The Industrial Evolution:

Two Decades of Change in the Philadelphia Metro Area's Economy

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EXECUTIVE SUMMARY

The longest peacetime economic expansions in U.S. history set the pace for the last 20 years of the 20th century and carried it into the 21st. The region's economy has grown along with the nation's, but the national economy expanded more. In the 1980s and 1990s employment and total income expanded faster in the nation than in the Philadelphia metropolitan area. But by some measures of personal well-being — per capita income and the unemployment rate — Philadelphia did better than the nation and many other large metropolitan areas.

Both the nation and the region continued to shift their focus from the production of goods to the production of services. Accompanying this industrial evolution has been a shift in the kinds of occupations Americans undertake. More and more jobs have greater educational and training requirements than in the past. This is especially true for jobs in metropolitan areas like Philadelphia. The recent economic expansion came to an end in March 2001, but in the current slowdown and in the next expansion, the long-term trends are likely to continue.

- **The shift to services has been more dramatic in Philadelphia and most other large metro areas than in the nation.**

  Growth in the Philadelphia region has been concentrated in nonfinancial services, especially health and business support services. Philadelphia has long had a strong health services sector, but business support services, though average vis-à-vis the nation, have not played as large a role in Philadelphia as they have in most other large metropolitan areas. This fact presents a challenge for the region in maintaining its position as a knowledge-based economy. Unfortunately for Philadelphia, the shift to services has been driven as much by a decline in goods-producing industries, primarily manufacturing, as by growth in services.

- **Philadelphia, like most large metro areas, has a larger share of workers in knowledge-based occupations than the nation as a whole.**

  The region even has a greater share of jobs in knowledge-based occupations than many other large metropolitan statistical areas. Having a larger proportion of workers in knowledge occupations—professional and managerial occupations that require a bachelor's degree or even higher education—bolsters personal economic well-being in the area. Highly educated workers have higher incomes and lower unemployment rates than less educated workers.

- **The shift to service industries and knowledge-based occupations is projected to continue.**

  Nonfinancial service industries will continue to grow as a share of output and employment, but not necessarily those nonfinancial services that have large shares in Philadelphia. The knowledge-based industries and occupations that will grow fastest in the current decade are in business support services, especially computer-related services, but Philadelphia does not have a greater share of these industries and occupations than other metro areas. Philadelphia does have a greater share of jobs in health care than most large metro areas. But the types of jobs in health care are likely to shift in the coming years, and Philadelphia's health-care industry will have to accommodate those shifts.

- **Philadelphia needs to be attractive to knowledge-based firms and workers.**

  Key elements for growth of a local knowledge-based economy are research and development activity, availability of venture capital, convenient transportation, access to business services, an educated labor force, and positive quality-of-life attributes. Philadelphia scores well on some of these factors but less well than many other metro areas on others. To compete as a center for knowledge-based economic growth, the region needs to focus its development policies on these critical factors.

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THE INDUSTRIAL EVOLUTION: Two Decades of Change In the Philadelphia Metro Area's Economy

The final 20 years of the last century began with back-to-back recessions (1980, 1981-82), but these years also included the two longest peacetime economic expansions in American history. The expansion that began in 1991, the longest on record, ended in March 2001. The long economic expansions and infrequent recessions of the past two decades were accompanied by major changes in the structure of the national economy.[1] And these changes will likely continue through the current slowdown and beyond. The industrial structure has been altered by advances in technology that have resulted in new and transformed products and services and in new methods of production. Changes have also come about as a result of demographic trends and shifts in the kinds of goods and services demanded by consumers. The economies of the nation's metropolitan areas have been subject to this broad evolution, but local economies have also experienced individual changes in their industrial and occupational structures. This report compares the changes in Philadelphia's economy over the past 20 years with the changes in the national economy and the economies of 13 other large metropolitan areas.[2] The metropolitan areas in the comparison group are the 10 largest metro areas in the country, including Philadelphia, and the other metro areas in the Northeast and Midwest with populations greater than 2 million.[3]

The Region's Economy Has Grown at a Modest Pace

The economy of the Philadelphia metropolitan area has expanded along with the national economy, but economic growth in the region has lagged growth in the nation. Personal income (adjusted for inflation) and payroll employment have both grown more slowly in Philadelphia than in the nation over the past 20 years (Figure 1). However, because the population and labor force in the region grew at less than half the national rate in the 1980s and 1990s, the metropolitan area's unemployment rate has generally been at or below the national average (Figure 2).

Although the Philadelphia area lagged the nation in overall growth, it surpassed the U.S. and many other large metropolitan areas in some important measures of personal well-being. Per capita income in the Philadelphia metropolitan area was 14 percent above the U. S. average in 1999 (latest local data available), and it was sixth highest among the 14 large metropolitan areas in our comparison

[1] Both recessions and expansions play a role in this restructuring. Firms often use slow periods to retrain workers and upgrade equipment in order to better position themselves for ensuing economic upturns. See Sill, 1998.

[2] The Philadelphia metropolitan area consists of five counties in Pennsylvania—Bucks, Chester, Delaware, Philadelphia, Montgomery—and four counties in New Jersey—Burlington, Camden, Gloucester, Salem.

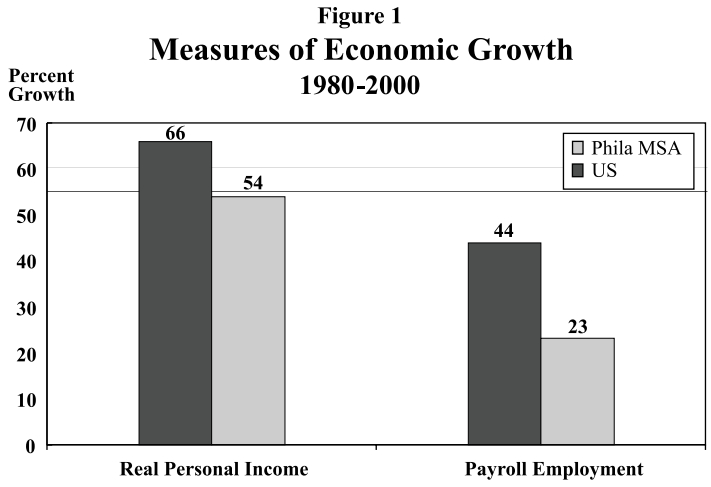
[3] Philadelphia is the fourth largest metropolitan area in the nation. The other nine largest are Los Angeles, New York, Chicago, Washington, Detroit, Houston, Atlanta, Dallas, and Boston. The other metro areas in the Northeast and Midwest with populations greater than 2 million are St. Louis, Baltimore, Pittsburgh, and Cleveland.

group. Since 1980 per capita income in the Philadelphia region grew faster than the national average and faster than per capita income in most other metro areas in our comparison group. Only Boston, New York, and Atlanta had greater per capita income growth (Figure 3). Personal economic well-being in the region has been sustained at a high level in part by the restructuring of the region's economy. The restructuring of the Philadelphia area economy reflects the broad features of the restructuring that has taken place in the national economy, but there are some important differences as well.

The Economy Has Shifted from Goods to Services in the Nation and the Region

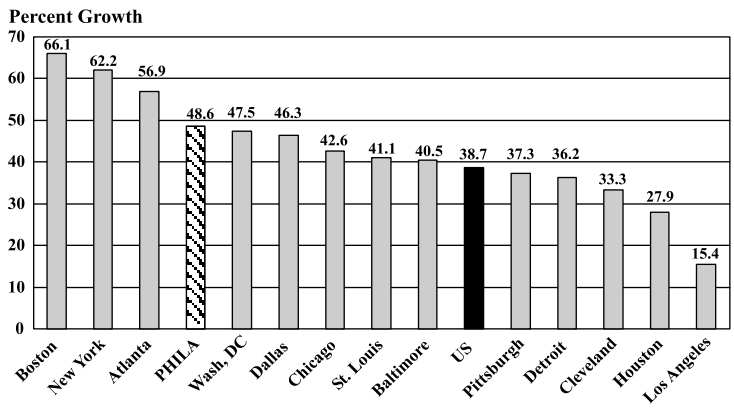
The economic growth of the last two decades has been accompanied by an evolution of the national economy away from the production of goods to the provision of services (Nakamura, 2000). This process began well before 1980, but between 1980 and 2000, services became a larger share of gross domestic product (GDP) than goods. In 1980 the production of goods accounted for 54 percent of GDP, and services accounted for the other 46 percent. By 2000 those shares were reversed.[4] A more detailed breakdown of output in the goods and service-producing industries is available in the estimates of gross product at the state level. (See *The Changing Composition of Gross State Product*.)

[4] In the Bureau of Labor Statistics' Standard Industrial Classification System (SICS), the goods-producing industries include agriculture, manufacturing, construction, and mining. The service-producing industries are trade, transportation and utilities, financial services (including banking, investing, insurance, and real estate), private nonfinancial services (including health care, business support services, and engineering, accounting, and management services), and government services. A new classification scheme, the North American Industry Classification System (NAICS), is being implemented, but complete statistical coverage by NAICS is not yet available so we use SICS.



Source: Bureau of Economic Analysis and Bureau of Labor Statistics

Source: Bureau of Labor Statistics



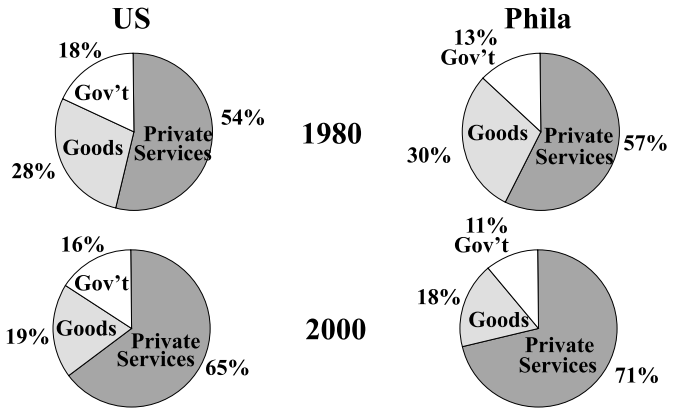
Source: Bureau of Economic Analysis

We do not have data on output for metropolitan areas that can be compared with national gross domestic product or gross state product. But we do have statistics on nonfarm employment and earnings that allow us to compare metropolitan areas with one another and with the nation as a whole. The trend toward a greater share of output in services and a smaller share in goods has been paralleled by similar trends in employment and earnings.[5]

The structural shifts in the economy over the past two decades were more pronounced in the Philadelphia metropolitan area than in the nation. The share of jobs and earnings in private service-producing industries rose nearly 14 percentage points in Philadelphia versus 11 to 12 in the nation (Figures 4a and b). In both the U.S and Philadelphia the private service-producing sector increased its share of total employment and earnings primarily at the expense of the goods-producing sector. Government's share of jobs and earnings fell in both the region and the nation. From 1980 to 2000 government employment declined from 13 percent to 11 percent of total employment in Philadelphia and from 18 percent to 16 percent in the nation. The Philadelphia economy was more oriented to private service production than the nation in 1980, and it became even more service oriented by 2000.

Figure 4a

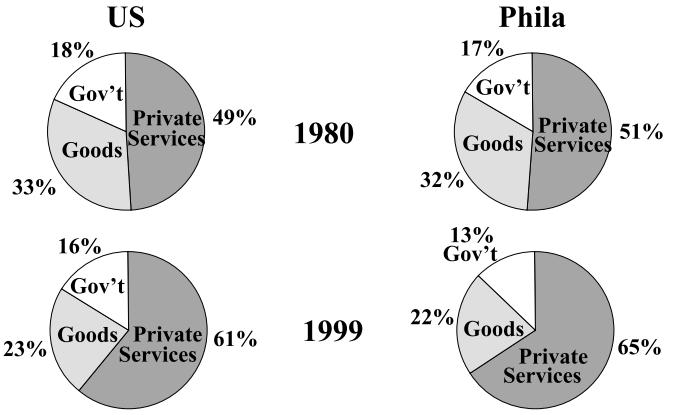
Shares of Nonfarm Employment 1980 and 2000



Source: Bureau of Labor Statistics

Figure 4b

Shares of Nonfarm Earnings 1980 and 1999



Source: Bureau of Economic Analysis

Philadelphia is not unique in its orientation toward the service industries; most large metropolitan areas have a higher share of employment and earnings in private service-producing industries than the national average. So how does Philadelphia compare with other large metropolitan areas? Among the 14 metropolitan areas in our comparison group, Philadelphia ranks fifth behind New York, Boston, Atlanta, and Pittsburgh in the percentage of jobs in the private service-producing industries (Figure 5a), and it ranks seventh in the percentage of earnings in the service-producing sector (Figure 5b). The shift to private service-producing industries was more pronounced in Philadelphia than in most of the metro areas in our comparison group. The share of Philadelphia's employment in the private service-producing industries increased 13.5 percentage points in the last 20 years, and the share of earnings in the region increased 14.5 percentage points.[6]

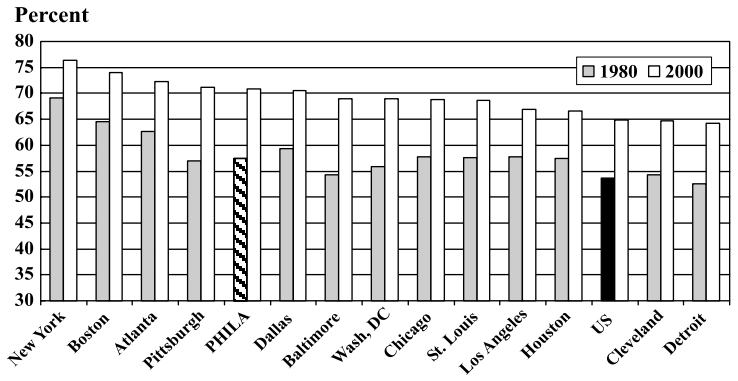
Unfortunately for Philadelphia and most other large metropolitan areas in the country, the shift in industrial structure has not been the result of faster-than-average growth in the private service-producing industries. For many large

[5] Earnings include wages and salaries, other labor income, such as employers' contributions to health insurance and retirement plans, and proprietors' income. The share of earnings in the private service-producing sector is smaller than the share of jobs because average wages and salaries are lower in those industries despite the fact that some service industries have very high wages and salaries. In Philadelphia wages and salaries are higher than the national average in both the goods- and service-producing sectors. The differential in the goods-producing sector is higher than the differential in the service-producing sector.

Figure 5a

Percent of Employment in Private Service-Producing Industries

1980 and 2000

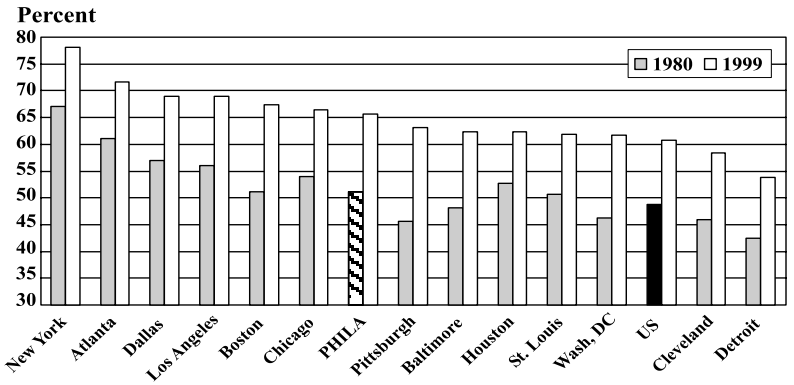


Source: Bureau of Labor Statistics

Figure 5b

Percent of Earnings in Private Service-Producing Industries

1980 and 1999



Source: Bureau of Economic Analysis

metropolitan areas, including Philadelphia, the shift in industrial structure has resulted from a combination of (1) slow growth or decline in goods-producing jobs, especially in manufacturing, and (2) relatively better, but still slower-than-average, growth of private service-producing jobs, especially in nonfinancial services. Only three of the 14 metropolitan areas in our comparison group (Atlanta, Dallas, and Washington, DC) had faster growth than the nation in private service-producing jobs between 1980 and 2000. These three were also the only ones to have gains in manufacturing jobs, and the only three to have faster overall employment growth than the nation. For the remainder of the metro areas in our comparison group the slower-than-average overall job growth is part of a general pattern over the last half century in which most large, dense metropolitan areas grew more slowly than small, less dense ones (Carlino and Chatterjee, 2001).

Decline in Goods-Producing Industries. In major metropolitan areas, including Philadelphia, trends in the goods-producing sector are driven by manufacturing. There is little mining or agriculture in the large metro areas in this country, and the rise in construction both nationally and locally between 1980 and 2000 had a strong cyclical component.

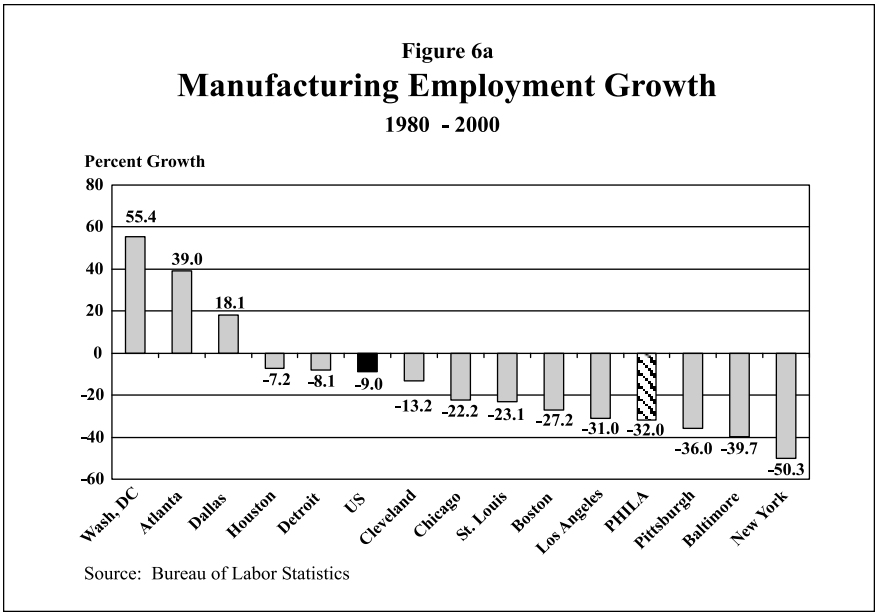
Manufacturing. For many years manufacturing employment in this country has declined even as output has increased. Productivity in the manufacturing sector since 1980 has risen twice as fast as overall productivity, permitting expanded output with fewer workers.[7] Manufacturing employment declined 9 percent in the United States, but output rose about 86 percent from 1980 to 2000. Real earnings —that is, earnings adjusted for inflation— increased 7 percent from 1980 to 1999 because of increased productivity.

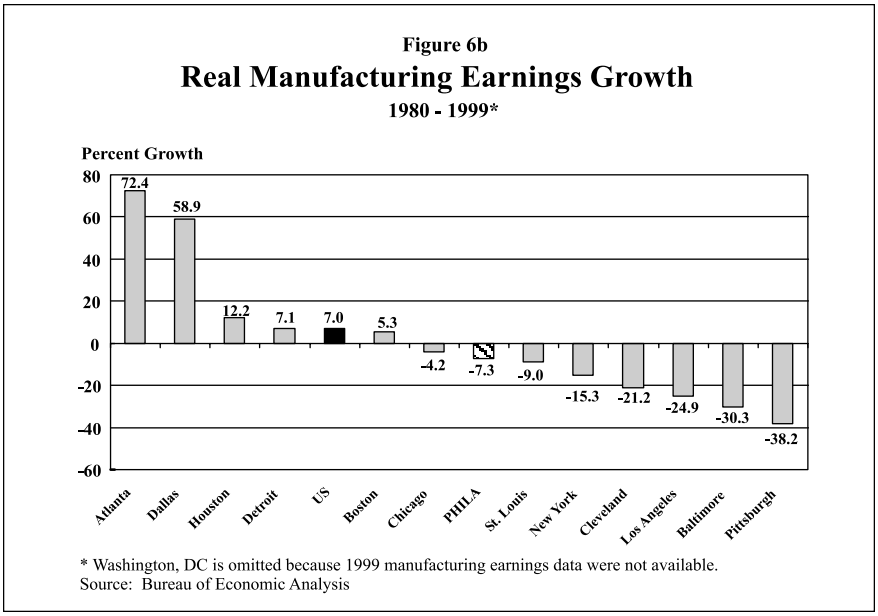
Philadelphia's manufacturing sector has not fared nearly as well as the nation's. Manufacturing employment in the Philadelphia area declined 32 percent from 1980 to 2000; among the 14 metropolitan areas in our comparison group, only New York, Baltimore, and Pittsburgh had larger percentage declines (Figure 6a). Manufacturing job losses were so steep in Philadelphia that the region, unlike the nation, experienced a decline in real earnings in the manufacturing sector (Figure 6b). The decline in manufacturing jobs in the Philadelphia area was similar to the decline in manufacturing jobs in

[6] Among the metro areas in our comparison group only Pittsburgh and Baltimore had larger increases in the percentage of jobs in the private service-producing sector. Only Boston, Pittsburgh, and Washington, DC had larger increases in the percentage of earnings in the private service-producing sector.

[7] Productivity increases in the computer and office equipment industry have been especially strong. The decline in jobs in that industry in the past two decades was greater than the decline in manufacturing jobs generally, but the output gain was several times the increase in other manufacturing industries.

Pennsylvania as a whole (32 percent in the metropolitan area and 30 percent in the state), less than the decline in New Jersey (41 percent), and greater than the decline in Delaware (17 percent). The heavy overall losses in manufacturing jobs in the tri-state region can be attributed to a number of factors, including slower growing markets, higher manufacturing wages than other parts of the country, higher taxes, and the relatively high price or lack of suitable industrial land (Crone, 1997). However, Philadelphia did better than six other metro areas in our comparison group in stemming earnings losses in manufacturing because Philadelphia retained a large share of its higher-paying manufacturing jobs while losing a greater portion of the low-paying manufacturing jobs.[8]





In the Philadelphia area, employment increased in only one major manufacturing sector — chemicals — although the chemical industry suffered job losses nationwide.[9] The job increases in the chemical industry in the Philadelphia area can be traced to the high proportion of these jobs in pharmaceuticals. Pharmaceuticals account for approximately 44 percent of the employment in the chemical industry in Philadelphia versus 25 percent for the nation. Nationally, pharmaceuticals had large gains in both output and employment in the 1980s and 1990s. Since Philadelphia has a larger share of jobs in pharmaceuticals than the nation, the growth in pharmaceuticals helped the chemical industry in the region proportionately more than in the nation.

The greatest percentage decreases in manufacturing employment in Philadelphia were in textiles, apparel, and primary metals. These industries also had the greatest decreases in jobs nationally and in the other large metropolitan areas. However, in Philadelphia percentage losses in these industries generally exceeded the declines nationally and in most major metro areas. Textiles and apparel are examples of lower-paying industries in which Philadelphia had large job losses. Nationally, employment in primary metals production has declined as imported metals gained market share relative to domestic production and technological change resulted in shifts toward greater use of more advanced materials, such as plastics and composites.

The decline of manufacturing in Philadelphia over the past two decades has been very severe when measured by the loss of jobs; it has been less severe when measured by the decline in real earnings. Nonetheless, the poor performance of the region's manufacturing sector has been a major factor in Philadelphia's shift to a service-producing economy.

[8] St. Louis, Cleveland, and Los Angeles had smaller manufacturing job losses than Philadelphia but larger losses in manufacturing earnings.

[9] Nationwide, four of the 20 major manufacturing sectors had job increases between 1980 and 2000—rubber and plastic products, printing and publishing, furniture and fixtures, lumber and wood products.

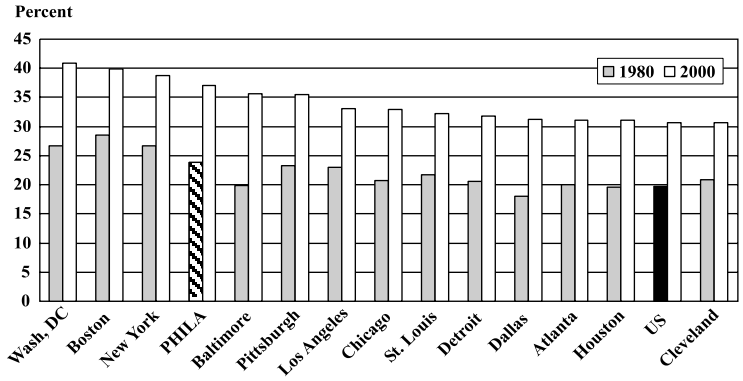
Growth in Service-Producing Industries. The private service-producing industries include transportation, utilities, trade, finance, insurance, real estate, and a large category called other nonfinancial services. The largest increase in jobs nationally and in the Philadelphia region has been in these other nonfinancial services like health care and business support services. Employment in these nonfinancial services more than doubled in the United States in the last two decades, growing more than twice the rate of overall employment. Employment in finance, insurance, and real estate grew at about the same pace as total employment in the last two decades. However, within the financial services sector, there has been a shift away from depository institutions and toward other types of financial services firms, such as investment companies, security and commodity brokers, and financial management firms.

Nonfinancial services. Jobs in nonfinancial services represent more than 30 percent of total jobs in the nation, and large metropolitan areas generally have a larger share of employment in nonfinancial services than the nation. Among the 14 large metropolitan areas in our comparison group, only Cleveland has a smaller percentage than the nation, and the difference is slight (Figure 7). Philadelphia ranks fourth among these large metropolitan areas in the share of jobs in nonfinancial services, and the share has increased more in Philadelphia than in the nation and in most of the metropolitan areas in our comparison group. This was not the result of faster-than-average job growth in nonfinancial services in Philadelphia, however. In our comparison group of 14 large metro areas, Philadelphia ranked fourth from the bottom in job growth in nonfinancial services and considerably below the national rate (Figure 8a). Even so, the number of nonfinancial services jobs has almost doubled in Philadelphia

Figure 7

Percent of Employment in Nonfinancial Services

1980 and 2000

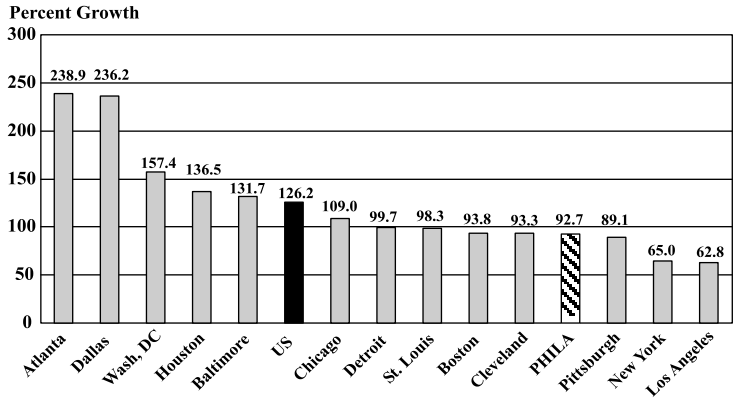


Source: Bureau of Labor Statistics

Figure 8a

Nonfinancial Services Employment Growth

1980 - 2000

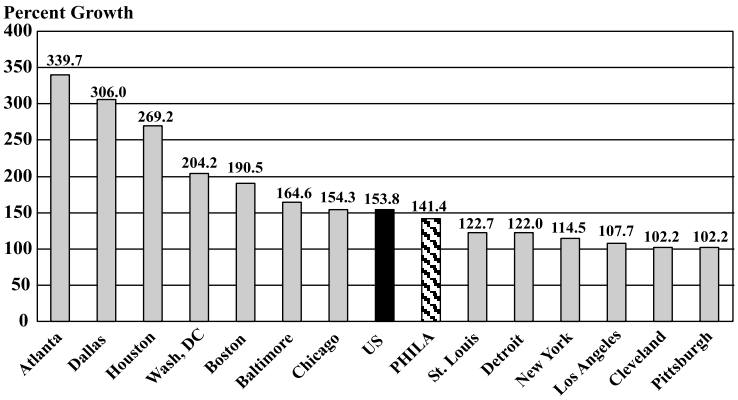


Source: Bureau of Labor Statistics

Figure 8b

Nonfinancial Services Real Earnings Growth

1980 - 1999



Source: Bureau of Economic Analysis

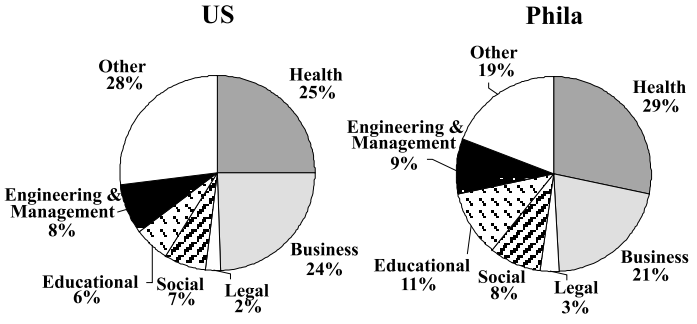
since 1980. But the shift to nonfinancial services in Philadelphia has accelerated because of the large declines in the goods-producing sector.

Real-earnings growth in nonfinancial services in the Philadelphia region was also lower than the national average, but it was much closer to the average than was Philadelphia's employment growth in nonfinancial services (Figure 8b). A disproportionate share of the nonfinancial services jobs generated or retained in Philadelphia were higher-paying jobs. Indeed, Philadelphia has a higher-than-average proportion of nonfinancial services jobs in many industries with higher-than-average earnings — health, legal, and engineering and management services (Figure 9).

Financial services. In contrast to the rapid growth in private nonfinancial services jobs since 1980, employment in the finance, insurance, and real estate sector grew at the same rate as overall employment.[10] This sector accounted for around 6 percent of total employment in the nation in 1980 and in 2000. In Philadelphia total financial services employment was around 7 percent of total employment in Philadelphia in 1980 and 2000, a slightly higher percentage than in the nation. But the average job growth in the broad finance, insurance, and real estate sector masks some significant changes within this sector over the past 20 years. The most significant changes have been in the more narrowly defined financial services category (depository institutions, nondepository lending institutions, investment companies, and securities and commodities brokers). This category is larger than either the insurance or the real estate category. Within financial services there was a substantial change in employment between types of businesses. Employment at depository institutions peaked in the nation around 1989. Jobs at these firms declined in the first half of the 1990s, as large numbers of state-chartered banks and savings institutions closed and commercial banks with national as well as state charters merged (Figure 10). Since the mid-1990s, employment levels at depository institutions nationwide have been relatively steady. In Philadelphia, however, jobs at depository institutions continued to decline after the mid-1990s, and the decline even accelerated at the end of the decade.

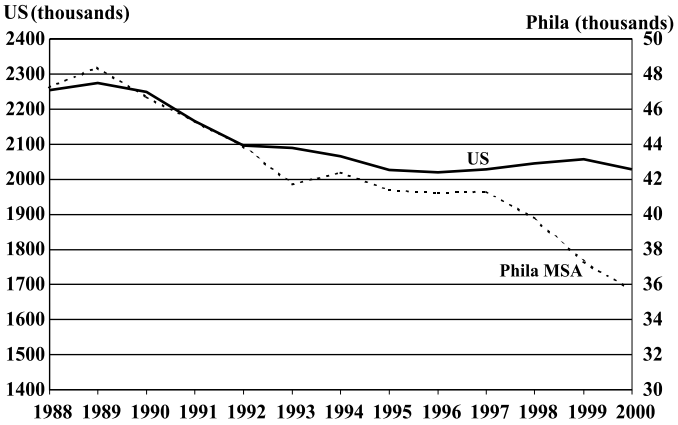
Some of the declines at depository institutions were offset by growth at investment firms in Philadelphia. Employment data are not available for these firms, but earnings growth has been especially strong for investment companies in the Philadelphia area (mutual funds, unit trusts, and holding companies). Earnings at investment companies in Philadelphia have grown at more than twice the national rate since 1982 (the first year for which detailed data are available) and at a higher rate than in any of the other metropolitan areas in our comparison group except Boston (Figure 11). The Philadelphia investment industry benefited disproportionately from the strong equity markets of the

Figure 9
Shares of Nonfinancial Services Employment 2000



Source: Bureau of Labor Statistics

Figure 10
Employment at Depository Institutions 1988 - 2000

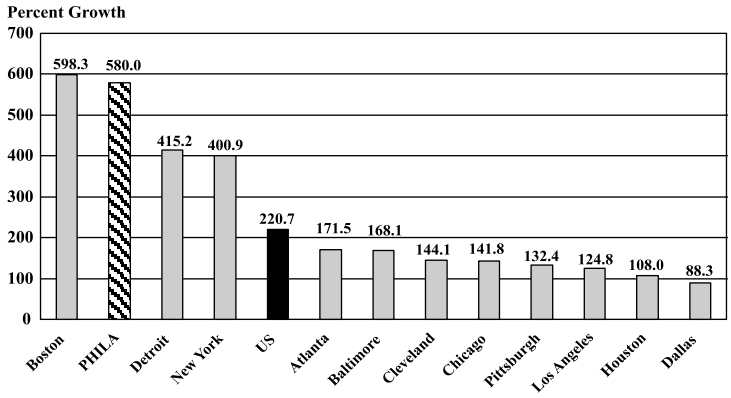


Source: Bureau of Labor Statistics

[10] These three industry categories—finance, insurance, and real estate—are combined as a major division in the Bureau of Labor Statistics' industrial classification system.

1990s. Investment company revenue depends largely on the value of equities under management, so as equity values rose in the 1990s, the industry's earnings increased. It is unlikely that this earnings growth has persisted in the last few years, since equity values have declined since that time. Nevertheless, since the percentage of the population that owns equities has increased since 1980, earnings in the investment industry are likely to continue to be a large share of financial services earnings in Philadelphia.

Figure 11
Investment Company Earnings Growth
1982 - 1999



*Washington, DC and St. Louis are omitted because of missing data.
Source: Bureau of Economic Analysis

The Metropolitan Area's Occupational Structure Is Knowledge Based

Shifts in the industrial structure of the Philadelphia region have brought changes in the kinds of jobs that people are doing in the region. In addition, changes in how work is done have resulted in changes in occupations within many industries. For example, computerization has greatly increased the proportion of workers in information technology in the financial services industry, and the rise of high-tech manufacturing has increased the employment of engineers and technicians in the manufacturing sector.

The occupational structure of the Philadelphia area's economy resembles what one would expect in a large metro area. The largest occupational categories nationally and in the Philadelphia metropolitan area are office and administrative support, sales, and production (Figure 12). These three occupational categories comprise almost 40 percent of the jobs in Philadelphia. Like most large metropolitan areas, Philadelphia has a larger percentage of workers in office and administrative support and a smaller percentage in production.[11] Some other occupational categories that are proportionately more numerous in Philadelphia and other large metropolitan areas are business and financial operations, health-care practitioners, and legal services.

Figure 12
Occupational Categories
Ranked by Size in Philadelphia*

Occupation	Percent of Total Workers	
	Philadelphia	US
Office and Administrative Support	20.49	17.73
Sales	10.33	10.17
Production	8.15	9.92
Management	6.89	6.34
Transportation and Material Moving	6.57	7.49
Education, Training, and Library	6.46	5.77
Food Preparation and Serving	5.85	7.61
Healthcare Practitioners and Technical	5.72	4.72
Business and Financial Operations	4.00	3.43
Installation, Maintenance, and Repair	3.95	4.04
Building and Grounds Cleaning and Maintenance	3.20	3.36
Construction and Extraction	3.18	4.67
Healthcare Support	2.49	2.33
Computer and Mathematical	2.32	2.06
Personal Care and Service	2.28	2.01
Protective Service	1.91	2.32
Architecture and Engineering	1.82	1.97
Community and Social Services	1.31	1.10
Legal	1.13	0.67
Arts, Design, Entertainment, Sports, and Media	0.95	1.22
Life, Physical, and Social Science	0.92	0.71
Farming, Fishing, and Forestry	0.08	0.36

*Shaded categories are those with a larger share of workers in Philadelphia than in the nation.
Source: Bureau of Labor Statistics

The occupational differences between large metropolitan areas, including Philadelphia, and the nation are not haphazard. Workers employed in most large metropolitan areas are more likely to be engaged in white-collar or professional occupations than are workers nationwide. According to the Bureau of Labor Statistics, most of the occupational specialties in these groups require formal education at the bachelor's degree level or higher.[12] With the

[11] The other occupations more heavily represented in Philadelphia than in the nation are shaded in Figure 12. Occupational categories of the Standard Occupational Classification system were revised and expanded in 1999. Comparisons to previous years are not appropriate, so we cannot measure how shares have changed over the past two decades.

[12] The occupational groups in which most occupational specialties require at least a bachelor's degree are management, education, health-care practitioners, business and financial operations, computer and mathematical, architecture and engineering, community and social service, legal, arts and entertainment, and science.

exception of architecture and engineering and arts and entertainment, these occupations figure more prominently in Philadelphia than in the nation. Because these occupations require more extensive formal education than others, we refer to them as *knowledge occupations*.

In the Philadelphia metropolitan area, almost 32 percent of workers are in knowledge occupations (Figure 13). In our comparison group of 14 metro areas, Philadelphia ranks sixth in the proportion of workers in knowledge occupations. Only Washington, DC and Boston have much higher percentages. Philadelphia ranks first among these 14 metro areas in education; third in life, physical, and social sciences and health-care professionals; fourth in legal occupations; and fifth in community and social service occupations.[13] The data on health and education occupations reinforce the data on employment and earnings to highlight the significant role these services play in the economy of the Philadelphia metropolitan area.

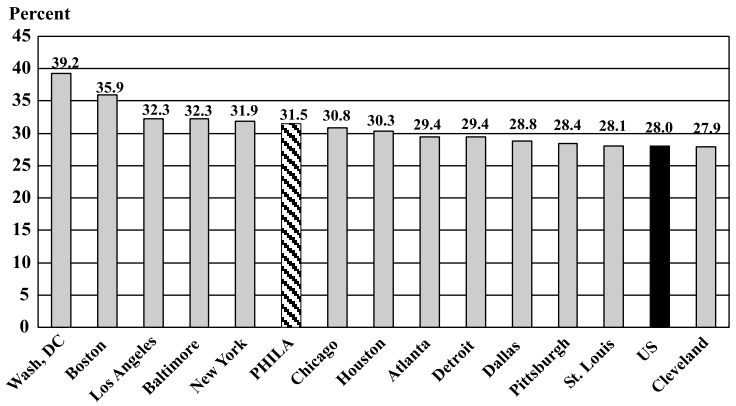
The concentration of knowledge occupations in the area means that a fairly large portion of the area's workers have jobs that typically suffer less unemployment than jobs that are filled by workers without higher education. Workers with bachelor's degrees have an unemployment rate half that for workers without formal education beyond high school and less than a third of the unemployment rate for workers without a high school diploma (Bureau of Labor Statistics, 2001). Philadelphia's concentration of knowledge workers contributes to a lower and more stable unemployment rate in the area.

Another aspect of knowledge occupations is their higher earnings. Workers with bachelor's degrees have average earnings 50 percent greater than workers with only a high school diploma and more than twice the earnings of workers without a high school diploma. A high proportion of knowledge workers contributes to the Philadelphia area's relatively high income level. Occupations with the highest educational requirements are also projected to be the fastest growing occupations through most of the current decade. Philadelphia may have to work to increase the educational level of its working-age population to take full advantage of the projected growth in these occupations. Among the largest metro areas, Philadelphia is only about average in the percent of the population age 25 to 64 with a bachelor's degree or more (Figure 14). The new jobs that the evolving economy is creating increasingly require education at the bachelor's level or beyond, and Philadelphia will need to raise the educational attainment of its work force if it is to fully participate in this job growth. This issue was identified as an important factor in the prospects for economic development in the region in *A Philadelphia Report Card* (Federal Reserve Bank of Philadelphia, 2001).

Figure 13

Percent of Workers in Knowledge Occupations*

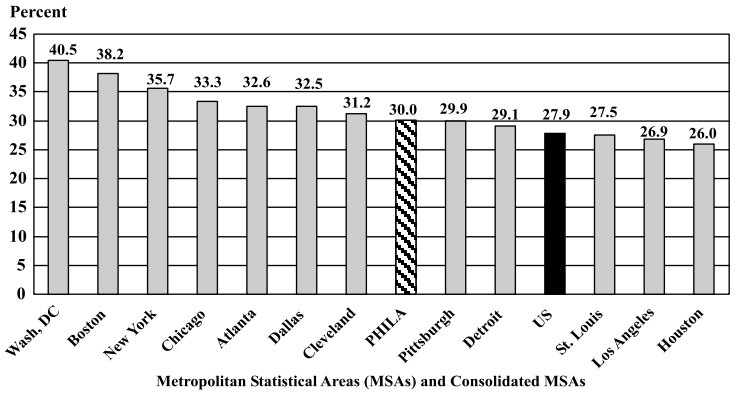
1999



*Knowledge occupations are those that require a bachelor's degree or higher education.
Source: Bureau of Labor Statistics

Figure 14

Percent of Population Aged 25-64 with Bachelor's Degree or Higher



*Baltimore is included in the Washington-Baltimore, - DC-MD-VA-WV CMSA.
Source: Bureau of Labor Statistics

[13] The Philadelphia area ranks below the median for business operations occupations, computer and mathematical operations (ninth place in each), architecture and engineering, and arts/design occupations (12th place in each).

Industrial and Occupational Trends Will Affect the Region's Development

As in most large metro areas, employment in the Philadelphia area is heavily concentrated in the private service-producing industries, especially in nonfinancial services. This concentration has increased over the last two decades and is likely to increase further over the next decade. Almost all the increase in nonfarm jobs in the next several years in the U.S. is expected to be in the service-producing industries, and more than half the net new jobs will be in nonfinancial services (Figure 15).[14] The largest absolute and percentage increases in nonfinancial services jobs will be in business services such as computer and data processing and personnel supply services, which are expanding into technologically and professionally oriented fields. Although Philadelphia has a large proportion of nonfinancial services jobs, they are not concentrated in these computer or technology-intensive services industries.

Philadelphia has a significantly higher concentration of nonfinancial services jobs in health and education services than the nation. While jobs in both sectors are projected to increase faster than overall job growth, they will not increase as fast as nonfinancial services jobs in general. Moreover, there is a shift under way in the delivery of health services that could reshape the health sector in the region. Job growth is projected to be stronger in home health care, analytic and diagnostic centers, outpatient services, and other specialized health-care service providers than in hospitals and traditional medical offices. Hospitals and traditional medical offices have been a large part of the health-care industry in the Philadelphia area, so significant change will be required in the area's health services sector if it is to continue to be a source of strength for the local economy. Changes in health care as an industry will bring changes in health-care occupations. Increasing provision of health care through channels other than hospitals could result in a shift toward a lower concentration of health-care practitioners, such as physicians, and a greater concentration of health-care support occupations, such as medical assistants, nursing and home health-care aides, and therapy assistants, with a consequent diminution of average earnings in this sector.

Across industries, knowledge occupations are generally projected to increase at a faster rate than other types of occupations in this decade (Bureau of Labor Statistics, 2000). Many of the occupations with the highest projected percentage growth and largest absolute employment growth require bachelor's degrees (Figure 16). Computer-related occupations that require bachelor's or more advanced degrees are projected

[14] Industry employment projections are from the Bureau of Labor Statistics (Berman, 2001).

Figure 15

Projected US Employment Growth by Industry, 2000-2010

Industry	Cumulative Change (percent)
Total nonfarm	**16.7**
Mining	**-10.3**
Construction	**12.3**
Manufacturing	**3.1**
Transportation	**20.7**
Communications	**16.9**
Utilities	**4.9**
Wholesale Trade	**11.0**
Retail Trade	**13.3**
Finance, insurance, real estate	**9.1**
Nonfinancial Services	**32.8**
Business Services	51.4
Health Services	28.1
Legal Services	33.7
Education Services	22.7
Engineering, etc. services	36.3
Government	**8.5**

Source: Bureau of Labor Statistics

Figure 16

Fastest Growing Occupations in US 2000-2010

Occupation	Cumulative Change
Computer software engineers, applications	**100%**
Computer support specialists	97
Computer software engineers, systems software	**90**
Systems administrators	**82**
Systems analysts	**77**
Desktop publishers	67
Database administrators	**66**
Personal and home care aides	62
Computer systems analysts	**60**
Medical assistants	57
Social and human services assistants	54
Physician assistants	**53**
Medical records technicians	49
Computer and information systems managers	**48**
Home health aides	47
Physical therapist aides	46
Occupational therapist aides	45
Physical therapist assistants	45
Audiologists	**45**
Fitness trainers and aerobics instructors	40
Computer and information scientists, research	40
Veterinary assistants	40
Occupational therapist assistants	40
Veterinary technologists and technicians	39
Speech-language pathologists	**39**
Mental health and substance abuse social workers	**39**
Dental assistants	37
Dental hygienists	37
Special education teachers	**37**
Pharmacy technicians	36

*Shaded occupations require a bachelor's degree or higher education.
Source: Bureau of Labor Statistics

to be the fastest growing, especially computer engineers, systems analysts, and network and systems administrators. These occupations are projected to be the most rapidly growing not only because of the growth of independent service companies but also because of the growth of in-house jobs in information technology.[15] While Philadelphia is likely to benefit from the rapid growth in computer-related occupations and the computer services industries, it is not likely to have any advantage over other large metro areas. Philadelphia has a larger share of jobs in computer-related occupations than the nation but not as large a share as most of the large metro areas in our comparison group. Philadelphia does have a greater share than most other large metro areas in health-care occupations. Among health-care occupations that require a bachelor's degree or more, physician's assistants, audiologists, and speech-language pathologists are projected to increase rapidly.

Occupations that are projected to decline include many that will be replaced by more sophisticated computer systems. Many of these occupations are in office and administrative support, such as typists, secretaries, clerks, and switchboard operators. Automated technology will also result in declining demand for production workers and testers in a variety of manufacturing occupations, such as machine operators, electrical equipment assemblers, and printing press technicians. As knowledge occupations grow in importance, metropolitan areas, which have been evolving more rapidly than nonmetropolitan areas toward knowledge-based economies, will become increasingly dependent on attracting and retaining knowledge-based jobs.

The Philadelphia Area Competes for Knowledge Workers and Firms

Philadelphia will be competing with other large metro areas in the next decade for the new knowledge-based jobs the U.S. economy is expected to create. Because knowledge firms and workers do not need to locate in a place that has key natural resources, other attributes determine where they locate. The local characteristics that encourage the formation and growth of knowledge-based firms include proximity to research institutions, access to venture capital, convenient transportation networks, a highly educated and skilled workforce, an existing network of suppliers and business support services, and quality-of-life factors, such as climate, cultural opportunities, population density, crime rates, and commuting time (DeVol, 1999; Markusen, Hall, and Glasmeier, 1986). Furthermore, workers in knowledge occupations have preferences in the goods and services they buy that are distinct from the preferences of workers in other occupations, and these personal spending differences have some influence on their choice of where to live (Cage, 1989; Glaeser, 2000).

Few metropolitan areas have all the features that are attractive to knowledge-based firms and workers. Philadelphia measures up well in some features but not so well in others.

Research and Development. Research and development (R&D) activity spurs the formation and growth of knowledge-based firms. Almost all the leading metropolitan areas with a high concentration of knowledge industries are located in states that rank high in R&D spending (Carlino, 2001). These areas have benefited from R&D activity that originated in an industrial setting or that was commercially developed after starting as academic or federal research. For example, Los Angeles and Seattle were centers for aerospace research long before these industries achieved the high profile they have today. Similarly, San Jose and Boston were centers of research in electronics, much of it federally funded and conducted by Stanford University and MIT.

R&D spending, whether by private industry, universities, or the federal government, has been highly concentrated. The National Science Foundation estimates that the 20 highest ranking states in total R&D expenditures account for 85 percent of the U.S. total (Bennof, 2001). California is the top state for total R&D spending. But when we measure R&D spending per worker, California's rank falls to eighth, and states on the East Coast become prominent. By this measure, all three states in this region are in the top 20 (Figure 17). Delaware ranks first because it is a small state with a high concentration of research activity. New Jersey ranks 10th and Pennsylvania 16th. Pennsylvania ranks fifth among states in total research and development spending at universities and colleges. Four universities in the state are among the top 100 in the nation for R&D expenditures.[16] Much of Pennsylvania's university-based research is in the Philadelphia area at the University of Pennsylvania. The major portion of the university's research spending is in medicine and life sciences, with a lesser portion in engineering and computer sciences. University research spending in certain scientific fields spawns educated workers and commercially viable ideas in those fields. The relative emphasis on medical research in the Philadelphia metropolitan area would seem to be a factor influencing the area's concentration in life sciences and medicine, and the

[15] Occupational employment projections are from the Bureau of Labor Statistics (Hecker, 2001).

[16] The University of Pennsylvania, Pennsylvania State University, the University of Pittsburgh, and Carnegie Mellon University (National Science Foundation, 2001).

Figure 17

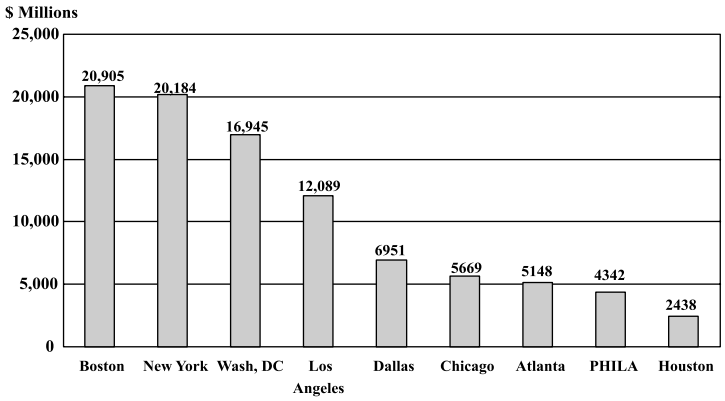
Top 20 States for R&D Spending Per Worker 1998

State	R&D Dollars Per Worker
Delaware	***$6,388***
Washington, DC	$4,248
Massachusetts	$4,212
New Mexico	$4,210
Rhode Island	$3,665
Maryland	$3,451
Washington	$3,262
California	$3,230
Michigan	$3,029
New Jersey	***$2,991***
New Hampshire	$2,275
Colorado	$2,220
Connecticut	$2,166
Idaho	$2,160
New York	$1,667
Pennsylvania	***$1,595***
Illinois	$1,497
Minnesota	$1,494
Virginia	$1,486
Utah	$1,460

Source: National Science Foundation and Bureau of Labor Statistics

Figure 18

Dollar Amount of Venture Capital Investment in Area Companies, 1990 - 2000 Total



*Areas do not correspond exactly to Census Bureau metropolitan areas.
Source: Venture Economics/National Venture Capital Association

relative lack of emphasis on engineering and computer sciences might be a factor in the relatively low concentration of workers in these fields in the area.

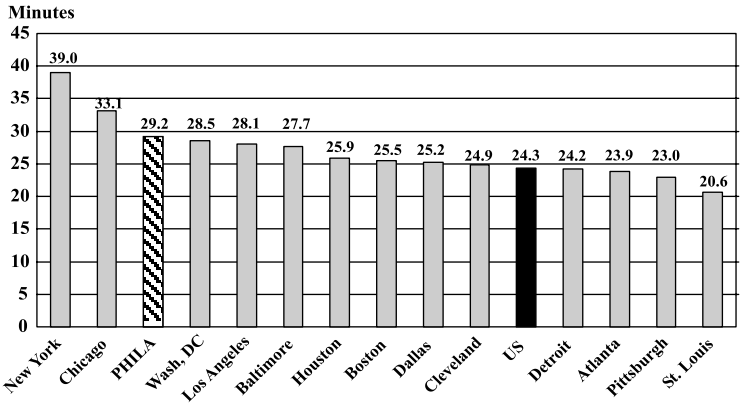
Venture Capital. Financial support for commercial development of research often comes from venture capital firms. They provide the money to get firms started, promote their development, and fund young firms until they can tap the capital markets or achieve profitability (Berlin, 1998). Like R&D funding, venture capital is geographically concentrated. California is dominant in venture capital funding, as it is in R&D spending, but large amounts of venture capital are also invested in metropolitan areas in the eastern and southern regions of the country. According to Venture Economics, among the top 20 metro areas for venture capital investments, the Philadelphia metropolitan area ranked 11th in cumulative dollar value of venture capital investments during the last economic expansion. Only nine of the metro areas in our comparison group made the top 20 ranking for venture capital; Philadelphia was one of these (Figure 18). The largest sectors for investment in the Philadelphia metropolitan area were the Internet, communications media, and biotechnology. The high concentration of venture capital investment in biotechnology is the result of Philadelphia's strengths in life sciences, medicine, and pharmaceuticals. Conversely, a relatively small share of venture capital in Philadelphia is invested in computer software and services. The annual investment by venture capital organizations in the Philadelphia metropolitan area has been only a small fraction of the national total. But venture capital funding has grown at a faster rate in the area than in the nation, an estimated 90 percent per year since 1992, compared with an estimated growth rate of 60 percent for the nation as a whole. Nevertheless, because the area started with a relatively small amount of venture capital, it remains near the bottom among metropolitan areas in terms of annual amounts of venture capital investment.

Transportation. Access to local and extended transportation links has been cited by some researchers as a desirable attribute for attracting and growing knowledge-based firms. The fact that Boston's early venue of electronics and computer firms was referred to as Route 128 is graphic evidence of this fact. Knowledge firms tend to be part of a network of firms made up of suppliers, support service enterprises, and customers that rely on close communication and integrated business planning at all stages of production. Quick, dependable transportation is necessary to make this kind of business structure possible. However, Philadelphia lags on a number of transportation measures.

Knowledge firms favor metropolitan areas with large airports and extensive highway networks. Nearly all of the metropolitan areas with a high concentration of knowledge-based industries have international airports, and most,

especially those in the West, have extensive freeway systems. Philadelphia's airport has grown rapidly in recent years, but the number of cities connected by nonstop flights from Philadelphia remains in the middle range, compared with other metropolitan areas (Greater Philadelphia First, 1999). Air transportation to the area is supplemented by rail transportation. Philadelphia, along with other eastern cities, benefits from more Amtrak service than is available in other parts of the country. The recent introduction of the high-speed Acela train has enhanced Amtrak service in the Northeast corridor.

Figure 19
Average Travel Time to Work by City 2000



Source: Census 2000 Supplementary Survey

Transportation links are also important to knowledge workers as consumers, especially the ability to travel quickly from home to work and recreation venues. Philadelphia has the third longest average commuting time among the metro areas in our comparison group, but it is significantly shorter than average commuting times in New York and Chicago and not much longer than those for Washington, Los Angeles, and Baltimore (Figure 19). The local road network is important for both commuting to work and moving around the area to shop and to gain access to theaters and other entertainment facilities. Philadelphia ranks low, as do many other older, eastern metropolitan areas in freeway lane-miles per capita.

Business Services. Besides suppliers that provide inputs directly into the production process, knowledge firms need a variety of support services, such as management consulting, accounting and data processing services, advertising companies, and testing laboratories. As new and growing firms, they will make use of many business functions that they cannot provide for themselves. Furthermore, as they grow they tend to concentrate their in-house efforts on those products and activities in which they have a competitive advantage, the so-called core competencies, and outsource other functions. For these reasons, knowledge firms will tend to favor metropolitan areas where business and professional services are readily available. The Philadelphia metropolitan area has a large established base of service companies, but the proportion of people working in business, accounting, engineering, and management services is not high when compared with other large metropolitan areas. Philadelphia's proximity to other metropolitan areas with high concentrations of firms in these service industries makes it possible for local firms to employ out-of-area businesses in these fields. Perhaps as a result, it is not unusual for firms in the Philadelphia area to use firms located outside the area for business services such as computer systems development, advertising, and commercial art.

Educated Labor Force. Knowledge firms often include the need for highly educated workers as a priority item on their lists of requirements for places in which to locate. However, the skills or education level of a metropolitan area's labor force and a high concentration of knowledge-based firms reinforce each other. Because knowledge-based firms, by definition, employ large numbers of highly educated workers, their location in an area ipso facto raises the educational level of the work force. Knowledge workers are much in demand and very mobile. They move from one part of the country to another, and even from one country to another, wherever the attraction of job, pay, and amenities is greatest. Nonetheless, an area in which a large percentage of the working-age population has attended college or graduate school will be attractive to knowledge firms. Indeed, a large number of college graduates may raise the number of start-ups of knowledge-based firms. Furthermore, knowledge workers participate in continuing education activities of various kinds, so an abundance of opportunities for advanced and continuous learning will reinforce other amenities of a region.

In education the Philadelphia area has pluses and minuses. The area has a large college-student population and many well-regarded graduate programs. However, the area is only about average in the percentage of the population with a college education (see Figure 14). Furthermore, although a large number of students attend area colleges, many of them do not remain after graduation. This brain drain has been recognized by local and state officials as a critical handicap in advancing the status of the region as a location for knowledge firms (The Reinvestment Fund, 2001; Pennsylvania Department of Community and Economic Development, 2001).

The educational facilities of an area are important in ways

other than preparing students to enter the working world and helping workers maintain their skills. As noted above, academic research and development as a source of potentially marketable business ideas has been crucial to the location and growth of knowledge industries. In this way, institutions of higher education serve as attractions for knowledge firms. As noted earlier, Pennsylvania and the Philadelphia metropolitan area rank high in university and college R&D spending. Much of that reflects medical research. Research spending in other fields, such as engineering, computer science, and physical sciences, at the area's universities and colleges is much less than in several of the other top metropolitan areas with large knowledge industries. This fact parallels the area's relatively low employment levels in these fields.

Elementary and secondary schools can also help attract high-tech firms. Knowledge workers are likely to place particular importance on the quality of schools for their children, so firms in areas with good schools will have an advantage in attracting employees. The public school situation in the Philadelphia region is like that in most other large metro areas; schools in most suburban areas measure up well, but academic performance by students in city schools lags (Crone, 1998).

Quality of Life. Schools are one of the amenities that are considered in workers' location decisions, but there are many other quality-of-life factors. Among these are climate and other geographical features, congestion, crime rates, cultural and entertainment facilities, outdoor recreational opportunities, restaurants, and so forth. Anecdotal evidence and focus group interviews suggest that these factors are especially important to knowledge workers and, consequently, to their employers (Arora, 2000; Florida, 2000; Gottlieb, 1995). It is difficult to measure these factors precisely, but several quality-of-life rankings have been published. On most of these, the Philadelphia metropolitan area ranks at the low end of the scale (Gyourko, 1991; Gabriel and Rosenthal, 2000). But Philadelphia's proximity to other metro areas in the Northeast corridor enables residents to take advantage of cultural attractions from New York to Washington.

Locally, regional policies can influence quality-of-life factors such as public education, transportation, crime, and cultural amenities, so low rankings on these are susceptible to improvement. Indeed, major efforts have been undertaken in the region to improve quality-of-life and cultural features. Philadelphia's center-city revitalization and the Avenue of the Arts have been paralleled in smaller communities throughout the area. Although the climate of the Sun Belt metropolitan areas cannot be reproduced in this region, many of the outdoor recreational opportunities that attract knowledge workers to those areas are available within or close to the Philadelphia metropolitan area. Mountain and ocean resorts are close to the area. Better transportation and visitor's facilities would make these attractions more accessible within the region. Better publicity about the area's entertainment and recreation facilities will help attract knowledge workers to the region. Philadelphia's new regional visitor's center is a big step toward making visitors to the city aware of the many other recreational venues in the area, and this awareness can influence potential new residents when they are presented with an opportunity to relocate to the area.

Summary

As the 21st century begins, the economic character of the Philadelphia metropolitan area is evolving. In the long-run shift in economic structure from manufacturing to services, Philadelphia is ahead of the nation. However, Philadelphia's greater service orientation reflects the fact that Philadelphia has suffered a larger decline in manufacturing than the nation has. Compared with the nation and with other large metropolitan areas, Philadelphia has had slower growth in service industries. In particular, business services and accounting, management, and engineering services have not developed in the Philadelphia metropolitan area to the extent that they have in faster growing areas. These industries have been significant factors in the economic evolution toward services and the growth of knowledge industries and occupations, and they are projected to be the main drivers of growth in the future as well. Meanwhile, changes already under way in the health-care industry — which makes up a large share of the Philadelphia area's economy — might not be as favorable to continued growth of the most intensively knowledge-based occupations in that industry, especially as containment of health-care costs becomes more pressing. Thus, the structure of the area's health-care industry will have to change.

The industrial trends that have gotten credit for the nation's long economic expansions in recent years — increased development and use of technology — have raised the importance of human capital in the economy. Human capital in the form of knowledge and skills possessed by workers has become more important in determining the economic prospects of individuals, the industries in which they work, and the places in which they live (Simon, 1998). Philadelphia's current relatively favored position in the national and global knowledge economy might be at risk unless its knowledge sector broadens out beyond the areas of its traditional strengths. Diversification among industries will make the area more resilient to any adverse structural or cyclical developments that might have disproportional effects on different knowledge industries (Markusen et al., 2001). The increasing value of knowledge as an economic resource

reduces the relative value of other factors of production, such as raw materials and energy. A consequence of this is the reduced importance of traditional locational attributes, such as proximity to raw materials, large pools of low-skill workers, and support facilities for heavy industry. Instead, the locational attributes that become paramount are those that facilitate work in the knowledge economy and are appealing to knowledge workers off the job. The Philadelphia area has some of these attributes. Furthermore, cultural and entertainment opportunities in the region that are important to knowledge workers are being enhanced. Business location attributes that are important to firms are being improved.

As the economy becomes increasingly dependent on knowledge workers who start new businesses and apply new technology to maintain growth in existing businesses, the Philadelphia area can build on its strengths as a knowledge economy. But that knowledge base will have to be broadened and the area will have to continue to develop its economic infrastructure and cultural features to attract and retain knowledge firms and workers.

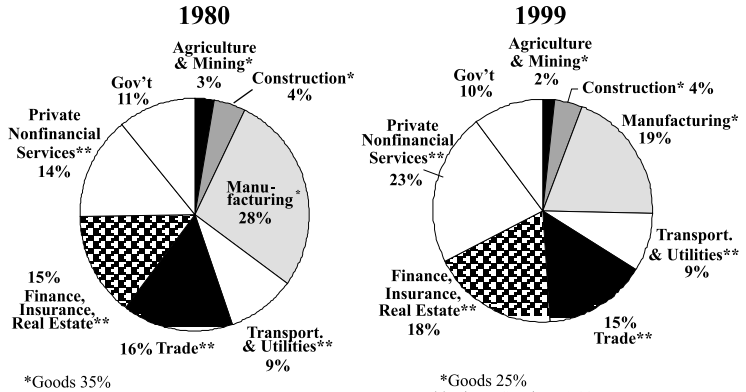
APPENDIX: The Changing Composition of Gross State Product

From 1980 to 1999, the combined output of the 50 states and the District of Columbia adjusted for inflation (real gross state product) increased 86 percent. The Philadelphia metropolitan area spans two states, Pennsylvania and New Jersey, and the consolidated metropolitan area includes a large portion of Delaware. Gross state product grew more slowly than the national average in Pennsylvania (60 percent) and more rapidly in New Jersey (100 percent) and Delaware (143 percent). During the past two decades, there were shifts in the shares of output produced by the major industry categories in each state (Figures A, B, and C). The government share of output declined slightly in each state, and the private economy moved toward greater output of services but at very disparate rates.

For all states in the nation, the share of output in goods production (manufacturing, construction, agriculture, and mining) fell from 32 percent in 1980 to 23 percent in 1999, and share of output in private services increased from 54 percent to 65 percent. In Pennsylvania, the shift in output from goods to services mirrored the shift for the nation. In New Jersey and Delaware, however, the shift from goods production to private services was much more dramatic. Private services production increased from 58 percent to 73 percent of total output in New Jersey, and from 46 percent to 72 percent in Delaware. In New Jersey the increased share of output in private services was distributed almost equally between nonfinancial services and the finance, insurance, and real estate sector. Each of these two sectors increased its share of New Jersey's output between 7 and 8 percentage points. In Delaware, the shift to private services was driven by the more than threefold increase in the share of the state's output in finance, insurance, and real estate. This increase was due to the very rapid growth in credit card operations and other financial industries in the state. The output of private nonfinancial services grew more rapidly in Delaware than in either Pennsylvania or New Jersey, but the increase was far surpassed by growth in financial services.

The loss of output share in goods production in each of the three states was almost totally absorbed by the manufacturing sector. In Pennsylvania, manufacturing's share of total output declined slightly more than in the nation between 1980 and 1999. In New Jersey and Delaware, manufacturing's share of output fell much more dramatically, declining by more than half.

Figure A
Pennsylvania
Gross State Product by Sector, 1980 and 1999

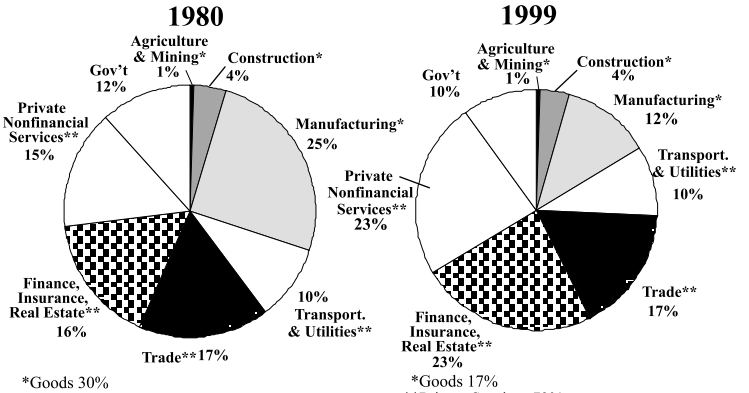


*Goods 35%
**Private Services 54%

*Goods 25%
**Private Services 65%

Source: Bureau of Economic Analysis

Figure B
New Jersey
Gross State Product by Sector, 1980 and 1999

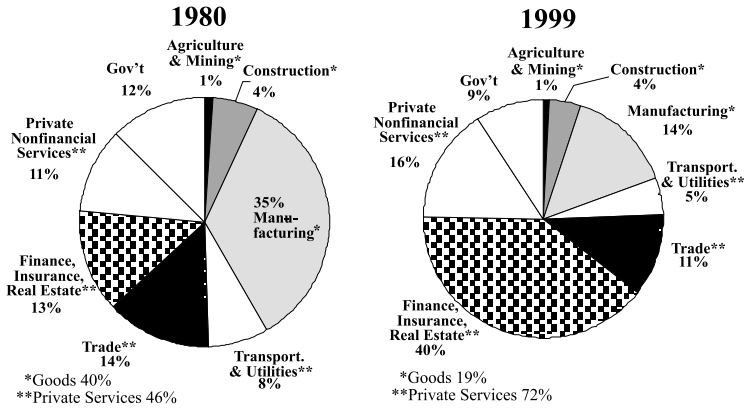


*Goods 30%
**Private Services 58%

*Goods 17%
**Private Services 73%

Source: Bureau of Economic Analysis

Figure C
Delaware
Gross State Product by Sector, 1980 and 1999



*Goods 40%
**Private Services 46%

*Goods 19%
**Private Services 72%

Source: Bureau of Economic Analysis

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