the past 20 years, though there is clearly a lag factor as productivity in the labor-intensive sector must negotiate a learning curve (*see Figure 25*).

When we pick up the worker productivity trend in 1977, it is already on a sharp downward path begun in 1974 with the onset of recession and intensified by oil embargo-related shocks. Over the previous several years, aircraft and parts employment had fallen 9,100 from 54,100 in 1974 to 45,000 by 1976. The events of that period would drive the sector's worker productivity level well below the state average.

The next up-cycle saw aircraft and parts employment rise at an annual rate of 20 percent to 79,600 by 1980. As the legions of new employees settled into their jobs, worker productivity rose at an annual rate of 21 percent from 1980-82, bringing it roughly back in line with the state average. The good times were short-lived, however, as severe recessions befell the economy and the aircraft and parts industry, which by 1983 resulted in 14,600 lost jobs and a paring back of employment to 65,000.

Figure 25
Worker Productivity in Other Transportation Equipment
Washington State, 1977-1997
Source: *Employment Security Department*



The latter half of the 1980s saw a surge in aircraft purchases as federal deregulation and noise and air quality standards and a strong economy prompted airlines to replace and expand their inventories. As plane orders and backlogs soared to record levels, aircraft and parts employment climbed at an annual rate of 9 percent to a record level of 116,300 by 1990.

Then came the crash. Recession, the Gulf War, and rising oil prices hit airlines hard, prompting them to cancel and/or delay orders which, in turn, caused the state's aircraft and parts industry to retrench. From its peak in 1990, aerospace employment contracted at an annual rate of 7 percent to 80,200 by 1995. All told, 36,100 workers lost their jobs. It didn't take long for the impact to cross over to worker productivity, which plunged 32 percent from 1994-95.

Just as quickly though, a new upcycle took root and aircraft and parts employment climbed once again, this time at a 14 percent annual rate to 104,600 by 1997. But something was different this time around. Worker productivity continued to fall. Boeing's hiring binge to keep pace with ambitious aircraft production schedules surely played a role as it has in the past. But Boeing has implemented a layoff strategy in the midst of this situation to help restore profits. The thrust is to see if worker productivity can be raised.

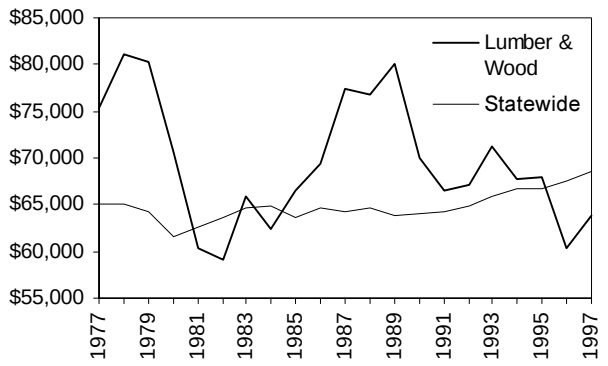
As mentioned, Washington's *other transportation equipment* sector also encompassed ship and boat building and repairing, an industry that saw employment decline from a peak of 14,300 in 1979 to 6,900 by 1997. Productivity has clearly lagged in this sector, as cited in a state-commissioned study by Prior/MarTech. Low productivity in the U.S. shipbuilding industry is an issue, largely due to inadequate investment in new technologies, automation, and worker training. For example, statistics show that Japanese shipyards produce at 20-23 manhours per commercial gross ton (MH/CGT) while the corresponding range for U.S. shipyards is 60-82 MH/CGT. Here in Washington, though, there is at least one prominent example of improved productivity. Since the early 1990s, Todd Shipyard has transformed itself from a "traditional" shipbuilder to one that embraces the use of new technologies and production methods. Chief among these changes is the modular construction technique imported from Japan that relies heavily on computerized design, production, and quality control and automated machinery and equipment.

Lumber and Wood Products. Washington's lumber and wood products industry is a study in structural change—change that has made it one of the most productive in the world. It has ambitiously pursued long-term productivity gains by substituting new equipment and technology for labor as opposed to short-term efficiency gains attained by cutting labor. While both cause dislocation, the latter boosts output while the former does not.

The state's lumber and wood products industry has taken a well-known beating over the past decade as timber supply constraints on federal forestland led to massive restructuring. The Asian market meltdown led to further dampening of output on top of an already lean employment base, which is pushing productivity down even further. Its flagging worker productivity is also closely aligned with its recent travails (*see Figure 26*).

In the 1970s, overseas sales of wood products rose significantly. From just over 42,000 in 1970, industry employment climbed to just over 55,000 by 1978. The gains would be short-lived, however, as structural and cyclical forces in the late 1970s through the mid-1980s triggered heavy losses that dropped employment to less than 40,000. This is reflected in the sector's worker productivity which fell at an annual rate of more than 7.5 percent from 1978-82.

Figure 26
Worker Productivity in Lumber & Wood Products
Washington State, 1977-1997
Source: *Employment Security Department*



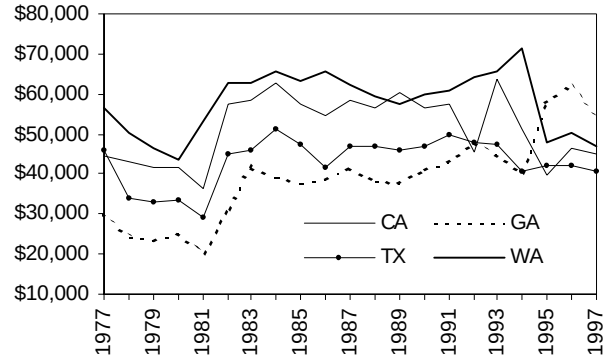
Evidence that Washington's lumber and wood products industry implemented real long-term productivity improvements, however, is revealed in the years that follow. Though the sector's employment base continued to erode through the latter half of the 1980s, worker productivity rebounded nearly to its previous high. The decade of the 1990s, however, has introduced an externality that even the high productive lumber and wood products industry could not overcome—court imposed timber supply constraints on public lands propelled by protection measures for endangered species, wildlife habitat preservation, and legal challenges to logging practices. With supply constrained, output fell dramatically—and with it the hard-earned worker productivity gains of the previous decade.

Key Industry Productivity Comparisons

While it is interesting to compare worker productivity trends in Washington industries against the statewide average, the critical test of an industry's productivity lies in how it compares to its competitors. While there are a number of reasons why workers in an industry in one state might be more or less productive than those in another, the disparities are usually tied to investment in new innovation or technologies or human capital. Toward that end, worker productivity for key industries in Washington was compared to that in similar industries in other states where those industries were known to be equally prominent. For the purposes of this study, only six were selected: other transportation equipment, food and kindred products, lumber and wood products, electronic and electrical equipment, industrial machinery and computer equipment, and business services.

Transportation Equipment. Worker productivity in Washington's transportation equipment industry (a proxy for aerospace) was compared to that in California, Georgia, and Texas (*see Figure 27*). Transportation equipment, especially aerospace, is a major industry in all four states, though California (to a certain extent), Georgia, and Texas tend to be dominated by military as opposed to commercial production. For the first 15 years of the 20-year observation period, worker productivity trends in all four states ran roughly in sync with

Figure 27
Worker Productivity in Transportation Equipment
Selected States, 1977-1997
Source: *Employment Security Department*



Washington's trend line effectively holding its position above those in the comparator states. This may well reflect the greater overall efficiency of Washington's commercially-driven transportation equipment sector compared to the government or military-driven nature of the sector in comparator states. That California, which had a major commercial presence in McDonnell Douglas, is right behind Washington lends weight to this theory. Around the mid-1990s, worker productivity fell significantly in Washington and California while it rose in Georgia and more or less held steady in Texas. For Washington and California, this reflects the sharp drop (not to mention cancellations and postponements) in commercial aircraft orders for Boeing and McDonnell Douglas, respectively, in the wake of a recession and the Gulf War, something Georgia and Texas with their military contracts did not face.

Food and Kindred Products. Worker productivity in Washington's food and kindred products industry was compared to that in California, New York, and Pennsylvania (*see Figure 28 on the next page*). The data show that worker productivity in Washington's food and kindred products industry has been lower than that in each of the comparator states over the 20-year observation period. A number of factors can account for this lower than expected level of worker productivity, including incidents of severe weather and the overall trade situation (which particularly affects states with large export markets for its processed food products). However, the largest factor at play in this case appears

Figure 28
Worker Productivity in Food and Kindred Products
Selected States, 1977-1997
Source: *Employment Security Department*

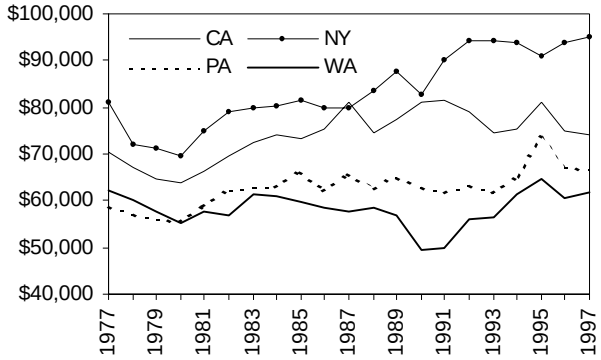
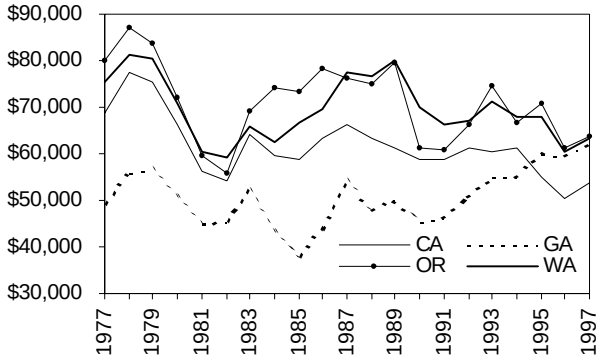


Figure 29
Worker Productivity in Lumber and Wood Products
Selected States, 1977-1997
Source: *Employment Security Department*

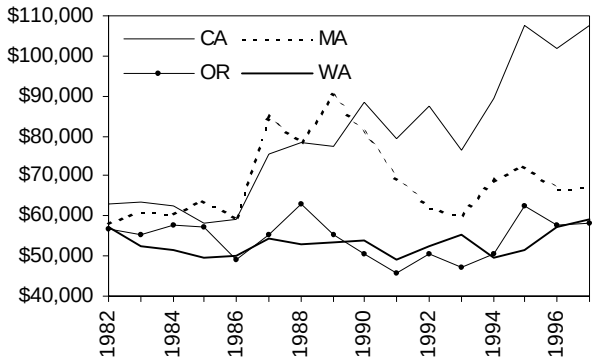


to be the nature of the food being processed. Here in Washington, many of the food products are relatively fragile fruits and vegetables. While technological innovation and advances are increasingly being introduced into the industry, a considerable degree of labor is still required in the production process.

Lumber and Wood Products. Worker productivity in Washington's lumber and wood products industry was compared to those in California, Georgia, and Oregon (*see Figure 29*). For the most part, the impact of business cycles is a constant that can be discerned to differing degrees in the productivity trends in all four states. That is where the similarities end. Worker productivity in Washington and Oregon marched virtually in lock step over the 20-year observation period, owed largely to the similarity of product (Douglas fir) and policies that affected the Pacific Northwest region (endangered species protection). Nevertheless, both consistently posted the highest worker productivity over the period compared to the other states. California's worker productivity trend line marched in step with those in Washington and Oregon until the early 1980s before setting off on a somewhat divergent path. That divergence was caused by a different set of national policies (timber lockup) that applied to a different product (redwood). Worker productivity in Georgia, meanwhile, was also much different due to its product (southern yellow pine). Also apparent is the disparate worker productivity trends over time between the western states and Georgia with the former declining while the latter has risen due to product differentiation.

Industrial Machinery and Computer Equipment. Worker productivity in Washington's industrial machinery and computer equipment industry was compared to that in California, Massachusetts, and Oregon (*see Figure 30*). All four states are home to key manufacturers of computers and computer-related equipment, a sector of the industrial machinery industry that is increasingly dominant. Viewed over a 15-year period from 1982-97, it should be noted that worker productivity in all four states was roughly at the same point in the early 1980s. The trends, however, began diverging as the states emerged from

Figure 30
Worker Productivity in Industrial Machines & Computer Eq.
Selected States, 1982-1997
Source: *Employment Security Department*



recession. Worker productivity in Washington and Oregon's industrial machinery and computer equipment sectors continued to hold within a relatively narrow band over time. Massachusetts saw worker productivity in its industrial machinery and computer equipment sector rise sharply in the latter half of the 1980s (the so-called "Massachusetts Miracle"), only to come crashing back down in the early 1990s. Worker productivity in California's industrial machinery and computer equipment sector rose in concert with Massachusetts' during the latter half of the 1980s and kept on climbing through 1997. California's industrial machinery and computer equipment sector is clearly head and shoulders above the rest with its sector expanding both output and employment while the comparator states have seen both categories rise and fall.

Electronic and Electrical Equipment. Worker productivity in Washington's electronic and electrical equipment industry was compared to that in California, Massachusetts, and Texas (*see Figure 31*). All four states are home to numerous key producers of electronic components, but especially semiconductors, a driving force in the computer age. As was the case with industrial machinery and computer equipment, worker productivity in all four states was also around the same point at the beginning of the observation period in the late 1970s. In fact, the electronic and electrical equipment sector in all four states marched largely in step into the late 1980s with only modest productivity gains. As the 1990s unfolded, however, the industry began to separate into "winners" and "losers." "Winners" were largely associated with the sector's high value-added research and development activities while "losers" were largely associated with low margin manufacturing and assembly. The woes of the latter were compounded in particular by an over-supply of semiconductors on the world market. Worker productivity in Washington's electronic and electrical equipment industry, which is dominated by manufacturing and assembly, continued to lag, leaving it bringing up the rear in the four-state comparison. California, Texas, and Massachusetts, meanwhile, saw worker productivity in their electronic and electrical equipment sectors rise dramatically. Some believe that worker productivity in Washington's electronics industry could rebound, since a shake out eliminated marginal players and Intel plans to invest heavily in research and development at its Du Pont, Washington facility.

Business Services. Worker productivity in Washington's business services industry was compared to that in California, Massachusetts, and Texas (*see Figure 32*). Though business services is a diverse industry, it was used as a proxy for software and computer services, which is a dominant player in the sector in the four states being compared. Viewed over roughly a decade from 1988-97, worker productivity in the business services sector has increased only modestly in all of the states except Washington. Worker productivity in Texas' business services sector remained relatively low while that in California and Massachusetts

Figure 31
Worker Productivity in Electrical & Electronic Equipment
Selected States, 1977-1997
Source: *Employment Security Department*

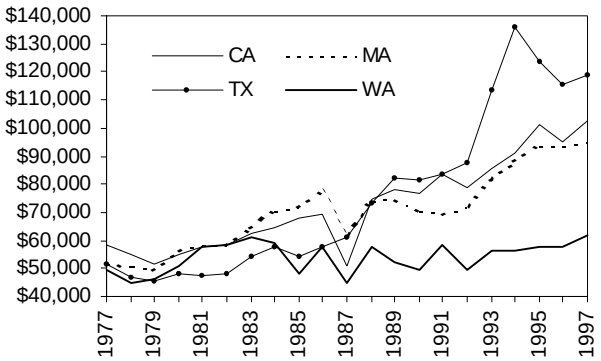
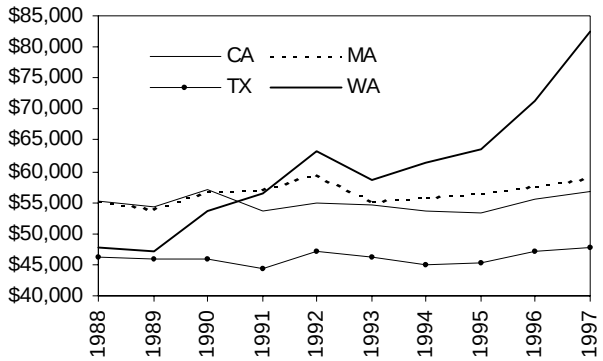


Figure 32
Worker Productivity in Business Services
Selected States, 1988-1997
Source: *Employment Security Department*



was only a little higher. Worker productivity in Washington's business services sector, on the other hand, rose at a very healthy clip over the period. The same dynamics appear to be at work here as were evident in the semiconductor industry. Only in this case, Washington's business services sector, buoyed by Microsoft, carried the day with both output and employment expanding strongly as Microsoft established the standard for computer operating language and business-related software programs.

Productivity, Technology, and the New Economy

Proponents of the *New Economy* theory believe that the U.S. has entered a period where economic growth will register at 4 percent to 5 percent a year. It is commonly held that that new era will be propelled largely by technology enhancements that improve productivity by leaps and bounds. This is a commonly held belief, yes. *But is it true?* Based on an accumulating wealth of research, most economists say *no*—at least not yet. (Allen, 1997; Baker, 1998; Carlson and Schweitzer, 1998; Oliner and Wascher, 1995; Sichel, 1999; Roach, 1998; Triplett, 1999)

Undermeasuring Computer Productivity. Though New Economy theorists believe the U.S. has already entered this new era, there is nothing in the official productivity data to support their claim. The data show dramatic productivity gains in the production of computers, but little from the use of computers. This has given rise to the so-called *productivity paradox*, which is the puzzle of weak productivity growth amidst myriad technological advances of the computer age. For New Economy advocates, the culprit is undermeasurement by government agencies that do not accurately account for the productivity gains reaped by technology.

Under-measurement is without question an issue, particularly with respect to the services sector where computer use is arguably the greatest and where computer software development is counted. A main critique is that productivity data do not adequately capture the conveniences provided to consumers by virtue of technology or the better working conditions provided to workers by virtue of technology. Economists Martin N. Bailey and Robert J. Gordon (1988) found that computers do indeed raise productivity, though their calculations pegged the impact at 0.5 percentage points—not nearly enough to account for the undermeasured growth that would propel productivity growth into the 4 percent to 5 percent range where New Economy advocates believe it should be.

Brookings Institution economist Jack E. Triplett noted that to have an impact on productivity, the *rate* of new technology innovations and introductions must be increasing at a rate that is higher than in the past, rather than simply increasing in number. He concedes that the latter is evident, but the former is not. Triplett argues that the belief that productivity growth has been understated because of mismeasurement has gained acceptance partly because observers have been incorrectly counting new technology enhancements on an arithmetic scale rather than on a logarithmic scale.

Rather than assume that the productivity slowdown can be accounted for through "missing" productivity data from technology improvements, a number of economists are taking a hard look at the way computers are used. Federal Reserve economists Stephen Oliner and William Wascher found that given the increasing availability of low-cost computing power, computers are now used in low-end activities that generate little revenue—something that would not have been justifiable on a cost basis in the past. For example, most desks now have a computer, though it is often used for relatively mundane tasks like word processing or e-mail—provided it isn't sitting idle. This suggests capacity under-utilization, not only of computers, but also of workers who have not been trained to exploit a computer's full potential. Oliner and Wascher ultimately concluded that the vast majority of computers are unproductive based on the standard that matters most—the share of revenue they generate.

Morgan Stanley Dean Witter chief economist Stephen Roach came to a similar conclusion (1998). In terms of capital-labor substitution, he questioned the notion that productivity gains automatically stemmed from investment in information technology, especially for knowledge-based workers. He conceded that capital-labor substitution worked for low-end tasks, citing

back-office consolidation as evidence, but felt that it was not a viable strategy for high-end, knowledge-based tasks where labor input tended to be cerebral and much more difficult to replace with a machine. He argued that barring breakthroughs in artificial intelligence or genetically-based reprogramming of the human brain, productivity breakthroughs in knowledge-based tasks would be scarce in the labor-intensive white-collar industries. Furthermore, while acknowledging the impressive advances in computational speed, miniaturization, networking, and the Internet, he questioned whether those advances truly boosted productivity as opposed to merely offering workers new ways of doing old things. Moreover, he questioned whether the new technologies were simply extended working days, enabling workers to produce more output by staying online longer—that is, working longer, not smarter. On this point, he underscores that sustained productivity growth is not about working longer, but rather about adding more value per unit of work time (see *Inefficiency Masquerading as Productivity*). For these and other reasons, Roach regards the linkages between information technology and sustained productivity gains as elusive.

Premature Measurement. For many, the hypotheses originally developed by economic historian Paul David have a certain ring of truth. David argued in the late 1980s and early 1990s that new technology disperses or diffuses gradually because it takes a while for prospective users to find practical applications for the technology and subsequently acquire the skills and competencies necessary to effectively use that technology on an economy-wide scale. Approximately a decade after David issued his hypotheses, the recent pickup in productivity strikes some as emerging evidence that businesses are finally reaping the long-awaited benefits of information technology. Mindful that David's theories may prove correct, many economists hedge their pronouncements that technology has not had a significant impact on productivity with the proverbial "*at least not yet*."

Computers as a Share of Capital Stock. A statistical certainty is that computers represent an extremely modest share of net business capital stock. Following up on earlier research by Oliner (1994) and Sichel (1994), Oliner and Wascher (1995) found that despite the rapid growth in computer investment over the past 25 years, computers accounted for less than 2 percent of the net business (or nonresidential) capital stock in the U.S. This seeming contradiction is explained by the fact that computers become obsolete very quickly, meaning that investment in new computers usually aims to replace rather than add to the existing stock. The bottom line is that computers are not prevalent enough in the economy to have generated much increase in the growth of aggregate productivity.

Additionally, Oliner and Wascher found that contrary to the conventional belief that U.S. businesses have invested in computers at an unprecedented rate in recent years, the 1990s were neither a period of exceptional computer investment nor of particularly dramatic declines in computer prices. Indeed, they assert that the 1970s saw the most explosive growth of computer investment over the past quarter century. This is consistent with the argument that more businesses would have been "computer naïve" in the 1970s than in the 1990s and thus more appropriate candidates for truly revolutionary computerization of their operations.

Does Not Compute. Ultimately, there is little evidence that computers have made much of a difference in the U.S. economy's aggregate output. This is because in terms of national output, the ultimate measure of a product's impact remains its ability to produce revenue. Whatever else it can or cannot do is irrelevant from an economic standpoint. Federal Reserve economist Daniel Sichel (1999) perhaps summed it all up when, in a twist on economist Robert Solow's famed utterance, he wrote that "computers weren't in the productivity statistics because computers weren't everywhere." Rather than computers, telecommunications is perhaps a more appropriate example of technology that has precipitated concrete productivity growth.

Mistaking Efficiency for Productivity

Stephen Roach, chief economist for Morgan Stanley Dean Witter, is a leading voice among those who contest the claim that corporate downsizing (e.g., layoffs, plant closings, outsourcing, etc.) in the 1990s produced

meaningful growth in U.S. labor productivity. To him, meaningful means *sustainable*.

Roach acknowledges that rising profits, sustained low inflation, greater competitiveness, and a soaring stock market improved U.S. business efficiency. He even concedes that in the short run, these efficiency gains showed up as improvements in measured productivity. He contends, however, that a short-term strategy like downsizing which requires making do with less cannot produce *sustained* gains in productivity and that there is no theoretical or empirical evidence that downsizing has ever boosted long-term productivity.

Sustained or long-term productivity growth, in Roach's view, requires getting more out of more by investing in innovation and human capital and gaining greater leverage from the expanding base of labor and capital that results. Indeed, he sees corporate America's fixation with downsizing as an impediment to long-term productivity growth because downsizing is in direct conflict with the increased capacity demands (hiring/rehiring workers and building/expanding facilities) that are critical to promoting sustained productivity growth.

As evidence that the decade's growth in measured productivity has, in fact, been short-term efficiency gains rather than long-term productivity gains, Roach posits that if the productivity gains were sustainable (i.e., tied to improvements in the quality of labor), they would have generated substantial increases in worker compensation. He bases this view on one of the basic foundations of economics: that workers are paid according to their productivity. However, since the profits of the 1990s flowed largely to the owners of capital rather than workers (as evidenced by nearly 20 years of real wage stagnation and a widening income distribution gap), he believes that we have experienced efficiency gains rather than sustainable increases in productivity. He also points to the tremendous rate of job growth over the past five years, arguing that if the U.S. economy were truly entering an era of sustained productivity gains, there would be a more efficient relationship between labor and output. Furthermore, the nation's jobless rate would not have fallen to a 30-year low. The fact is that today's economy reflects fundamental relationships that would not be evident if this were truly a sustained period of productivity growth. Finally, he also points out that periods of rising productivity have historically been associated with increasing employment and that from a theoretical point of view, only in a world of fixed output and capital stock would work force downsizing be necessary to boost productivity.

Ultimately, Roach argues that one needs to distinguish between long-term productivity growth and short-term efficiency gains, recognizing that one is sustainable and the other is not. A timely example of this here in Washington is the year-long labor dispute between nearly 2,300 union steelworkers and Kaiser Aluminum & Chemical Corporation. Negotiations have stalled over the company's demands that 239 jobs be outsourced to non-union subcontractors to help it achieve what it calls productivity goals. Roach would argue that Kaiser is inappropriately using the term "productivity" to describe what are in fact short-term efficiency goals. In the end, Roach turns to the words of Robert Solow, who once wrote, "Productivity growth is a better way to produce leading to a better way to produce. And downsizing is not that."

Inefficiency Masquerading as Productivity

Economists have largely dismissed claims that mismeasurement in official government statistical programs have failed to capture the increased output attributable to information technology. Stephen Roach sees a more pressing mismeasurement problem in the underreporting of *hours worked*—a key component in calculating labor productivity. He believes that white-collar workers in particular are "on the job" much longer than the official data suggest, thanks to the growing amount of work that can be done away from the office via tools of the Information Age: the Internet, laptop computers, fax machines, cell phones, and pagers. If true, it would mean that productivity is overstated. This is because productivity is about delivering more output per unit of work time and not about putting in more (unmeasured) time on the job.

Roach sees this trend as a further anathema to enhanced productivity because much of this increased

work is being done at the expense of leisure time. This threatens the most basic and powerful benefit of an improvement in productivity—an increase in one's standard of living. Improvement in living standards appears to be fading for white-collar workers in the Information Age as the line between work time and personal time blurs and the work-leisure tradeoff puts increasing stress on family and personal priorities.

Useful Applications for Productivity Data

Beyond the theoretical discussion of worker productivity are a number of practical applications:

- Worker productivity data, an economic indicator and one of the broadest measures of economic growth, can be used to analyze the current economic situation both statewide and by industry.
- Worker productivity data can help those implementing the Workforce Investment Act to evaluate progress toward their goal of helping entrants into the work force secure better wages and higher standards of living.
- Worker productivity data can help career and vocational counselors to ascertain which industries have high or low productivity or rising or declining productivity, especially in terms of labor supply and demand and advise their clients appropriately.
- Worker productivity data can help managers determine if long-term productivity trends in their industry have been positive or negative and, if the latter, determine if additional investment in capital stock or human capital is warranted.
- Worker productivity data can help human resource managers to review their industry's compensation structure and determine whether or not its workers have shared in the benefits of any productivity increases.
- Worker productivity data can help researchers studying the relationships between productivity, wages, prices, and employment.
- Worker productivity data can help economic development officials and planners determine if a particular industry is viable on its own merits or in comparison to those in other areas.

Are We Truly Productive?

An analysis of national labor productivity data and state worker productivity data essentially confirms what has been presented in the literature: productivity has been more or less stagnant over the past couple of decades. On the up side, productivity has clearly risen recently, though the jury is still out as to whether these gains were driven by short-term efficiency measures or long-term productivity gains. Nevertheless, the U.S. economy has responded quite favorably to rising productivity (whatever its foundation) by producing sustained real growth in an environment of low price and wage inflation.

As economist Stephen Roach (1996) wrote, "There are no shortcuts to raising long-term trends in productivity growth. Most agree that such growth comes from accelerated technological innovation combined with improvement in the quality of the work force." In this respect, the jury is still out. That is certainly the case in Washington where there is evidence of both short-term efficiency gains and long-term productivity gains. Regardless, the official U.S. labor productivity measures have clearly picked up on an upturn in productivity, though it remains to be seen whether this is sustainable or not. This lack of consensus can also be discerned in the U.S. labor productivity forecasts generated by DRI McGraw-Hill for the 1999-2023 period which show an optimistic annual growth rate of 1.8 percent and a pessimistic annual growth rate of 1.2 percent. Ultimately, U.S. industries know what it takes to achieve lasting productivity growth and whether and how they choose to pursue it will be watched with great interest.

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