

People in the Production Recipe

The following three chapters look inside the “value-added” generated by businesses and business networks to see how structural change in the U.S. economy is transforming the nature of work. Networks measured earlier in terms of flows of money can also be described as networks of people contributing time, skill, dedication, compassion, and inspiration. The kinds of human contributions needed to provide an amenity like Housing, Transportation, or Health are changing even more rapidly than the shares of different business sectors described in chapter 5. Trends measured in these areas are difficult to interpret, since there appears to be an enormous range of choice in the kinds of jobs created by production systems using emerging technology.

As was the case in Part 11, there is no good vocabulary for describing many of the changes taking place. Structural change must be measured in several different ways: the share of all occupations held by different occupations; the scale and scope of working teams; the way such teams are managed formally and informally.

Many traditional occupations (i.e., machine operators, farmers, and data entry clerks) are declining while jobs are growing rapidly in areas lacking clear definition. Out of desperation, new jobs are often called things like “para-professionals,” “para-librarians,” or “super-clerks.”

For many, the most critical skill has become an ability to keep abreast of change, to determine what needs to be learned, and learn while performing the work that needs to be done. The most important attribute of formal training maybe the extent to which it creates a capacity for functioning effectively in ambiguous situations. While modern technology may theoretically permit a production system to operate efficiently with a small, elite group of managers controlling large groups of employees, whose tasks have been reduced to mindless repetition monitored by computers, such an approach seems unlikely to be compatible with the need to tailor products and react quickly to changing conditions.

When an insurance clerk must adapt to a new computer terminal, for example, he or she is forced

to learn both a new keyboard and new underwriting software—in effect, learning a new job in the process. A nurse heading a ward must keep books in a different way, in order to satisfy changed public regulations and the expectations of newly cost-conscious hospital management. A cutter in an apparel factory now learns how to use laser cutters instead of those based on knives, and must become an alert member of a “quick response” team—spending a considerable amount of time in brief meetings to establish schedules for rapidly shifting production requirements, rather than working in isolation with a rigidly prescribed schedule.

In an odd way, changing production strategies and new technologies may make disparate jobs more similar. Farm managers, operators of nuclear power plants, insurance salesmen, and teachers all spend an increasing amount of time wrestling with abstractions in front of terminals. Jobs with high degrees of independence, such as independent physicians, teachers, and independent home builders, are now being integrated into networks—though not necessarily into hierarchical structures. Jobs once part of hierarchies may be given greater independence.

A large fraction of new jobs require the capacity for working with other people. Operation of production networks capable of delivering specialized products rapidly to markets depend increasingly on groups of people working effectively as a team. The teams may last for many years, or may be assembled on a temporary basis for a specific purpose. The performance of such teams often depends as much on the social skills of their participants as on formal training or experience.

Members of complex production networks often have never met one another. Few of them actually meet the consumers that enjoy the final products of their work. This may well change as production networks become more closely coordinated and operate with more intimate understanding of final markets.

The emerging economic systems could create a work environment that is more rewarding in a variety of ways. They can also lead to problems. Iron-

ically many of the advantages and liabilities emerge from the same factors, Flexible production systems often require skills that are quite general; the employee is expected to learn the specifics of a new task quickly. This provides employees with greater freedom, but it can also weaken their bargaining power and make employment more tenuous. This, in turn, can lead to an increase in use of part-time and temporary employees, and can tempt employers to achieve flexibility through “disposable” workers. Technology may also be used to create an enormous gap between well paid, creative professionals and employees given narrowly defined tasks who are monitored electronically.

While many new jobs do not expose workers to the risks of traditional industrial accidents, stress can be greatly increased in a poorly designed office environment. Many of the most dangerous, least skilled, and most poorly paid jobs in the economy are unlikely to be affected by new technology or structural change. Farm laborers, food preparers, hospital orderlies, and other occupations seem likely to remain those of poorly paid minorities.

The following three chapters address these issues with the following plan:

- Chapter 10 builds on the analysis of changing business structures to explore changing networks of people at work. It begins by showing how occupations of each type enter the production recipes of different businesses. Changing patterns of jobs created by each business sector are explained by examining changes in final demand, trade, production recipes, and labor productivity. The chapter also examines changing patterns of occupations, finding that these changes depend primarily on changes in staffing within each business type.
- *Chapter 11* shows how changes in the supply of labor and changes in demand implicit in the new economic structure combine to change the quality of jobs. The chapter explores the changing demand for skills, forces affecting the distribution of wages and compensation, employee and employer demands for flexibility, job safety, and factors affecting aspects of job satisfaction not easily measured in quantitative terms. In particular, the discussion examines the rapid changes occurring in the rules governing connections between skills and wages. Inequality in education may well become the most significant source of wage inequality.
- *Chapter 12* provides a different perspective on these issues by taking a more detailed look at changes in the way different production networks create jobs. Some of the structural changes *within* business types that remained a mystery in chapter 10 can only be explained by looking at factors affecting work in places like hospitals, farms, and grocery stores.

Chapter 10

**How America Uses
People at Work**

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How America Uses People at Work

LABOR IN THE PRODUCTION RECIPE

The jobs created by the American economy in the 1980s often bear little resemblance to the jobs of the early 1970s. Employment in manufacturing continues to fall while jobs in transactional enterprises have increased rapidly. If current trends continue, each sector will contribute roughly 16 percent of U.S. jobs in the early 1990s. Of all jobs added between 1980 and 1986, 85 percent were classified as “managerial, professional, technical, sales, or administrative support.” These categories were responsible for less than half of all jobs in 1972.

Building on the analysis of structural change in production undertaken in chapter 5, this chapter explores the forces responsible for some of these changes. The discussion attempts to explain recent trends, and provides the basis for examining choices about how skills can be combined to produce amenities in the future. The analysis begins by describing how labor enters the production recipes; it next closes the circle introduced in figure 1-2 of chapter 1 by explicitly calculating the mix of skills required to achieve each amenity. The chapter then describes recent trends in U.S. jobs—both by business and occupation categories. Lastly, the analytical tools introduced at the beginning of the chapter are used to explain how the direct and indirect effects of changes in domestic demand, trade, productivity, and shifting production recipes are responsible for different patterns of employment.

While there are some exceptions, productivity, domestic demand, trade, and production recipes have all led to declining employment in manufacturing and increasing employment in transactional firms. In most cases, however, shifts in household and government consumption (final demand) and changes in production recipes (intermediate demand) seem to have had a larger impact on employment than changes in productivity. New patterns of trade and new patterns of domestic consumption have played approximately equal roles.

It appears, however, that changes in hiring within business sectors like farming, banking, or textile manufacturing have had a much greater effect on the shifting mix of skills in the American economy than changes in the net jobs created by each business. It is difficult to use available statistics to explore the change in occupations within business types. For this, it is necessary to appeal to the more qualitative analysis of chapter 12.

Accounting by categories of jobs and job types avoids many of the empirical difficulties encountered in chapter 5, which traced changes in “constant dollar” value-added contributed by different business categories. This occurs for several reasons:

- Jobs provide a more reliable measure of change—unlike prices, the basic unit does not change over time.
- Using job types avoids the problem of defining a “manufacturing” or “service” enterprise. Job classifications provide a way of seeing whether a manufacturing firm is also engaged in activities not usually classified as “manufacturing.”
- Measuring job changes provides a way to trace the results of research and development through complex networks. It would seem, for example, that the Recreation and Leisure network does comparatively little research. In fact, one dollar spent on Recreation and Leisure generates as much work for scientists and engineers as the average dollar spent in the economy as a whole.

Introducing People Into the production Recipe

The tables in chapter 4 traced the interconnections that exist in the U.S. economy, by showing how U.S. businesses combine products purchased from other businesses (intermediate inputs) with their own “value-added” to produce output. Chapters 5 and

6 discussed changes in the share of GNP (the sum of telephone and public utilities (electric, gas, and of all value-added) made by the various sectors, how sanitary services). Very little of the value-added in businesses are organized to generate this value, and heavily capitalized real estate businesses is paid as how patterns in which businesses purchase products and services from each other have changed. The challenge of the present discussion is to describe changes within the value-added portion of the production recipe.

Value-added consists of three components:

1. property-type income (the returns paid to investors and any income of self-employed persons)—approximately one-third of all value-added;
2. indirect business taxes (a category that includes most taxes other than corporate income taxes), which account for around 8 percent of value-added; and
3. compensation paid to employees with different skills which represents the bulk, 59 percent, of value-added.

The first two categories have relatively straightforward interpretations and are discussed in greater detail in chapter 11. Since compensation paid to employees for their associated skills is such a large part of the value-added portion of the production recipe and represents the contribution of labor to the economy, it is the object of interest for this chapter.

Trends in the share of value-added paid to employee compensation in several specific business categories are shown in table 10-1. The gradual convergence in patterns of sector organization described in Part II can also be seen in this table. In general, the percent of value-added paid to employees increased for sectors with comparatively low ratios in 1956 (farming; mining; finance, insurance, and real estate; health services; legal services; and auto repair). Many of these sectors approached the 0.7 ratio that has been typical of manufacturing.

Technology and market structures have had uneven effects on compensation. The compensation to value-added ratio increased in areas like legal and health services, where capital invested per worker has grown (statistics on capital investment are provided later in this chapter—see table 10-9). The ratio fell in some heavily capitalized businesses, such

Lacking any good alternative, the skills people contribute to production can be measured using occupation categories. As has been the case in so many parts of this analysis, the selection of occupation categories is no easy task. Critical changes can be missed if the wrong units are selected to measure change. While the U.S. Bureau of Labor Statistics takes great pains to maintain a consistent set of occupation descriptions, and to update them when necessary, enormous ambiguities remain—some of the greatest of which are found in precisely the occupations where the fastest growth is occurring. A work force moving rapidly to new jobs built around advanced information equipment or networks of semi-autonomous work teams does not fall into convenient categories.

Two sets of occupation categories are used in the discussion:

- The 16 occupations summarized in box 10-A were selected because they expose areas where the most rapid occupation changes are occurring.
- Use of the 11 summary categories, shown in table 10-2, were made necessary by a major change in the occupation classification system in 1980 that makes more detailed comparisons between the 1970s and 1980s impossible.²

A table providing more detail on both systems appears in the Appendix.

Skills in the Production Recipe

Using pay as a proxy for the contribution made by each occupation, table 10-2 describes how skills enter production recipes, showing how much and what kind of employment is needed to produce a unit of output. Table 10-2 is identical to table 4-2 of chapter 4, except that table 10-2 provides more

¹Percentage breakdown of value-added is based on the "1977 Input-Output Tables," *Survey of Current Business*, vol. 64, No. 5, May 1984.

² See John Tschetter, "Producer Services Industries: Why Are They Growing So Rapidly?" *Monthly Labor Review*, vol. 110, No. 12, December 1987, pp. 31-41.

Table 10-1 .—Compensation as a Percent of Value-Added by Selected Businesses

	1956	1966	1976	1986
All private industries	52.8%	52.7%	54.4%	54.3%
Natural Resources				
Agriculture, forestry, and fishery services	15.8	18.5	18.9	21.3
Mining	34.4	35.2	31.8	32.2
Electric, gas, and sanitary services	34.3	30.1	29.8	28.2
Construction	70.0	70.4	67.1	67.3
Manufacturing	68.0	66.5	70.0	70.0
Fabricated metal products	80.0	76.8	74.7	74.9
Food and kindred products	58.7	56.0	58.8	60.3
Apparel and other textile products	86.6	84.2	85.1	82.2
Machinery, except electrical	72.8	71.1	73.6	80.3
Instruments and related products	76.9	69.9	76.1	74.0
Motor vehicles and equipment	56.4	49.3	67.5	78.0
Chemicals and allied products	53.4	53.8	55.1	62.8
Transportation and Trade				
Transportation	65.3	63.8	67.4	63.9
Wholesale trade	53.6	54.4	54.5	56.7
Retail trade	56.3	58.7	59.8	59.0
Transactional Activities				
Telephone and telegraph	52.5	43.3	47.1	41.5
FIRE ^b	18.7	19.2	23.1	26.6
Business services	60.8	67.0	63.6	62.1
Legal services	22.5	22.6	40.8	53.9
Personal Services				
Hotels and other lodging places	57.6	57.8	58.6	65.3
Automobile repair and services	39.7	39.7	38.6	43.3
Amusement and recreation services	47.4	51.8	60.4	63.2
Social Services				
Health services	41.5	49.0	71.7	76.6
Educational services	84.8	93.7	93.4	93.6
Social services and membership organizations	98.8	98.4	98.5	97.7

^aIncludes production of computers

^bFinance, insurance, and real estate includes U.S. Department of Commerce imputations for owner-occupied housing

NOTE Only a sample is shown for some categories

SOURCE Based on U.S. Department of Commerce, Bureau of Economic Analyses, "National Income and Product Accounts," historical diskettes, Tables 6.1 and 6.4.

detail on the value-added portion of the production recipes while table 4-2 provided more detail on intermediate inputs. Both show that value-added in manufacturing is a comparatively small fraction of the total value of manufacturing output, since manufacturing businesses are more highly linked to other parts of the economy by intermediate inputs. But table 10-2 reveals that certain occupations, like executives and managers or administrative support workers, are endemic to all sectors; others, such as machine operators or professional specialties, are relatively concentrated in one or two sectors. The table also shows the relative importance of skill in the production recipes of the sectors. For example, per unit of output, the Social Services sector uses a greater amount of inputs from the administrative support occupation than High Wage Manufacturing uses from all of the blue-collar occupations (preci-

sion production, craft, & repair; machine operators, assemblers, & installers; and transportation & material moving).

The direct contribution employment and its associated skills makes to a sector's production recipe depends on the interaction of two factors: the staffing pattern of the sector, and the compensation paid for a particular skill or occupation.

The factors connecting skills and wages are obviously complex. The summary data in table 10-3 show the difficulty of using occupations as a proxy for skills. Wages, for example, do not necessarily correlate to experience or levels of education. A variety of factors, such as skillful union bargaining, discrimination on the basis of race, age, and sex, and measurable forces of supply and demand, interact to establish wages. Wages in the service industries, for

Box 10-A.—Selecting Occupations

1. *Managers and Management Support* include executives, administrators, and support occupations like accountants and tax examiners.
2. *Technical Professionals* include engineers; natural, computer, and mathematical scientists; and architects and surveyors.
3. *Education and Health Professionals* include teachers, librarians, counselors, physicians, registered nurses, therapists, and other medical professionals.
4. *Other Professionals and Related Support* include social scientists, social workers, ministers, lawyers, judges, writers, artists, soothsayers, entertainers, and athletes.
5. *Technicians, and Related Support* include drafters, computer programmers, licensed practical nurses, surgical technicians, air traffic controllers, paralegals, and other technicians working in health, engineering, and the sciences.
6. *Sales Workers* include cashiers, insurance agents, real estate agents, travel agents, and a variety of other marketing and sales occupations.
7. *Other Customer Contact* workers include occupations directly involved with customers but not involved in sales. These include receptionists, insurance adjusters, and hotel desk clerks.
8. *Information Distribution* occupations include telephone operators, mail carriers, duplicating machine operators, meter readers, stock clerks, dispatchers, and other people responsible for keeping records, scheduling, dispatching, and distribution.
9. *Data Entry, Manipulation, and Processing* workers include computer operators, bookkeepers, secretaries, file clerks, tellers, and other office occupations.
10. *Food and Beverage Preparers* include most workers in restaurants and other commercial and institutional food service firms (e.g., bartenders, cooks, waiters, and waitresses).
11. *Other Service Workers* include, firemen, police, guards, child care workers, nursing aids, flight attendants, barbers, janitorial services, and private household workers.
12. *Precision Production, Craft, and Repair* occupations include the most highly skilled of the “blue collar” workers and their supervisors. The category includes machinists, tool and dye makers, the construction trades, mine workers, mechanics, and repair workers.
13. *Machine Operators, Assemblers, and Inspectors* involve more routine blue-collar work: machine set-up and operation, machine tending, and a variety of hand-work occupations such as hand sewers and welders.
14. *Transportation and Material Moving* workers include aircraft pilots, drivers of trucks, buses, and other equipment, and operators of forklifts and other industrial vehicles.
15. *Handlers, Equipment Cleaners, Helpers, and Laborers* are the lowest paid blue-collar workers. The jobs include refuse collectors, hand backers, and vehicle washers.
16. *Farming, Forestry, and Fishery* occupations include farm managers and supervisors as well as farm workers.

SOURCE: Based on classifications provided by the U.S. Department of Labor, Bureau of Labor Statistics.

example, have grown faster than measured productivity. This is presumably because employees in service enterprises gained some share of the productivity increases generated elsewhere in the economy.³ Chapter 11 discusses a number of reasons for believing that the connections between occupations and wages shown in table 10-3 will change during the next decades.

³This effect, sometimes known as the “Baumol disease,” is described in W.J. Baumol, “Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis,” *American Economic Review*, June 1967, pp. 415-426.

Table 10-4 avoids some of the problems inherent in accounting by wages, showing only the jobs required in each sector of the U.S. economy and each sector’s occupational staffing pattern. The table, of course, suffers from a limitation of its own—it cannot show how much each occupation contributes to the value-added in each industry. But it does show the mix of skills employed by each sector and how members of certain occupations are distributed across the sectors of the economy.

Tables 10-2 and 10-4 provide two perspectives on the way people enter production recipes that are use-

Table 10-2.—A Production Recipe Including Labor

	Natural Resources	Construction	Manufacturing			Transportation & Trade	Transactional Activities	Personal Services	Social Services
			Low	Medium	High				
Total Intermediate Inputs	53.3%	56.8%	63.5%	63.7%	70.4%	39.2%	27.2%	41.0%	21.7%
Value-Added	46.7	43.2	36.5	36.3	29.6	60.8	72.8	59.0	78.3
Property-Type Income	31.4	7.1	10.6	10.9	8.3	13.6	40.9	21.8	5.0
Indirect Business Taxes	3.5	1.1	1.1	1.7	2.2	9.6	9.9	3.5	0.2
Compensation	11.8	35.0	24.9	23.7	19.0	37.6	22.0	33.7	73.0
Executive, Administrative, & Managerial	1.3	6.4	2.1	3.0	2.4	6.1	5.7	5.1	8.9
Professional Specialty	1.0	0.6	0.4	2.1	2.0	1.0	2.7	2.7	30.4
Technical & Related Support	0.3	0.3	0.2	0.8	0.6	0.3	0.9	0.3	3.8
Sales	0.1	0.4	0.5	0.9	0.4	11.0	1.4	2.2	0.4
Administrative Support (including clerical)	1.2	2.2	1.9	2.7	1.7	5.1	7.6	2.8	12.5
Service Occupations	0.1	0.2	0.2	0.3	0.2	5.3	1.5	12.6	10.0
Precision Production, Craft, and Repair	2.8	18.0	5.3	4.9	5.2	3.6	1.5	4.0	3.8
Machine Operators, Assemblers, and Inspectors	0.3	0.6	11.2	6.7	4.8	0.4	0.2	1.5	0.6
Transportation and Material Moving	0.9	2.4	0.7	1.1	0.8	3.6	0.2	1.0	1.6
Handlers, Equipment Cleaners, Helpers, and Laborers	0.5	3.8	2.0	1.2	1.0	1.2	0.3	0.7	0.8
Farming, Forestry, and Fishing	3.1	0.0	0.3	0.0	0.0	0.0	0.1	0.8	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

How To Read This Table: \$100 in Output from Natural Resource Businesses combined \$53.30 of materials purchased from other businesses with \$46.70 of value-added in Natural Resource businesses. The value-added paid included the following: \$31.40 was in the form of returns to capital, \$1.30 was paid as compensation to executives, administrators, and managers, \$1.00 was for compensation to professionals (mostly scientists and engineers), and \$1.20 was paid to clerks and other administrative support personnel.

NOTE: See appendix for a key to the occupations classification scheme. Numbers may not add due to rounding.

SOURCES: 1977 Input/Output Table, Survey of *Current Business*, May 1984, used for decomposition of value-added; 1980 Input/Output Tables, Bureau of Economic Analysis, unpublished; 1984 Occupation by Industry Employment Matrix, Bureau of Labor Statistics, unpublished; Table 5, "Median Weekly Earnings for Wage and Salary Workers in 1984," Bureau of Labor Statistics, adjusted to include compensation; U.S. Department of Labor, "Total Employment By Occupation, 1984," adjusted to account for self-employed workers, unpublished.

Table 10-3.—Characteristics of the Occupations, 1984

Occupation ^a	Median earnings ^b (\$ weekly)	Percent female	Percent black ^c	Education ^d		Age		Unemployment rate
				Percent high school	Percent college	Percent 16-24	Percent 25-54	
Executive, Administrative, and Managerial	\$483	33.6%	6.1%	49.6%	45.0%	7.5 %/0	79.60/0	2.70/0
Professional Specialty.	455	48.5	6.7	24.1	74.5	8.0	81.8	2.5
Technicians & Related support	379	48.1	20.5	67.9	28.6	23.1	70.1	2.9
Sales	319	47.9	12.4	65.4	21.0	24.8	64.1	5.4
Administrative Support (including clerical)	275	79.9	11.6	82.0	11.0	21.3	68.1	5.1
Private Household Services Protective and Other Services.	134	96.2	29.6	42.3	1.6	30.9	51.0	6.9
Precision Production, Craft, and Repair.	232	58.2	23.7	63.2	5.7	31.4	58.3	9.2
Machine Operators, Assemblers, and Inspectors	384	8.5	7.9	70.9	5.4	16.0	73.2	7.5
Transportation and Material Moving	277	41.1	13.9	61.0	2.8	18.6	70.1	10.7
Handlers, Equipment Cleaners, Helpers, and Laborers	344	8.3	15.1	63.4	3.1	15.8	72.7	9.2
Farming, Forestry, and Fishing.	251	16.6	22.7	60.1	2.6	43.3	49.9	15.1
Average	203	15.6	8.0	52.2	7.9	24.2	61.8	8.5
	326	43.7	10.1	60.0	22.1	19.7	69.5	6.6

^aSee appendix fo, a key to the OCCUPATIONS classifications scheme. Service occupations are here broken out into "private household" and "Protective and other."

^bMedian earnings data in current dollars, calculated for "wage and salary workers who usually work full-time."

^cRace data compiled from *Employment and Earnings*, annual review issue. Data are for 1985.

^dEducational attainment data collected from annual survey (not annual averages).

SOURCE: Office of Technology Assessment, 1988, based on unpublished data provided by the U.S. Department of Labor, Bureau of Labor Statistics.

ful for understanding recent patterns of change. For example:

- Although High Wage Manufacturing only spends about 4 cents per dollar of output on inputs from the Transactional Activities sector (see table 4-2 of ch. 4), it spends nearly twice that amount (7.1 cents) on labor inputs that would be considered transactional: managers, professional specialists, technicians, sales workers, and administrative support workers.
- About one-quarter of all jobs in Social Services (dominated by teaching and health activities) are held by individuals requiring professional training, making this by far the most highly educated sector.
- Over three-quarters of the managers and management support jobs are in the service sectors.
- About one out of eight jobs fall into the data entry, manipulation, and processing occupations—more than double the number employed as food and beverage preparers. The data entry occupation represents nearly one-third of all jobs in the Transactional Activities sector.
- More people work in Transportation & Trade

than in all of manufacturing and Construction combined.

The remaining element connecting jobs and skills to structural changes in the economy is the unseen, indirect requirement for different types of labor generated through firms' purchases of inputs needed for their production recipes. Using methods described in chapter 4 (and data in tables 10-2 and 10-4), table 10-5 traces the links connecting the natural resources & construction, manufacturing, and service sectors in 1984.⁴ The impact of sectoral linkage on the work force is similar to that found for value-added (table 4-4 of chapter 4) and trade (table 7-10 of chapter 7). Demand for manufacturing and natural resource & construction products tends to generate a significant portion of jobs outside these sectors, while the service sector tends to be relatively insular.

Fully 14 percent of all service sector jobs result indirectly from demand for the natural resource and manufacturing products; manufacturing alone was

⁴The table shows only domestic jobs, since imports have been removed using methods described in ch. 7.

Table 10-4.--Employment by Occupation and Industry, 1984

	Natural Resources	Construction	Low Wage Manuf.	Med Wage Manuf.	High Wage Manuf.	Transportation and Trade	Transactional Activities	Personal Services	Social Services	Total	Millions of Jobs
Percent of all jobs in each occupation, by sector:											
Managers and Management Support	2.2%	5.9%	2.3%	8.1%	5.0%	26.9%	22.3%	4.7%	22.6%	100.0%	113
Technical Professionals	6.3	2.4	1.6	21.0	18.3	5.8	23.5	0.3	20.9	100.0	2.1
Education and Health Professionals	0.3	0.0	0.0	0.1	0.0	1.7	1.0	1.4	95.4	100.0	71
Other Professionals	1.5	0.3	0.6	6.3	2.1	8.1	21.0	5.9	54.2	100.0	3.6
Technicians	2.6	1.4	1.0	11.3	7.0	6.2	18.2	1.4	50.9	00.0	3.2
Sales Workers	0.4	0.6	0.9	3.9	1.3	79.0	8.9	3.3	1.8	00.0	11.2
Other Customer Contact	1.8	0.2	0.4	1.0	0.4	15.2	4.0	11.6	29.2	00.0	1.3
Information Distribution	1.8	0.7	3.4	9.0	5.1	35.8	15.3	1.5	27.3	00.0	3.8
Data-entry, Manipulation, and Processing	2.1	2.5	1.9	6.8	3.2	18.2	31.4	2.0	3.1	00.0	13.6
Food and Beverage Preparers	0.1	0.0	0.0	0.1	0.0	72.2	0.7	9.1	17.9	00.0	6.6
Other Service Workers	0.5	0.4	0.7	1.7	1.2	7.0	14.2	22.9	51.5	00.0	9.9
Precision Production, Craft, and Repair	5.7	1.9	7.1	15.3	12.5	18.1	6.7	4.3	11.2	00.0	12.5
Machine Operators, Assemblers, and Inspectors	1.2	1.2	27.0	37.7	21.0	4.1	1.8	2.9	3.1	100.0	8.2
Transportation and Material Moving	5.3	7.3	2.8	9.4	5.2	51.2	2.3	3.1	13.4	100.0	4.7
Handlers, Equipment Cleaners, and Helpers	4.4	16.7	10.9	15.0	9.8	24.2	5.5	3.2	10.2	100.0	4.2
Farming, Forestry, and Fishing	70.9	0.3	4.2	1.0	0.4	0.6	4.5	9.7	8.4	100.0	3.6
Total (percent)	4.5	4.5	4.5	9.3	5.7	26.3	2.8	5.6	26.8	1000	106.8
Percent of all jobs in each sector, by occupation:											
Managers and Management Support	5.2%	13.8%	5.6%	9.2%	9.2%	10.8%	8.4%	8.8%	8.9%	10.6	
Technical Professionals	2.8	1.1	0.7	4.5	6.4	0.4	3.6	0.1	1.6	2.0	
Education and Health Professionals	0.5	0.0	0.0	0.0	0.0	0.4	0.5	1.7	23.8	6.7	
Other Professionals	1.1	0.2	0.4	2.3	1.2	1.0	5.4	3.5	6.7	3.3	
Technicians	1.8	0.9	0.7	3.6	3.7	0.7	4.2	0.7	5.7	3.0	
Sales Workers	0.8	1.4	2.2	4.4	2.4	31.4	7.2	6.1	0.7	0.5	
Other Customer Contact	0.5	0.1	0.1	0.1	0.1	0.7	3.7	2.4	1.3	1.2	
Information Distribution	1.5	0.5	2.8	3.5	3.2	4.9	4.3	0.9	3.7	3.6	
Data-entry, Manipulation, and Processing	6.0	7.1	5.5	9.3	7.1	8.8	31.2	4.5	15.2	2.7	
Food and Beverage Preparers	0.1	0.0	0.0	0.1	0.0	17.0	0.3	10.0	4.1	6.2	
Other Service Workers	0.9	0.8	1.5	1.7	2.0	2.5	10.3	37.8	17.9	9.3	
Precision Production, Craft, and Repair	15.0	50.2	18.6	19.2	25.6	8.0	6.1	9.0	4.9	11.7	
Machine Operators, Assemblers, and Inspectors	2.1	2.1	46.5	31.0	28.1	1.2	1.0	3.9	0.9	7.6	
Transportation and Material Moving	5.2	7.2	2.7	4.4	4.0	8.5	0.8	2.4	2.2	4.4	
Handlers, Equipment Cleaners, Helpers	3.9	14.5	9.5	6.3	6.7	3.6	1.7	2.2	1.5	3.9	
Farming, Forestry, and Fishing	52.7	0.2	3.2	0.4	0.2	0.1	1.2	5.7	1.0	3.3	
Total (percent)	100.0	100.0	100.0	1000	100.0	100.0	100.0	100.0	100.0	100.0	
Millions of jobs	4.8	48	4.8	99	6.1	281	13.7	6.0	28.6	106.8	

How To Read This Table: 2.2% of all managers and management support jobs are provided by natural resource businesses (top table). 5.2% of all jobs in Natural Resource businesses go to managers and management support (bottom table).

NOTE: Employment displayed is for wage and salary jobs adjusted for the self-employed. The 16 occupation categories listed here accord with the 11 listed in table 10-2, except that certain occupations are subdivided for a more complete listing of occupation categories (e.g., "professional specialty" is subdivided into "technical professionals," "education & health professionals," and "other" (mostly law and science). self-employed persons are accounted for through data provided by the Bureau of Labor Statistics. See the appendix for a key to the occupations classification scheme. Numbers may not add due to rounding.

SOURCE: Office of Technology Assessment, from 1984 Industry by Occupation Employment Matrix, developed by the U.S. Department of Labor, Bureau of Labor Statistics, Office of Economic Growth and Employment Projections.

Table 10-5.—1984 Wage and Salary Employment Generated From 1984 Demand for Natural Resources, Construction, Manufactured Products, and Services

Sector	1984 jobs (percent)	Percent of 1984 jobs resulting from 1984 demand for:		
		Natural resources and construction	Manufacturing	Services
Natural Resources and Construction:				
Natural Resources	3.5%	12.8%	6.6%	1.2%
Construction	4.5	28.6	2.7	1.7
Subtotal	7.9	41.4	9.4	2.9
Manufacturing:				
Low Wage Manufacturing	4.6	4.5	15.8	1.0
Medium Wage Manufacturing	9.6	13.1	26.1	3.8
High Wage Manufacturing . . .	5.9	6.1	18.9	1.7
Subtotal	20.0	23.7	60.8	6.5
Services:				
Transportation & Trade	26.3	19.8	18.0	29.9
Transactional Activities	13.0	12.2	9.2	14.3
Personal Services	5.5	1.4	1.6	7.4
Social Services	27.2	0.5	1.1	39.0
Subtotal	72.1	34.9	29.8	90.6
Total (percent)	100.0	100.0	100.0	100.0
Total (millions of jobs)	96.9	9.2	21.2	66.6

How To Read This Table: In 1984, demand for natural resource and construction products, indirectly and directly, generated 9.2 million jobs, 41.4 percent of which were in the Natural Resource sector, 23.7 percent were manufacturing jobs, and 34.9 percent were service sector jobs.

SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, various tables; and "1980 Input/Output Tables, unpublished; U.S. Department of Labor, Bureau of Labor Statistics, "1984 Occupation by Industry Matrix," unpublished; and 1984 trade estimates, rebased from \$1977 to \$1980, unpublished

responsible for 1 out of 11 service jobs. Of the service jobs created indirectly, 72 percent appeared in three industries: wholesale & retail trade, business services, and transportation & warehousing.⁵ Purchases of manufactured goods were responsible for nearly one-quarter of all transportation and warehousing workers, 23 percent of all business service jobs, and 16 percent of all wholesale and retail employees in 1984. Although a strong link exists between the demand for manufacturing goods and service sector jobs, the natural resources & construction sector contributes proportionately more to service sector employment than does manufacturing.

⁵ This analysis does not attempt to factor in the indirect effect of manufacturing workers spending their wages on service products like travel, and on the service jobs that might be produced in the process. Rather, this analysis merely looks at the indirect effect caused by manufacturing businesses purchasing service inputs for their production recipes. For further analysis on the connections between manufacturing and business services see Bobbie H. McCrackin, "Why Are Business and Professional Services Growing So Rapidly?" *Economic Review*, Federal Reserve Bank of Atlanta, August 1985; and John Tschetter, op. cit., footnote 2.

Of the 86 percent of service jobs created directly through demand for service products, nearly 90 percent appear in six industries: wholesale & retail trade (28 percent), government (25 percent), health, education, & social services (17 percent), business services (9 percent), and eating & drinking places (9 percent). Demand for service products indirectly created about the same number of jobs in the manufacturing sector as the number of service sector jobs created by demand for manufactured goods, albeit at a proportionately much lower rate.

Some manufacturers depend heavily on demand from service industries. Aircraft manufacturers, for example, sell primarily to airlines. Over half of all the jobs in the furniture & fixtures (non-household) industry were generated through demand for service products, presumably an indirect result of furnishing service industry office buildings. A similar situation held for 46 percent of printing & publishing jobs, 39 percent of the service industry machine employees, and 34 percent of the scientific and controlling instruments workers.

Closing the Circle: Converting Skills to Amenity

Using methods similar to those employed in chapter 4 to convert value-added by production sectors into categories of amenity, the jobs and occupations needed to provide the amenities can also be calculated. These estimates, shown in table 10-6, complete the circuit outlined in chapter 1. They trace value from the labor offered by households to the amenities received for their skills.

The table is an interesting measure of the distance the economy has moved from subsistence. A table computed for a developing economy (or indeed the American economy of 1874) would show most jobs involving farming or manual labor used to provide basic food and housing. In 1984, however, less than one-third of all American workers were directly or indirectly involved in the provision of the Food and Housing amenities. Only about 11 percent of these

workers were farmers or other laborers. Most were managers, professionals, technicians, service workers, or sales workers.

Health, Education, and the Government employ disproportionately large numbers of professionals. The U.S. Department of Defense is responsible for about 7.2 percent of all jobs in the economy, but one-third of these jobs are categorized as managers and professionals.

Managers and administrators account for about 10 percent of all jobs in most amenity categories, and administrative support occupations (such as clerks and secretaries) provide about one-sixth of the jobs needed. Not surprisingly, most sales employees work to provide Food (restaurant and grocery sales), Housing (real estate), Transportation (travel), and Clothing and Personal Care (clothing sales). Over one-third of all manual jobs, including precision craft jobs, are involved in the production of Food and Housing.

TRENDS IN NET JOB GENERATION AND LOSS

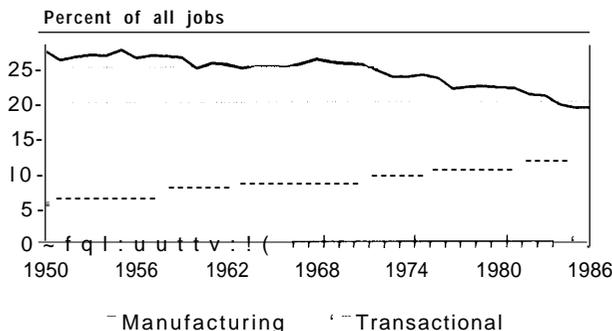
The data just introduced will be used to explore the forces driving changes in U.S. job creation during the last decade. Before proceeding, it is worth reviewing the nature of these changes in greater detail:

- A steady 30-year decline in the manufacturing sectors' share of employment has been almost exactly offset by increases in Transactional Activities (see figure 10-1a). Taken together, Low

and High Wage Manufacturing lost more than one million full-time jobs between 1978 and 1986 (see figure 10-1b). Manufacturing was the only sector to lose jobs over this time period.

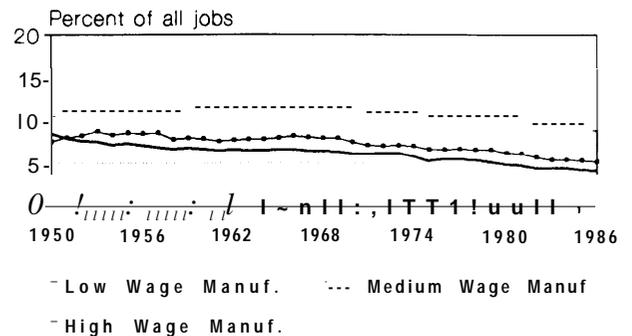
- Between 1950 and 1975, the share of employment lost by Natural Resource businesses (primarily farming) was almost exactly off-set by the increased share of Social Services (dominated by education, medicine, and government). Both

Figure 10-1a. -Manufacturing and Transactional Activities Jobs as a Percent of All Jobs



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, table 6.10.

Figure 10-1b.-Low Wage, Medium Wage, and High Wage Manufacturing Job as a Percent of All Jobs



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, table 6.10.

Table 10-6.—Jobs Required To Supply Different Kinds of Amenity in 1984

	Food		Transportation	Health	Clothing and		Education	Personal		Government	Federal	Exports	Total	Millions of jobs
	Housing	Personal			Care	Business and		Leisure	n.e. c.					
<i>Percent of jobs in each occupation category, by amenity network:</i>														
Managers and Management Support	14.5%	15.1 %	8.3%	12.1 %	6.6%	7.9%	8.8%	7.8%	5.0%	7.1%	6.8%	100.0%	11.3	
Technical Professionals	9.6	13.9	8.0	9.1	4.5	9.5	6.2	6.9	5.7	14.1	12.5	100.0	2.1	
Education and Health Professionals*	1.5	1.1	1.1	30.9	0.7	27.0	1.2	7.3	12.6	16.1	0.4	100.0	7.1	
Other Professionals	7.1	7.3	4.0	23.9	3.5	15.0	5.9	11.9	7.4	9.9	4.1	100.0	3.6	
Technicians	6.8	9.4	4.9	26.0	3.4	12.3	5.2	9.2	6.2	9.5	6.9	100.0	3.2	
Sales Workers	23.8	17.0	12.7	6.3	13.0	2.0	4.7	8.8	1.9	2.6	7.2	100.0	11.2	
Other Customer Contact	7.7	10.2	6.7	18.3	6.4	7.5	19.4	9.5	4.7	5.0	4.6	100.0	1.3	
Information Distribution	16.1	17.4	9.5	9.3	8.9	5.4	7.7	7.8	3.7	5.9	8.3	100.0	3.8	
Data-Entry, Manipulation, and Processing	10.3	12.3	7.0	15.2	5.3	10.5	12.5	7.2	6.0	7.9	5.7	100.0	13.6	
Food and Beverage Preparers	56.2	4.8	2.7	10.2	4.3	3.0	2.2	7.6	2.8	3.7	25	100.0	6.6	
Other Service Workers	6.1	188	3.0	22.2	4.8	13.4	3.5	10.5	6.6	8.4	2.8	100.0	9.9	
Precision, Production, Craft, and Repair	13.4	22.9	11.1	7.3	7.2	6.2	3.9	6.8	4.8	6.9	9.4	100.0	12.5	
Machine Operators, Assemblers, and														
Inspectors	13.4	17.1	10.0	6.2	16.7	3.1	2.8	7.6	2.7	6.8	13.6	100.0	8.2	
Transportation and *Material Moving	18.6	17.8	13.4	7.3	6.7	6.8	2.3	7.1	4.8	6.1	9.2	100.0	4.7	
Handlers, Equipment Cleaners, and														
Helpers	17.4	22.2	10.4	7.1	8.3	6.0	2.8	6.6	4.7	5.7	8.8	100.0	4.2	
Farming, Forestry, and Fishing	43.7	15.6	1.7	4.7	1.9	4.3	0.9	7.2	2.3	2.5	15.4	100.0	3.6	
Total (percent)	16.3	14.8	7.6	13.0	7.0	8.6	5.5	8.0	5.1	7.2	7.0	100.0	106.8	
<i>Percent of jobs in each amenity category, by occupation:</i>														
Managers and Management Support	9.4%	10.8%	11.5%	9.8%	9.9%	9.7%	7.1%	10.3%	10.3%	10.4%	0.3%	10.6		
Technical Professionals	1.2	1.9	2.1	1.4	1.3	2.2	2.3	1.7	2.2	3.9	3.6	2.0		
Education and Health Professionals	0.6	0.5	1.0	15.8	0.6	21.0	1.4	6.1	16.5	15.0	0.4	6.7		
Other Professionals	1.4	1.7	1.8	6.1	1.7	5.8	3.6	5.0	4.8	4.6	2.0	3.3		
Technicians	1.3	1.9	1.9	6.0	1.5	4.3	2.9	3.4	3.6	4.0	3.0	3.0		
Sales Workers	5.2	12.0	17.6	5.1	19.4	2.4	9.0	11.6	3.9	3.8	0.8	10.5		
Other Customer Contact	0.6	0.8	1.0	1.7	1.1	1.0	4.2	1.4	1.1	0.8	0.8	1.2		
Information Distribution	3.5	4.3	4.5	2.6	4.6	2.2	5.1	3.5	2.6	2.9	4.3	3.6		
Data-Entry, Manipulation, and Processing	8.0	10.6	11.8	14.8	9.6	15.6	29.3	11.4	15.1	14.0	10.4	12.7		
Food and Beverage Preparers	21.4	2.0	2.2	4.9	3.9	2.2	2.5	5.9	3.4	3.2	2.3	6.2		
Other Service Workers	3.5	11.8	3.6	15.9	6.4	14.5	6.0	12.3	12.0	10.9	3.7	9.3		
Precision, Production, Craft, and Repair	9.6	18.1	17.1	6.6	12.1	8.5	8.4	10.0	11.0	11.3	15.7	11.7		
Machine Operators, Assemblers, and														
Inspectors	6.3	8.9	10.1	3.6	18.2	2.8	4.0	7.2	4.1	7.3	14.9	7.6		
Transportation and Material Moving	5.0	5.3	7.7	2.5	4.2	3.5	1.8	3.9	4.1	3.7	5.8	4.4		
Handlers, Equipment Cleaners, and														
Helpers	4.1	5.9	5.3	2.1	4.7	2.7	2.0	3.2	3.6	3.1	4.9	3.9		
Farming, Forest, and Fishing	8.9	3.5	0.7	1.2	0.9	1.6	0.5	3.0	1.5	1.1	7.3	3.3		
Total (percent)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
Millions of jobs	17.5	15.8	8.1	13.9	7.5	9.2	5.8	8.5	5.4	7.7	7.5	106.8		

NOTE: Employment displayed is for wage and salary jobs adjusted for the self-employed. The 16 occupation categories listed here accord with the 11 listed in table 10-2, except that certain occupations are subdivided for a more complete listing of occupation categories (e.g., "professional specialty" is subdivided into "technical professionals," "education & health professionals," and "other" (mostly law and science). Self-employed persons are accounted for through data provided by the Bureau of Labor Statistics. See the appendix for a key to the occupations classification scheme. Numbers may not add due to rounding.

SOURCE: Office of Technology Assessment, from 1964 Industry by Occupation Employment Matrix, developed by the U.S. Department of Labor, Bureau of Labor Statistics, Office of Economic Growth and Employment Projections and U.S. Department of Commerce, Bureau of Economic Analysis, "1980 Input-Output Tables," unpublished.

sectors have held a relatively constant share of all jobs since 1975 (see figure 10-1c).

- The share of employment held by Construction, Transportation & Trade, and Personal Services has not changed significantly since 1950 (see figure 10-1 d). The steady share of jobs held by the Transportation & Trade sector resulted from gains in wholesale and retail trade, which were offset by losses in transportation. Construction employment is highly cyclical.
- Government employment (including defense) peaked in 1970. Federal civilian employment is now below the levels of 1950. State and local governments gained share through 1980.⁶

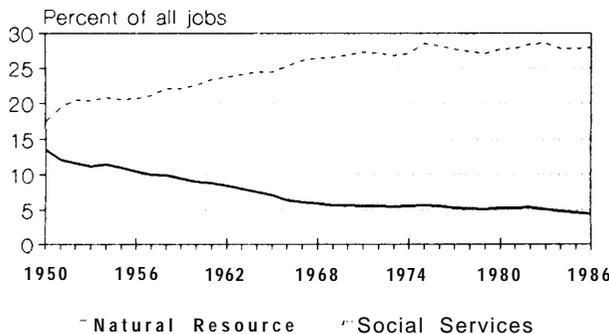
Accounting for Changes in Job Share

Changes in each business' share of U.S. employment are driven by the forces described in earlier chapters: domestic demand, production recipes, and trade patterns. The effect of these forces on the changing value-added contributions of each major business sector was traced in chapter 5. Clearly, any factor that changes the contribution a sector makes to the gross national product (GNP) affects the number of jobs contributed by that sector, depending on the productivity with which the sector uses labor. These effects are examined separately in table 10-7. Some highlights:

- Comparatively stable full-time-equivalent employment in Natural Resources during 1972-84

⁶U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, table 6.7b.

Figure 10-1c.-Natural Resource and Social Service Jobs as a percent Of All Jobs



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, table 6.10,

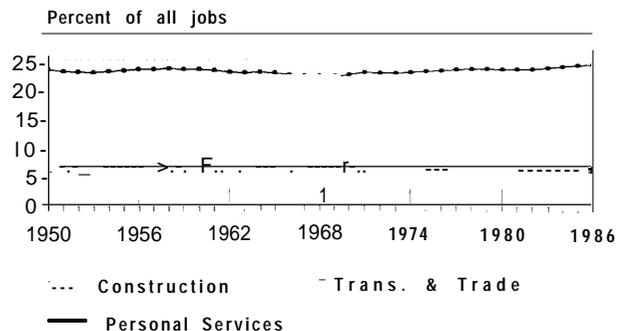
resulted from declining measured productivity (requiring more jobs for a given level of output), which offset the effects of declining domestic demand.

- Manufacturing's share of all employment fell sharply as a result of three effects: rising productivity, shrinking domestic markets for High Wage Manufacturing enterprises, and increasingly unfavorable terms of trade,
- Transportation and wholesale & retail employment grew both because of increased domestic and international demand and changes in production recipes.
- Explosive growth in transactional employment occurred because of comparatively slow productivity growth and rapid growth in demand for Transactional activities both as final and intermediate demand.

The major difference between table 10-7 and table 5-1 of chapter 5 is the addition of labor productivity. Labor productivity, or output per job in an industry, depends on the level of technology utilized, the quality of management, the capital invested per worker, and the skills, experience, and esprit of the staff. All of these factors are in flux.

Table 10-8 summarizes recent trends in productivity, as measured by output per hour worked. Output per hour in 1984 was comparatively high for Natural Resource and Medium and High Wage Manufacturing enterprises, and comparatively low for the poorly capitalized Personal and Social Services—this despite the fact that most workers in Social Services are relatively well educated.

Figure 10-1d.-Construction, Personal Service, and Transportation & Trade Jobs as a Percent of All Jobs



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, table 6.10.

Table 10-7.—Changes in Industry Share of Full-Time Equivalent Employees (FTEs) from 1972 to 1984 for Various Factors
(in percent; numbers will not necessarily add due to rounding and interactive effects)

	Natural Resources	Construction	Low Wage Manufacturing	Medium Wage Manufacturing	High Wage Manufacturing	Transportation and Trade	Transactional Activities	Personal Services	Social Services* and Rental†	Real Estate
Job shift share	0.0	-0.5	-1.9	-1.3	-1.7	1.5	3.3	0.1	0.3	0.3
Productivity °	0.5	0.2	-0.8	-1.4	-0.5	-0.9	1.3	0.4	1.0	0.1
Production recipe and demand	-0.6	-0.8	-1.0	0.1	-1.1	2.3	2.0	-0.3	-0.8	0.1
Production recipe	-0.1	-0.0	-0.3	-0.2	-0.3	1.4	1.0	-0.2	-1.2	-0.1
Final demand	-0.5	-0.7	-0.6	0.2	-0.8	0.8	1.0	-0.1	0.5	0.1
Domestic demand	-0.5	-0.8	-0.0	0.4	-0.4	0.3	0.8	-0.1	0.2	0.1
Trade	-0.0	0.1	-0.6	-0.3	-0.3	0.5	0.2	0.0	0.4	0.0
Interactive	0.1	0.0	-0.1	0.0	-0.1	0.1	0.0	0.0	0.1	0.1

How To Read This Table: Between 1972 and 1984, employees of businesses in the Transactional Activities sector increased their share of the U.S. work force by 3.3%. Of this increase, 1.3% can be attributed to changes in this sector's productivity; 1.0% to changes in intermediate demand for Transactional Activities ("production recipe"); and 1.0% to changes in final demand for Transactional Activities (0.8% was domestic demand).

*Includes Federal Defense.

†Real Estate and Rental has been broken out of Transactional Activities due to the difficulty in estimating total output in 1984.

°Estimated using 1984 and 1972 Output per FTE.

NOTE: Job Shift Share = Productivity + Production Recipe and Demand + Interactive

Final Demand = Domestic Demand + Trade

Numbers may not add due to rounding.

SOURCE: Office of Technology Assessment, 1988.

Table 10-8.—Productivity and Productivity Growth
(measured in 1977 dollars)

	Output per hour in 1984	Annual growth rates in productivity (in percent)		
	(\$1977)	1958-1984	1958-1973	1973-1984
Natural Resources	\$31.50	3.11%	5.47%	0.62%
Construction	24.88	-0.74	0.74	-1.32
Manufacturing	35.24	2.02	2.61	1.32
Low Wage	23.52	2.26	2.53	2.16
Medium Wage	32.72	2.03	2.15	1.90
High Wage	48.19	1.97	3.03	0.64
Transportation and Trade	14.91	1.71	2.79	0.54
Transactional Activities	25.65	1.04	1.38	0.58
Personal Services	10.40	1.83	2.76	0.22
Social Services	11.20	0.88	1.08	0.35
Total	23.07	1.58	2.67	0.41

NOTE: Growth rates represent regressions on the log of output per hour.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, "Time Series Data Base for InPut-OutPut Industries," June 1985, unpublished.

Low rates of productivity growth between 1973 and 1984 have been the source of considerable anguish.⁷ There are no completely satisfactory explanations, though a large variety have been offered: a surge of less experienced workers from the baby boom, a decrease in R&D expenditures, dramatic shifts in oil prices that led to greater inputs of both capital and labor, and new government regulations that increased labor without increasing sales.⁸ There is, of course, always the possibility that measurement techniques are inadequate.⁹

There is reason to believe that traditional patterns of productivity growth may be changing. Information technology maybe able to produce productivity gains in areas never before expected. While most national productivity growth once depended on manufacturing, it is possible that productivity growth in

crucial information industries may make major contributions to national productivity growth during the next two decades. All of this is obviously speculative since table 10-8 shows no significant recent growth in the productivity of service activities. The discussions of chapter 6, however, clearly showed the potential for real productivity growth.

There are also no acceptable techniques for measuring the productivity with which a complex production network delivers concrete services like health or education to final consumers. In periods of transformation, one of the most important products generated by businesses is learning and experience with new production paradigms. None of this learning can be gauged using short-term measures of output. The advantage of new and more flexible systems of production can only be measured by examining how they operate in a fast-moving, competitive environment over a significant period of time. Indeed, in order to achieve system-wide productivity improvements it might be necessary for some components of the network to experience productivity declines. The increased use of less-than-truckload delivery to keep inventories at a minimum is such an example. The discussions in chapter 6 provided some perspective on this issue for individual sectors.

Some evidence of the potential for *changes in* productivity growth can be found in statistics tracing new patterns of capital investment following the 1982 recession (see table 10-9). Capital investment in areas such as retail services averages less than

⁷ Edward F. Denisen, *Accounting for Slower Productivity Growth* (Washington, DC: The Brookings Institution, 1974) and Martin N. Baily, "What Has Happened to Productivity Growth?" *Science*, vol. 234, October 1986, pp. 443-450.

⁸ See Edward F. Denisen, "The Interruption of Productivity Growth in the United States," *The Economic Journal*, vol. 93, March 1983; Herbert Giersch and Frank Welter, "Towards an Explanation of the Productivity Slowdown: An Acceleration-Deceleration Hypothesis," *The Economic Journal*, vol. 93, March 1983; Wayne B. Gray, "The Impact of OSHA and EPA Regulation on Productivity," working paper, National Bureau of Economic Research, Cambridge, MA, July 1984; Assar Lindbeck, "The Recent Slowdown of Productivity Growth," *The Economic Journal*, vol. 93, March 1983; Zvi Griliches, "R&D and the Productivity Slowdown," *The American Economic Review*, vol. 70, No. 2, May 1980; Martin N. Baily and Alok K. Chakrabarti, "Innovation and Productivity in U.S. Industry," *Brookings Papers on Economic Activity*, No. 2, 1985.

⁹ See Michael R. Darby, "The U.S. Productivity Slowdown: A Case of Statistical Myopia," *The American Economic Review*, vol. 74, No. 3, June 1984.

Table 10-9.—Capital Invested Per Person Engaged in Industry, 1982 and 1985
(all figures in thousands of 1982 dollars per person)

	Total capital stock			
	Gross stock per person		Net stock per person	
	1982	1985	1982	1985
Natural Resources ^a	\$305	\$345	\$172	\$187
Construction	23	17	12	9
Manufacturing	71	73	40	39
Transportation and Trade	47	46	26	26
Wholesale trade	34	41	20	26
Retail trade	22	23	13	14
Transportation	186	172	93	86
Transactional Activities				
Finance, insurance, and real estate ^b	151	161	92	98
Banking	63	80	38	48
Credit	132	137	80	85
Security	11	11	7	7
Insurance carriers	16	21	10	13
Business services	31	29	18	17
Legal services	9	10	5	6
Personal Services				
Auto repair services and garages	81	84	45	49
Hotels and other lodging	56	57	32	34
Motion pictures	37	37	20	20
Amusements and recreation	50	49	26	26
Social Services				
Health	11	12	7	8
Education	2	2	1	1

How To Read This Table: In 1982, net holdings of capital equipment in the natural resource industry were valued at \$172,000 per person employed in that industry. By 1985, this value had grown (in real dollars) to \$187,000.

^aIncludes agriculture, forestry, fisheries; mining; and electric, gas, and sanitary services.

^bAlso includes insurance agents and brokers, and services; real estate; and holding and other investment companies.

NOTE: Net capital excludes all equipment that has been fully depreciated using standard techniques. "Persons" refers to Full-Time Equivalent Employees plus self-employed persons in that industry, as defined in the National Income and Product Accounts, table 6.10.

SOURCE: J.C. Musgrove, "Fixed Reproducible Tangible Wealth in the United States, 1982-1985," p. 37; U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, August 1988; and "National Income and Product Accounts," historical diskettes.

half of that in manufacturing. Still, between 1982 and 1985, capital investment per worker grew more rapidly in many service businesses—in areas as diverse as wholesale trade, health care, automobile repair, law, and insurance—than in manufacturing.¹⁰ Insurance companies, hospitals, and banks are now making heavy investments in information technologies and other equipment; these kinds of expenditures

are beginning to result in real productivity gains. " Similarly, grocery stores spent nearly as much on computers and related peripheral equipment in 1982 as the entire motor vehicle industry.¹² Education was an exception to the trend; as table 10-9 shows, this industry remained close to the bottom of the list.

¹⁰See James Brian Quinn, "The Impacts of Technology in the Services Sector," in Bruce R. Guile and Harvey Brook (eds.), *Technology and Global Industry* (Washington, DC: National Academy Press, 1987), for a more detailed discussion of capital investments by services.

¹¹James Brian Quinn and Christopher E. Gagon, "Will Services Follow Manufacturing Into Decline?" *Harvard Business Review*, vol. 64, No. 6, November-December 1986, p. 99.

¹²U.S. Department of Commerce, Bureau of the Census, "1982 Enterprise Statistics: General Report on Industrial Organization," October 1986, table 8, p. 292.

TRENDS IN OCCUPATIONS

The discussion thus far has followed changes in the total employment of different production sectors. Changes in the organization of work *within* these sectors have been much greater than shifts of employment *between* sectors. Again, it is useful to examine trends in job creation by occupation before attempting an explanation.

Figure 10-2 traces changes in occupations during the past century. Table 10-10 provides greater detail for the period between 1972 and 1987. There has been a consistent increase in the number of people who spend most of their day in front of office equipment or computer terminals, and a sharp decline in demand for people living by the strength of their backs or the talents of their hands. In particular:

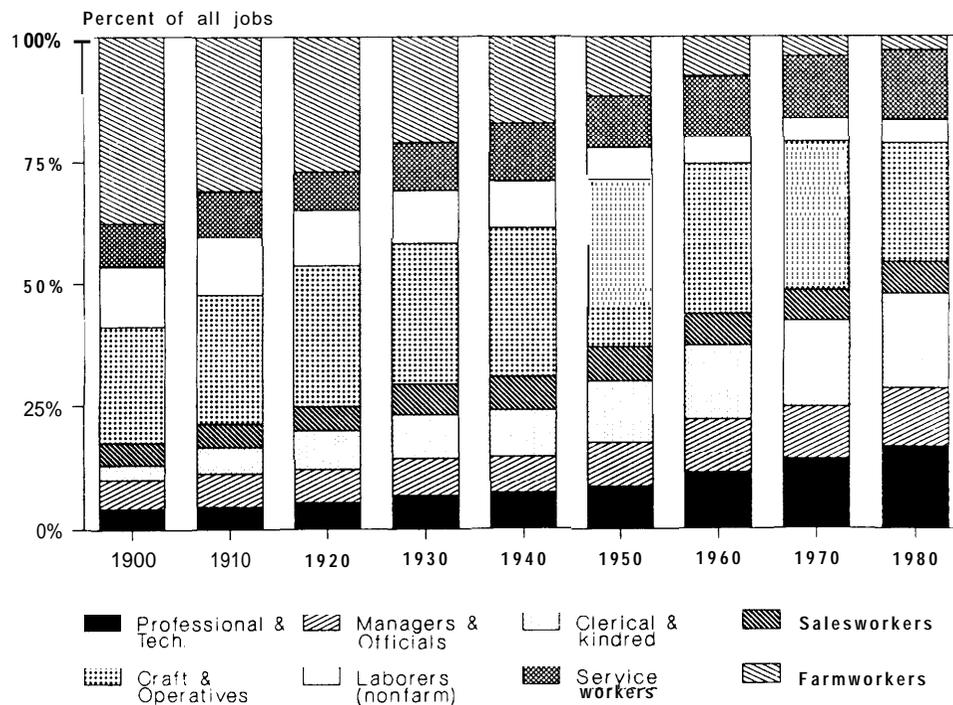
- Farm workers have declined from about one-third of the work force at the turn of the cen-

tury to less than 3 percent of the total.

- Operatives and craft workers increased from about 20 percent of all workers in 1900 to more than 35 percent at their peak in the 1950s, but their numbers have since fallen.
- There was consistent growth in clerical work between 1910 and 1980. This trend has slowed only in the last few years. The number of secretaries actually declined during the 1982/83 recession; growth since then has been moderate.¹³
- Since 1972, most job growth has been in either “administrators, executives, professionals” and their support staffs, or in sales and “other service workers”—a category that includes food handlers. Most manual jobs lost share.

¹³ H. Hartmann, R.E. Kraut, and L.A. Tilly, eds., *Computer Chips and Paper Clips* (Washington, DC: National Academy Press, 1986).

Figure 10-2.—Major Occupational Groups of the U.S. Civilian Labor Force, 1900-80



NOTE: Figures are approximate, due to changing classification systems. See sources for details.

SOURCES: U.S. Department of Commerce, Bureau of the Census, *Historical Statistics of the United States, Part 1* (Washington, DC: U.S. Government Printing Office, 1975), Series D, p. 139; and U.S. Bureau of the Census, *Statistical Abstract of United States, 1982-83* (103rd ed.), Washington, DC, 1982, table 848.

Table 10-10.—Job Growth by Occupation: 1972 to 1987

Occupation category	Percent share of				
	1972 jobs	1972-80 job growth	1980-86 job growth	1986 jobs	November 1986- November 1987 job growth
Managerial and professional specialty	19.6	34.6	43.9	24.2	38.5
Executive, administrative, and managerial	8.9	17.1	23.6	11.5	19.5
Professional specialty	10.8	17.5	20.3	12.7	17.0
Technical, sales, and administrative support	28.8	39.1	39.1	31.3	17.7
Technicians and related support	2.3	5.3	5.1	3.1	-1.0
Sales	10.4	13.3	23.2	12.1	-1.4
Administrative support, including clerical	16.0	20.5	10.8	16.2	20.1
Service occupations	13.2	13.1	15.6	13.4	14.5
Private household	1.8	-2.2	-0.8	0.9	1.2
Protective service	1.5	1.7	2.9	1.6	6.2
Other service	10.0	13.6	13.6	10.9	7.1
Precision production, craft, and repair	12.6	11.2	11.0	12.2	4.3
Operators, fabricators, and laborers	21.2	3.7	-8.4	15.7	28.1
Machine operators, assemblers, and inspectors	10.5	1.4	-9.0	7.2	9.9
Transportation and material moving,	5.0	2.0	0.7	4.2	5.9
Handlers, equipment cleaners, helpers and laborers	5.7	-0.3	-0.1	4.3	12.3
Farming, forestry, and fishing	4.7	-1.2	-1.8	3.1	-1.0
Total employed	100.0	100.0	100.0	100.0	100.0

How to Read this Table: In 1972, 19.6 percent of all jobs were in the category "managerial and professional specialty," but 34.6 percent of job growth between 1972 and 1980 (and 43.9 percent of such growth between 1980 and 1986) occurred in this occupation category.

NOTE: See the appendix for a key to the occupations classification scheme. Numbers may not add due to rounding.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*, for data since 1983. Bureau of Labor Statistics conversions used for data prior to 1983, in order to make it consistent with Occupational Employment Survey classifications shown.

The rapid growth of occupations classified as "executive, administrative, and managerial" shows the difficulty of interpreting the data. While only about 9 percent of all jobs in 1972 were placed in this category, it was responsible for more than 20 percent of all job growth between 1972 and 1986, and almost one-quarter of all such growth since 1980. Some of these new "executive" jobs result from changes in the scale and scope of enterprises, some from new technologies that affect occupational structure, some from a shift to production systems built around smaller work teams that require more managers, and some from a shift of business activity to sectors that employ more managers (e.g., fast food franchises and video rental). Some of the growth may also result from upgrading of clerical jobs to quasi-professional status, or simply from inflation of job titles. The educational level of these new managers also provides some clues. In 1980, 25 percent of all managers

aged 25-34 had no more than a high school degree, 25 percent had one to three years of college, and only one in five had more than four years of college.¹⁴

Changes in employment by occupation and industry necessarily deal with national averages. But these numbers shed little light on the actual problems faced by the millions of workers forced to adjust to a new occupation or industry. Some of the adjustment, of course, can be accommodated by natural attrition, since the number of job openings due to death, retirement, or other reasons is several times greater than the number of openings created by employment growth¹⁵—while 9 million workers left the

¹⁴S.E. Berryman, "Shadows in the Wings: The Next Educational Reform," Occasional Paper No. 1, National Center on Education and Employment, Teachers College, Columbia University, New York, NY, Mar. 13, 1987.

¹⁵U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Projections and Training Data*, Bulletin 2202, Washington, DC, 1982, p. 9.

work force in 1985, 11 million new jobs were created, meaning that two million new jobs were the result of economic growth. Nevertheless, within this economy-wide picture of job replacement and creation, millions of people must face the difficulties of looking for work in an unfamiliar field.

Statistics showing the number of persons forced to change jobs during the past few years leave little room for doubt about changing demands for different occupations. Manufacturing workers with three or more years on their jobs were more likely to lose their jobs than people with similar job tenure employed in other businesses.¹⁶ Of all U.S. manufacturing employees, 15 percent lost their jobs between 1979 and 1983, and roughly 14 percent between 1981 and 1985.¹⁷ Job loss from 1981 to 1985 was particularly great among machine operators, assemblers, and inspectors, occupations that involved the physical work of creating and assembling durable goods; this group comprised 7.2 percent of the 1986 labor force but 23 percent of all displaced workers. During 1987, absolute manufacturing employment increased somewhat while growth of sales jobs slowed.

Declining demand for manufacturing occupations meant that only 66 percent of manufacturing workers displaced between 1981 and 1985 were re-employed by January 1986.¹⁸ Displaced professional and technical personnel were most likely to be re-

hired, although not necessarily in the same occupation. The shift from production to service occupations is apparent in patterns of displacement and rehiring (see table 10-11). Slightly more than half of service workers displaced had found work—virtually all in the same occupation. Over half of all machine operators, assemblers, and inspectors able to find work after being displaced were reemployed in service occupations. Similarly, 68 percent of displaced craftsmen were able to find new jobs but only 56 percent were working in their prior occupation. On average, displaced workers in blue-collar occupations spend twice as long looking for new work as white-collar professionals.¹⁹

Accounting for Occupational Changes

Most of the changes in occupation just described are explained by shifts in broad occupational patterns; some changes, however, defy explanation from this perspective, and must be addressed through an analysis of the underlying factors. Building on table 10-7, table 10-12 attempts to disentangle the several different effects. Changes in domestic demand, trade, production recipes, and productivity effects fail to explain most shifts in occupations. The bulk of the changes result from shifting patterns of staffing within each industry.

International trade and domestic demand have had some effect on occupations. Between 1972 and 1984, trade increased the share of jobs held by managers, professionals, sales workers, and service workers, and reduced demand for production occupations (more detail on this is found in chs. 7 and 8). Changes in domestic demand have had a similar effect. Even without the effects of trade, new patterns of consumer expenditures would have increased demand for managers, scientists, and clerical personnel, while reducing demand for precision craft workers and farm, forestry, and fishery workers.

The major limitation of the the analysis shown in table 10-12 is the assumption that productivity changes affect demand for all occupations in an industry in the same proportion. It assumes, for example, that labor productivity changes in automobile production resulted from equal growth in the productivity of the clerks, managers, and craft workers employed in that industry.

¹⁶Paul O. Flaim and Ellen Seghal, "Displaced Workers of 1979-83: How Have They Fared?" *Monthly Labor Review*, vol. 108, No. 6, June 1985. The U.S. Bureau of Labor Statistics has recently published data on this subject from 1981 to 1985; see Francis W. Horvath, "The Pulse of Economic Change: Displaced Workers of 1981-85," *Monthly Labor Review*, vol. 110, No. 6, June 1987. pp. 3-12.

See also U.S. Congress, Office of Technology Assessment, *Technology and Structural Unemployment: Reemploying Displaced Adults*, OTA-ITE-250 (Washington, DC: U.S. Government Printing Office, February 1986); Robert L. Crosslin, James S. Hanna, and David W. Stevens, "Identification of Dislocated Workers Utilizing Unemployment Insurance Administration Data: Results of a Five State Analysis," National Commission for Employment Policy, RR-84-03, Washington, DC, 1984; Jeanne Prail Grodus, Paul Jarley, and Louis A. Ferman. *Plant Closings and Economic Dislocation* (Kalamazoo, MI: W.E. Upjohn Institute, 1981); and Avery F. Gordon, Paul G. Schervish, and Barry Bluestone, "The Unemployment and Reemployment Experience of Michigan Auto Workers," Boston College, Social Welfare Research Institute, August, 1985.

¹⁷Job loss is defined to mean a layoff from which the person was not recalled or a loss resulting from a plant closing, an employer going out of business, or "other reasons." See Michael Podgursky, "Job Displacement and Labor Market Amusement: Evidence from the Displaced Worker Survey," Department of Economics, University of Massachusetts, Amherst, MA, Jan. 19, 1986.

¹⁸F. Horvath, *op. cit.*, footnote 16.

¹⁹Paul O. Flaim and Ellen Seghal, *op. cit.*, footnote 16.

Table 10-11.—Reemployment of Workers Displaced Between 1981 and 1985

Occupation category	Percent reemployed	Percent employed in the same occupation	Percent employed in service occupations
Executive, administrative and managerial	72.1	43.0	0.2
Professional specialty	77.6	59.8	5.2
Technicians and related support	76.4	30.1	6.7
Sales	65.1	45.3	6.2
Administrative support (including clerical)	67.7	44.9	7.6
Service occupations	53.5	52.2	52.2
Precision production, craft and repair	68.5	55.7	7.3
Machine operators, assemblers, and inspectors	41.0	36.6	18.4
Transportation and material moving	17.1	45.9	11.2
Handlers, equipment cleaners, helpers, and laborers	68.6	26.7	10.7
Farming, forestry, and fishing	72.5	n/a	n/a

How To Read This Table: 72.1 percent of people displaced from executive, administrative, and management support occupations between 1981 and 1985 were reemployed by 1986. 43% of all people displaced from these occupations were reemployed in the same occupation. Only 0.2% were reemployed in service businesses.

SOURCE: Francis W. Horvath, "The Pulse of Economic Change: Displaced Workers of 1981-85," *Monthly Labor Review* vol. 110, No. 6, June 1987, pp. 3-12

Table 10-13 provides some insight into patterns of occupational productivity within business categories. Between 1983 and 1986, for example, the number of executives and managers grew faster than the overall employment in every industry except wholesale trade, making it the fastest growing occupation over this time period. Job growth for professional specialists (engineers, scientists, teachers, doctors, nurses, lawyers, etc.) nearly equalled U.S. average job growth, but this occupation had disproportionately high gains in the agriculture, manufacturing, and public utilities industries. The two slowest growing occupations over this time period were operators, assemblers & inspectors, and service workers (food service employees, private household workers, and custodians). The rapid growth of transactional businesses, most notably in the other services and the FIRE (finance, insurance, and real estate) industries, which had 7 percent annual growth in demand for managers, has fueled total national job growth in this occupation.

The last few years have also seen wide divergences in hiring practices for administrative support and clerical personnel. Manufacturing, mining, and transportation, as well as the finance, insurance, and real

estate industries, all added jobs in this occupation category at a slower rate than average industry job growth. In contrast, the professional service and other service industries, including health and education, added clerical jobs more rapidly than jobs in other areas. Professional service employers are using clerical workers in quasi-professional jobs by substituting computers for functions like routine underwriting, and are eliminating many routine data entry functions in the process. Hospitals and other professional health organizations are using increasing numbers of clerical employees to manage what has become a complex, information-intensive enterprise. Management of health facilities has come to be dominated by professional specialists, bringing with them a growing demand for expertise in record keeping and billing as well as patient care.

These statistics describe massive changes in the way the United States is using different skills to produce goods and services demanded by the American public. They have little explanatory power. Understanding the changes requires a deeper comprehension of the way people are used in new production networks. This is the task of chapter 12.

Table 10-12.—Change in Occupational Job Share from 1972 to 1984 for Various Factors (in percent)

	Executive, administrative, and managerial	Professional specialty	Technicians and related support	Sales	Administrative support (including clerical)	Service occupations	Precision production, craft and repair	Machine operators, assemblers, and inspectors	Transportation and material moving	Handlers, equipment cleaners, helpers, and laborers	Farming, forestry, and fishing
Job Shift Share	2.1	1.9	0.7	1.8	-0.1	0.3	-0.2	-2.9	-0.8	-1.5	-1.3
Productivity	0.2	0.5	0.1	-0.2	0.5	0.2	-0.3	-0.8	-0.1	-0.1	0.2
Production Recipe & Demand	0.2	-0.2	-0.0	0.9	0.5	0.2	-0.6	-0.6	0.1	-0.2	-0.3
Production Recipe Final	0.1	-0.3	-0.0	0.5	0.1	-0.0	-0.1	-0.2	0.1	-0.0	-0.1
Demand Domestic	0.1	0.2	0.0	0.3	0.4	0.2	-0.5	-0.4	-0.0	-0.2	-0.3
Demand Trade	0.1	0.1	0.0	0.2	0.3	0.1	-0.4	-0.0	-0.0	-0.1	-0.3
Trade	0.1	0.1	0.0	0.2	0.1	0.2	-0.1	-0.4	0.0	-0.1	-0.0
Staffing Patterns	1.7	1.6	0.6	1.1	-1.1	-0.1	0.7	-1.4	-0.8	-1.2	-1.1

How To Read This Table: Between 1972 and 1984, the share of all jobs classified as executive, administrative, and managerial increased by 2.1 percentage points. Of this change, only 0.2 percentage points could be explained by changes in production or consumption recipes and -2 percentage points could be explained by changes in the productivity of different business types. The bulk of the change (1.79%) was attributable to changing staffing patterns.

NOTES: Job Shift Share = Productivity + Production Recipe and Demand + Staffing Patterns. Final Demand = Domestic Demand + Trade Numbers may not add due to rounding. See the appendix for a key to the occupations classification scheme.

SOURCE: Office of Technology Assessment, 1988.

Table 10-13.—Growth Rates in Employment by Occupation and Industry
(average annual percentage increase, 1983-1986)

	Total employees	Executive, administrative, and managerial	Professional specialty	Technicians and related support	Sales	Administrative support (including clerical)	Service occupations	Precision production, craft and repair	Machine operators, assemblers, and inspectors	Transportation and material moving	Handlers, equipment cleaners, helpers, and laborers	Farming, forestry, and fishing
Agriculture	-2.2	12.1	5.1	5.3	0.0	1.3	-4.4	-5.2	6.9	0.0	4.3	-2.9
Mining	-1.5	0.2	-2.3	-1.8	9.1	-5.2	-11.2	-3.7	-4.5	2.4	7.7	0.0
Construction	5.8	8.5	2.3	12.9	5.2	3.8	-5.7	6.2	-1.4	1.2	7.2	-4.1
Manufacturing	1.7	4.5	3.8	2.4	2.8	0.6	0.1	1.8	0.5	-1.4	4.7	-6.1
Transportation and public utilities	3.1	7.3	5.0	1.5	0.1	2.4	2.1	0.8	-0.9	3.1	1.9	-7.2
Trade	2.6	2.1	1.9	8.2	3.0	2.0	1.8	1.7	2.4	4.7	2.8	10.5
Wholesale	0.8	-2.8	-1.8	3.5	1.7	-0.1	-7.8	-0.9	-1.0	3.6	3.7	6.3
Retail	3.0	4.0	2.9	12.4	3.3	3.3	1.9	2.4	5.5	5.8	2.6	10.7
FIRES	4.4	6.5	4.4	6.0	5.6	3.0	0.8	3.5	-4.7	9.1	3.2	-3.6
Services	3.4	7.0	2.5	3.1	9.6	4.1	2.4	2.1	3.2	7.4	6.2	0.7
Private household	-0.3	0.0	-3.1	-38.0	0.0	2.9	18.4	-3.1	0.0	-17.0	-14.0	-4.5
Other	3.5	7.0	2.5	3.4	9.6	4.1	2.3	2.1	3.1	7.6	8.2	2.8
Professional services	2.3	5.9	2.0	2.6	9.3	3.3	0.1	-1.7	2.9	5.6	6.6	2.8
Public administration	2.7	3.7	3.5	4.9	0.0	1.9	2.8	-0.1	-3.9	7.4	-1.2	3.9
Total	2.8	5.5	2.5	3.1	3.7	3.0	1.8	2.5	1.0	2.5	2.0	1.0

NOTE: From the time between 1983 and 1986, employment in agriculture fell at an average rate of -2.2 percent per year, while total U.S. employment grew 2.8 percent per year. In spite of the declining employment in agriculture, the number of executives and managers employed in agriculture increased by 12.1 percent per year. Taking all sectors together, executives and managers increased at an average rate of 5.5 percent per year.

FIRES = Finance, insurance, and real estate.

NOTE: See the appendix for a key to the occupations classification scheme.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*, various issues.