More Information, Better Jobs?: Occupational Stratification and Labor Market Segmentation in the United States' Information Labor Force

Rob Kling

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Department of Information and Computer Science
University of California, Irvine
Irvine, CA 92717
kling@ics.uci.edu
(714) 856-5955
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ROB KLING

Department of Information and Computer Science,
and Public Policy Research Organization
University of California—Irvine
Irvine, CA 92717

Abstract *This article examines the mix of good and bad jobs in the restructuring of United States' labor markets for information work between 1900 and 1980. Is the information sector still growing relative to other occupational sectors? What is the relative proportion of good to bad jobs in the information sector today? Is the mix of good bad jobs within the information sector changing over time? To answer these questions, we examine changes in the relative size of the information sector's labor markets and changes in five occupational strata within it—professional, semiprofessional, supervisory and upper-level sales personnel, clerks, and blue-collar workers.*

The information occupations mushroomed in size from 17% of the United States work force in 1900 to over 50% in 1980. Information sector jobs vary widely in quality. Few information sector jobs are fully professional, and clerical jobs form the largest single occupational stratum. When we examined the growth of the various strata between 1900 and 1980, we found that clerical jobs became more dominant, not less dominant. But this distribution has been masked by the steady growth of information sector jobs in the highly professional and semiprofessional strata, as well as clerical jobs. The occupational stratum between clerks and semiprofessionals—the supervisory and upper-level sales workers—has steadily declined in relative size.

Two lower strata—clerks and sales and supervisory workers—account for 55% of the jobs in the information sector. Our data suggest that information labor markets are divided into relatively impermeable segments. As the information sector expanded, it took on many characteristics of the overall economy. It includes a mix of jobs that are diverse in their pay, status, and power. Its internal divisions reflect patterns of segmentation that have developed elsewhere in the society—a dual labor market. Overall, the information sector has become sufficiently large that it is not an alternative to the dominant social order—it simply reproduces many of its features.

Keywords Computerization, skills, gender, labor markets, information workforce, knowledge workforce.

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Work in an Information Economy

Is the United States' economy producing a large number of relatively good jobs, relatively poor jobs, or some mix? Are there increasing opportunities for occupational mobility across occupations and labor submarkets, or are occupations and labor markets sharply segmented? This article answers these questions by examining the changing patterns of employment in the United States.

The information sector is a relatively new construct. It is composed of those jobs in which people record, process, or communicate information as a large fraction of their work. These are diverse occupations, including managers, lawyers, accountants, realtors, stockbrokers, and clerks of all kinds. Although people process information in important ways as part of any job—including truck drivers, trapeze artists, and machinists—the label *information work* is a concise way to characterize jobs where information is a key product of the job, or where the person is likely to spend a large fraction of each work week communicating, reading, searching for information, or handling paperwork in its various forms, including electronic transactions.

The information work force differs significantly from the hi-tech work force in that the hi-tech work force is composed of people who work in a variety of jobs within hi-tech manufacturing firms. These firms have over half of their work force in hi-tech occupations, such as engineers and biologists. But 30–40% of their work force can be comprised of people in other occupations, such as secretaries, accountants, assemblers, and truck drivers.

In contrast to the hi-tech work force, the information work force is composed of a specific set of occupations. The information work force gives us a complementary, but larger window, through which to examine social change.

Information processing jobs are playing a major role in today's economy. Several analysts have argued that information handling is not simply a feature of existing jobs, nor even a central element in a few jobs. Rather, they see it as a key dimension for characterizing labor markets and urban economies. Castells (1984), for example, has simply declared that information handling is a defining activity in new metropolitan formations. He dubs a leading edge urban development as "an informational city." Fishman (1987) labels postsuburban regions as "technoburbs." Thus he indicates that their dependence on transportation and communication technologies undergrids their social and spatial forms. Knight (1986) follows Daniel Bell's characterization of postindustrial societies and argues that knowledge work is a core activity in a transformed urban economy.

These provocative theses are worthy of investigation. They provide an important alternative entry point to the study of the work force in advanced economic areas than do the traditional trichotomy of agriculture, manufacturing, and services. Unfortunately, analysts who write about the primacy of information work usually treat it as a "social fact." They rarely examine the meanings of information work in new social formations. In contrast, Lyon (1988) argues persuasively that information work should be examined as a new problematic, and not be taken for granted. Zuboff (1988) goes further than lyons. She argues that organizations with highly "informated" jobs require specially skilled workers who can challenge traditional managerial styles and whose skill is a novel resource for managers to cherish.

The *information sector* is a relatively new analytical category, which we believe is worth exploring. The United States work force is composed of people in hundreds of occupations. Every simple category scheme mixes diverse occupations and working

conditions. The traditional economic sector scheme mixes field hands and agri-business accountants (agriculture); welders, stock clerks, and industrial engineers (manufacturing); cab drivers, waitresses, and lawyers (services). Distinctions between union and nonunion cut across occupations and depend upon local circumstances. Similarly, the crude distinctions between information work and other kinds of work mix diverse occupations, like postal clerks and lawyers. Here we go beyond the usual accounts of information work by grouping information workers into five occupational strata which differ in the typical quality of their jobs.

We examine the composition of the information work force with special attention to simple differences between better and worse jobs, primarily using demographic data to examine the changing composition of different strata in the information work force.

The Concept of an Information Economy

Social analysts characterize the major economic transformations of this era with two different rubrics (1) a *postindustrial society* (Bell 1973; Ginzberg et al., 1986) and (2) an *information society* (Porat 1977; Bell 1981; Huppes 1987). Some analysts loosely mix these two terms, (Naisbitt 1984; Huppes 1987) but they have different connotations. The service sector dominates in Bell's (1973) characterization of postindustrial economies. He argues that postindustrial societies also depend critically upon credentialed experts, especially "knowledge producers," such as scientists and engineers. But scientific and engineering occupations form only a small fraction of the jobs in even the most technologically advanced societies. The service sector is dominated by a variety of industries, from transportation to restaurants, and from insurance and banking to utilities (Ginzberg et al. 1986). These service industries are composed of two key kinds of jobs:

(1) Jobs where people provide direct service, such as bank tellers, waitresses, stock brokers, lawyers, security guards, bus drivers, insurance agents, etc.
(2) Jobs in the administrative core of these organizations, such as clerks, accountants and office managers of various kinds, as well as specialists in marketing, computers, etc. (These jobs are found in all industries, not just service industries.)

In contrast, the imagery of an information economy focuses upon occupations in which the processing of information is central and time-consuming activity. All jobs require that people process some information, even if only sensory information, to know where they stand and where they are going. But some workers also provide information as a central element of the services they provide. These jobs include certain service jobs, such as teaching, practicing law, research, and so on. We should note that information jobs don't include all service jobs. The dividing line is not sharp. But at the extremes, driving a bus, washing dishes, and working as a cook are service jobs in which processing or providing information is a small fraction of the job. Other service jobs that provide information, as a central element include core administrative jobs, such as clerks, accountants, and computer programmers, wherever they may be found—in agriculture, manufacturing, or services. For example, Scott (1988, p. 178) notes that over 35% of the United States' manufacturing work force is composed of white collar workers. Most of these are information workers, such as engineers, inspectors, clerks, and accountants.

Timothy Luke and Stephen White (1985) argue that capitalism has entered a new phase, *informational capitalism*, in which "data-intensive techniques, cybernetic knowledge, and electronic technologies" are the new strategic resources for corporate production (p. 31). In their central image, "the computer console has replaced the factory smokestack as the determinant sign of economic power." They go on to assert that "informationalization has reconstituted labor and management (p. 32).

Whie and Luke point out that core information services have expanded (banking, insurance, telecommunications, mass media, advertising, education). In addition, managers of service, industrial, and agricultural firms have invested heavily in strategies to base production on information: banks invest in data processing and electronic-funds transfer; manufacturing plants invest in automated inventory control and robotics; agricultural firms invest in computer-based farm management programs; and managers in all sectors invest in information systems to support basic accounting and cash flow management. Behind these strategies sit a variety of workers—from the specialists who design them to the wide variety of people who use them.

Marc Porat (1977) estimated that the information sector accounted for more employment than manufacturing or services by 1950, and that approximately 46% of the work force was employed in the information sector in 1970. Although Porat's (1977) study provides the data that is most widely used, he reports it in graphical form. Bell (1981) reports his estimates of employment in the four economic sectors in a more precise numerical format (Table 1).

Most of the occupations in the information sector are white collar jobs. The terms *white collar* work force and *information work force* overlap substantially, but they are not identical. The information work force includes some blue collar workers who operate and repair computer, communications, and office equipment, and the white collar work force includes like sales clerks, jobs, which have a strong informational component, but which are not wholly information-handling jobs.) Much of the growth of the information sector in this century was driven by the same forces that drove the growth of white collar employment: the massive gains in productivity in agriculture and manufacturing; the rise of services; and (especially) the rise of large bureaucraceies—public and private (Mills 1951, p. 68–69).

Even though the term *information economy* and *information work* are becoming commonplace, they often are used loosely. We see three problems with these casual usages:

(1) Many authors talk about an "information age" or "information economy" as a social fact that can be taken for granted (e.g., Naisbitt 1984; Huppes 1987; Strassman 1985; Luke & White 1985). These accounts usually draw upon Porat's (1977) pioneering analysis, which segmented the United States' economy into four sectors. The national data used by Porat and often repeated in other publications aggregates workers across regions with widely disparate industrial mixes and misses any distinguishing regional characteristics. Employment in rural regions, such as California's San Jauquin Valley, centers of smokestack industry such as Gary, Indiana, and service centers, such as Hartford, Connecticut, are all combined. But some metropolitan economies are much more information intensive than others (Kling & Turner, in press).
(2) Many analysts who examine the information economy focus on the best jobs,

Table 1
Four-Sector Aggregation of the United States Labor Force
Experienced Civilian Workforce

Year	Information Sector		Agriculture Sector		Industry Sector		Service Sector		Total
1860	480,604	(5.8%)	3,364,230	(40.6%)	3,065,024	(37.0%)	1,375,525	(16.6%)	8,285,383
1870	601,018	(4.8%)	5,884,971	(47.0%)	4,006,789	(32.0%)	2,028,438	(16.2%)	12,521,216
1880	1,131,415	(6.5%)	7,606,590	(43.7%)	4,386,409	(25.2%)	4,281,970	(24.6%)	17,406,384
1890	2,821,500	(12.4%)	8,464,500	(37.2%)	6,393,883	(28.1%)	5,074,149	(22.3%)	22,754,032
1900	3,732,371	(12.8%)	10,293,179	(35.3%)	7,814,652	(26.8%)	7,318,947	(25.1%)	29,159,149
1910	5,930,193	(14.9%)	12,377,785	(31.1%)	14,447,382	(36.3%)	7,044,592	(17.7%)	39,799,952
1920	8,016,054	(17.7%)	14,717,742	(32.5%)	14,492,300	(32.0%)	8,061,342	(17.8%)	45,288,438
1930	12,508,959	(24.5%)	10,415,623	(20.4%)	18,023,113	(35.3%)	10,109,284	(19.8%)	51,056,979
1940	13,337,958	(24.9%)	8,233,624	(15.4%)	19,928,422	(37.2%)	12,082,376	(22.5%)	53,582,380
1950	17,815,978	(30.8%)	6,883,446	(11.9%)	22,154,285	(38.3%)	10,990,378	(19.0%)	57,844,087
1960	28,478,317	(42.0%)	4,068,511	(6.0%)	23,597,364	(34.8%)	11,661,326	(17.2%)	67,805,518
1970	37,167,513	(46.4%)	2,466,883	(3.1%)	22,925,095	(28.6%)	17,511,639	(21.9%)	80,071,130
1980	44,650,721	(46.6%)	2,012,157	(2.1%)	21,558,824	(22.5%)	27,595,297	(28.8%)	95,816,999

Data from Table 9.2 Daniel Bell (1982:522). Based on Bell's median definition of the information economy, which differs somewhat from our own definition reflected on other tables.

particularly professional, technical, and managerial jobs.[1] Some of them ignore the poorer jobs, such as clerical work in its various forms (Strassman 1985), or they treat poorer jobs as transitional occupations which may soon disappear (Giuliano 1982).[2] Or they argue that office automation will eliminate a large portion of the least skilled "entry level" jobs (Rosenberg 1986, p. 234) Are good or bad jobs most prevalent in an information economy? Is the mix of jobs tilting toward a larger number of better jobs?

(3) Some authors assume there is a natural evolutionary sequence from agricultural to manufacturing to service economies, and that information economies are simply the fourth step in the sequence (Huppes 1987). Daniel Bell argued that agricultural economies naturally evolve into postindustrial (service) economies, and he saw the information sector as part of the infrastructure for a postindustrial society (Bell 1981). Strassman (1985) follows Bell in arguing that information work is part of the infrastructure for service economy, making his links much more explicit than Bell. We do not assume there is a natural four stage evolutionary sequence from agricultural societies to information societies.[3] Rather, we treat the information sector as an important economic sector which crosscuts the traditional three sectors and whose occupational structure may shed interesting light on work in modern society.

Many commentators confuse the social meanings of information work by confounding it with the use of some form of information technology, especially advanced computer systems. For example, Giuliano (1982) advanced a typical interpretation of "information work" and "information-age" offices when he examined the shift of office technologies from pen and paper through typewriters and mechanical devices to interactive computer-based systems available on every desk.

He argues that the social organization of office work is evolving through three stages, (a) an informal "preindustrial" office; (b) a highly regimented "industrial" office; and (c) a flexible "information age" office in which computerized information systems are available on every desktop. There are major technological differences in his illustrations of these archetypical offices. His preindustrial office relies on telephones, paper, and organized files. His industrial office relies on batch-run computerized infor-

[1]Naisbitt (1984) is an interesting exception. He characterizes the transformations of the U.S. work force from agriculture to information in the terms "farmer, laborer, clerk." We don't share his belief in a linear progression of dominant sectors, which ends with an information sector. But he is forthright in arguing that clerks play a central role in the information sector. But he doesn't examine the size of their role, and its possible changes over time.

[2]Some writers, like Kuttner (1983) argue that the service sector is generating a much larger number of low-end, dead-end service jobs than better professional, managerial, and technical jobs. For example, the Department of Labor estimated that the occupations with the 10 largest number of job openings in 1980 would be retail sales clerks, miscellaneous managers and administrators, cashiers, secretaries, waiters, cooks, stockhandlers, bookkeepers, and "miscellaneous" clerical workers. Six of these occupations are in the information sector, and one might suspect that the most prevalent information sector jobs will be those in the low-end dead-end section. Kuttner's analysis is controversial since he only examines the absolute number of openings in jobs with relatively high turnover. Even so, we find his analysis suggestive.

[3]Bell's evolutionary approach to postindustrial societies is best critiques in Kumar (1978). Kumar observes that the service sector has always employed more people in England than the manufacturing sector, from before the industrial revolution through the 1970s.

mation systems, as well as paper and telephones. His information age office relies on universal desktop computing linked to interactive data bases.[4] He characterizes the information age office as one which

> exploits new technology to preserve the best aspects of the preindustrial office and avoid their failings. At its best, it combines terminal-based work stations, a continuously updated data base, and communications, to attain high efficiency along with a return to people centered work rather than machine-centered work. In the information age office the machine is paced to the needs and abilities of the person who works with it . . . The mecahnization of office work is an essential element in the transformation of American society to one in which information work is the chief economic activity (Guiliano 1982).

Guiliano's article illustrates the typical confusion of information work and specific technologies. All of this illustrations refer to offices which are exclusively devoted to information handling in some form. There is no substantive rationale for distinguishing any one of these office forms as an "information age" office. The label glamorizes the kind of office technology which Giuliano would like to see widespread—interactive computer systems linked to integrated data bases. As Porat's study of the information work force shows, the information work force was 17% of the national work force by 1900, and it grew to 30% by 1950—long before electronic computer systems were installed in offices.

We believe that these computer technologies can be very interesting and become indispensable. But the ways in which they transform work are still open to question and investigation (see Dunlop & Kling 1991). As Iacono and Kling (1987) observe, "Despite the dramatic improvements in office technologies over the past 100 years, career opportunities and working conditions for clerks have not similarly improved. Although clerical tasks today require more skills in using a complex array of technologies, these skills are not reflected in status or pay. A new generation of integrated computer-based office systems will not automatically alter the pay, status, and careers of clerks without explicit attention" (p. 75). While these issues of pay, status, and career lines are peripheral to understanding how the labor process and phenomenology of information work differs from other kinds of work, such as craft work, we return to them in the next section when we examine the occupational structure of the information work force.

Shoshana Zuboff's *In the Age of the Smart Machine* (1988) is the most daunting and serious recent study that examines the labor processes and phenomenology of work with computer-based systems. She provides vivid and often brilliant descriptions of the phenomenology of work with special computer systems in specific work settings, examining three cases in substantial detail. In each case some sort of information system was imposed on the workgroups she studied. This type of implementation process is commonplace for large scale systems and those used by many clerks and blue collar workers. However, many work groups have actually fought to get com-

[4]The information age office is the only office type which Giuliano illustrates with computer terminals; and computer terminals are located on every desk. It is also the only office with plants. There is one photograph of a computerized office in his article. It is an insurance claims office which combines an industrial work organization of a matrix of desks in an open area with his information-age element of a terminal on every desk and plants!

puter technologies. These grass-roots implementations have different dynamics, which Zuboff ignores.

Superficially, her account differs substantially from Giuliano's. For example, her illustrations portray workplaces such as his industrial age office as much less pleasant than information age offices.[5] But she makes similar errors to Giuliano by not carefully distinguishing between the phenomenology and labor process of computer based work and information work more generally.[6] Like Giuliano, Zuboff coins a special term ("informate") with broad informational connotations to describe some special aspects of work with computers (pp. 9–10).

Zuboff (1988) identifies abstraction as a special feature of computerization, rather than as a generic feature of symbol systems, whether represented by cuneiform on papyrus, quill pen marks on parchment, pencil marks on paper, or data displays on an electronic screen (pp. 69, 79, 83–84). Moreover important kinds of information work do not always entail the use of abstract symbol systems.

A good deal of information work also entails interpersonal communication—often face to face, but sometimes mediated by telephone—between students and teachers, judges and defendants, clerks and organizational clients. Although it is difficult to find occupations in which participants do not rely on any symbol systems, workers vary in the extent to which their world is mediated by symbol systems rather than communicated by personal experience. Hotel concierges and realtors, for example, often work with a good deal of key information based on their personal knowledge of localities and provide it to clients verbally. In contrast, other information workers, such as stockbrokers, are much more wrapped in a complex world of abstract symbols and systems of relationships between them (e.g., stock prices, trading volumes, market averages, interest rates, transaction costs). Through the 1970s and even early 1980s, most stockbrokers relied upon paper systems, telephones, and specialized information services such as Quotron. By the 1980s, most stockbrokers gained access to more complex information systems which provide a wider array of data faster and which allow easier comparisons between data. They can also routinely monitor and trade in a wider variety of financial instruments and international markets, ranging from Eurodollars to the Japanese stock market. Information technologies have helped reshape the job of stockbrokers. Their work may have been much simpler in the 1960s than in the 1990s. But their knowledge was anchored in complex symbolic systems, although it was based on paper. The routine dynamics of stock markets and their relationships to other markets, such as money and bond markets, have not substantially changed because of computer systems—except for the special phenomenon of program trading.

Zuboff (1988) views computerized work as a major transformation in labor pro-

[5]Unlike Giuliano, Zuboff is sensitive to the problems that people and organizations can face in computerization projects. However, like Giuliano, she usually portrays computerization as a relatively homogeneous process that has similar consequences for most workers. Giuliano views computerization as economically efficient and psychologically satisfying. Zuboff portrays computerization as a process which usually disorients, isolates, and demoralizes workers. Both of them ignore key contingencies which lead to different outcomes.

[6]On page 171, Zuboff does try to distinguish between the work in mechanized offices and computerized offices. She argues that computer systems can be much more expansive than mechanical systems. This is a small point relative to her major theses, and she does not carefully distinguish between computer-based work and other forms of information work or office work when she makes her major arguments.

cesses that diminishes the importance of the physical body as an acting and knowing agent. But Zuboff glosses key similarities between information work and computer-based work. She focused on a small set of cases in which relatively low-level paper plant operators and clerks were beginning to use computer-based systems that were thrust upon them. (See Kling, Iacono, & George (1990) for a characterization of the ways in which clerks and professionals have different levels of influence in computerization projects.) Her sensitive observations about the phenomenology of computerized work in these special settings can often apply just as well to many forms of information work.

Giuliano's and Zuboff's accounts of information work, information technology and work illustrate common arguments about the kinds of labor processes that undergird information work. Both of these accounts are suggestive, but also misleading, because they confuse information work with special kinds of work which use advanced computer systems.

Although a more careful investigation of the phenomenology of information work would be very useful, it would apply to information work wherever it is done and in whatever historical period: London, England in the 1600s, and Irvine, California in the 1990s. But it will not teach us about recent changes in the work and labor markets within the United States without important additional information about the distribution of jobs, occupations, and technologies in the region.

Changes in the Distribution of Information Occupations

Studies based on different units of analysis could shed special light on changes in a regional labor market that is, a study of changes in specific occupations within the region, a study of changes in information work at the firm level, and studies of the occupational mix in a specific labor market, for example. We will focus on changes in the distribution of jobs within the information sector of the United States as a way to better understand the changing mix of good and bad jobs. This choice helps shed light on the structure of information labor markets by using the same kinds of data that protagonists of the information economy use.

Our basic strategy is very simple:

(1) We have adapted Porat's (1977) characterization of information workers and his list of information workers, (Table 2) which he used for estimating the size of the information work force in the United States. We use a similar list of occupations (Table 3) to estimate the overall size of the information work force in the United States in 1980. See Table #2 for a list of our information occupations. For *a description of the ways* in which our list differs from Porat's, see Appendix A. While some of Porat's occupational assignments can be seriously questioned, they do *not* substantially alter his estimates of the size of the information work force. By using his categories, we can more readily compare our results with his and with other studies. These are aggregate estimates of employment.

(2) We are particularly concerned with the mix of good and bad jobs in the information work force. Many analysts treat the information work force as relatively homogeneous. We have divided information jobs into five status strata: professional, semiprofessional, supervisory and upper-level sales personnel, clerks, and blue-collar information workers (Table 3). We examine the relative number of jobs in each of these strata. For example are professional jobs, such

Table 2
Occupations in the Information Economy

Professionals

- accountants
- architects
- lawyers and judges
- life scientists
- operations researchers
- physicians and related practitioners
- physical scientists
- social scientists
- teachers, college and univ.

Semiprofessionals

- bank officers
- computer specialists
- engineers
- financial managers
- foresters and conservationists
- health administrators
- librarians, archivists, and curators
- managers and administrators (nec)
- nurses, dietitians, and therapists
- office managers
- officials and administrators (public)
- personnel and labor relations workers
- research worker
- school administrator
- social and recreation workers
- teachers, except college
- technical workers (nec)
- vocational and educational counselors
- writers, artists, and entertainers

Sales & Supervisory

- advertising agents and sales workers
- blue-collar worker supervisors (nec)
- buyers and purchasing agents
- clerical supervisors (nec)
- credit and collection managers
- engineering and science technicians
- health technologiests and technicians
- inspectors
- insurance adjusters and examiners
- insurance investigators
- insurance agents and brokers
- insurance underwriters
- officials of lodges and societies
- real estate agents and brokers
- sales managers, including retail trade
- sales representatives, manufacturing
- sales representatives, wholesale
- stock and bond sales agents
- union officials

Clerks

- bank tellers
- billing clerks
- bookkeepers
- cashiers
- clerical workers (nec)
- collectors, bill and account
- counter clerks, except food
- demonstrators
- dispatchers and starters, vehicle
- enumerators and interviewers
- estimators and investigators (nec)
- expediters and production controllers
- file clerks
- hucksters and peddlers
- library attendants and assistants
- mail carriers, post office
- mail handlers, except post office
- messengers and office helpers
- newspaper carriers and vendors
- office machine operators
- payroll and timekeeping clerks
- postal clerks
- receptionists
- sales clerks, retail trade
- sales workers, except clerks
- secretaries
- shipping and receiving clerks
- statistical clerks
- stenographers
- teacher aides, except school monitors
- telephone operators
- ticket, station, and express agents
- typists
- welfare service aides

Blue Collar Information Workers

- checkers, examiners, manufacturing
- data-processing machine repairers
- inspectors, manufacturing
- office machine repairers
- photographic process workers
- printing craft workers
- radio and television repairers
- telephone line installers
- telephone repairers

Porat estimated the number of workers in each occupation from U.S. Census data and industry-occupation matrices of the 1967 National Income Accounts.

Table 3
1980 Employment in the United States Information Sector: by Occupation

Occupation	Employment 1980 thousands
Fully Professional	
accountants	1,076
physicians, dentists, & related practitioners	803
teachers, college, & university	564
lawyers & judges	558
life & physical scientists	309
social scientists	285
operations & systems researchers & analysts	173
architects	92
Semiprofessional	
all other managers & administrators	6,621
teachers, except college & university	3,209
nurses, dietitians, & therapists	1,607
engineers	1,472
writers, artists, & entertainers	1,313
bank officers & financial managers	659
computer specialists	598
social & recreation workers	509
school administrator, college & elementary	435
official & administrators, public administrators	433
health administrators	213
librarians, archivists, & curators	201
vocational & educational counselors	183
research worker	180
foresters & conservationists	67
all other professional & technical workers	62
Upper-Level Sales and Supervisory	
blue-collar workers supervisors, (nec)	1,754
engineering & science technicians	1,127
sales representatives, wholesale trade	935
sales managers, including retail trade	721
real estate agents & brokers	598
health technologists & technicians	588
insurance agents, brokers, & underwriters	543
personnel &: labor relations workers	461
buyers & purchasing agents	460
sales representatives, manufacturing industry	434
clerical supervisors, (nec)	245
insurance adjusters, examiners, & investigators	179
stock & bond sales agents	137
advertising agents & sales workers	112
inspectors, except construction & public	111
officials of lodgers, societies, & unions	108
credit and collection managers	69

(*Table continued on next page*)

Table 3 (*Continued*)
1980 Employment in the United States Information Sector: by Occupation

Occupation	Employment 1980 thousands
Clerical	
secretaries	3,944
sales workers, (nom)	3,149
bookkeepers	1,942
all other clerical workers	1,899
cashiers	1,592
typists	1,043
office machine operators	959
receptionists	644
estimators and investigators, (nec)	545
bank tellers	542
shipping and receiving clerks	515
statistical clerks	396
teacher aides, except school monitors	391
counter clerks, except food	358
file clerks	332
telephone operators	323
postal clerks	291
mail carriers, post office	247
expediters & production controllers	238
payroll & timekeeping clerks	237
hucksters & peddlers	181
mail handlers, except post office	168
billing clerks	165
library attendants and assistants	155
ticket, station, and express agents	144
newspaper carriers & vendors	112
dispatchers & starters, vehicle	105
messengers & office helpers	98
demonstrators	92
welfare service aides	89
enumerators & interviewers	87
collectors, bill & accounts	81
stenographers	66
Blue-Collar Information Workers	
checkers, examiners, & inspectors, manual	750
printing craft workers	415
telephone & line installers & repairers	390
inspectors	150
radio & television repairers	122
photographic process workers	90
data processing machine repairers	86
office machine repairers	82

The data for this table came from Table B20, Bureau of Labor Statistics (1982). Acronyms in parens. (nec)—not elsewhere classified; (nom)—not otherwise mentioned.

as accountants and lawyers, the largest stratum of jobs in the information sector?

(3) We are also concerned with changes in the information sector over time. Is the information sector still growing in relative size?[7] Is the mix of good and bad jobs within the information sector changing over time? To answer these questions, we examine the information sector in the United States national economy level from 1900 to 1980.

No one has asked these questions about the character of jobs in the information economy so directly. Some answers appear implicit in key writing about the information labor force, for example, that it is relatively large and is the dominant sector of the United States labor force (Porat 1977; Bell 1981; Huppes 1987; Strassman 1985); that it is continuing to grow in size; and that good jobs are most prevalent (Parker 1981, p. 73; Giuliano 1982; Strassman 1985). We will critically examine these ideas below.

Stratification of Jobs in an Information Economy

Optimistic themes of universal progress undergrid most accounts of the information economy. (Lyon's (1988) critique and Perrolle's (1987) textbook are rare exceptions) However, few authors carefully explain how good jobs replace bad ones. Giuliano (1982) implies that jobs will be upskilled. In three diagrams that illustrate his article, he indicates that highly specialized accounting clerks will become account managers when work is electronically integrated through the use of advanced information systems.[8] Giuliano's claim goes beyond the arguments about upskilling and deskilling since he implies that job holders take on new jobs moving from narrow clerical jobs, such as posting clerks to much broader account managers. In bureaucratic terms, these information oriented jobs have simply been reclassified. Indeed, Kuttner (1983) argues that many jobs actually become worse while managers upscale their titles.

We were originally critical of accounts of information work like Giuliano's which casually assumed that semiprofessional jobs would replace clerical jobs. During the twentieth century, there has been a white collar revolution in the United States. White collar workers shifted from about 18% of the work force in 1900 to about 48% in 1974.[9] Manual work remained at 35–40% of the work force during these 75 years. And farm work declined from 38% of the work force in 1900 to 3% by 1974.

We were also critical of accounts which focused on professionals and ignored

[7]Cooper (1983) argued that the information economy is no longer expanding rapidly at the national level.

[8]There are major debates about the extent to which computerization upskills or deskills jobs. Gregory and Nussbaum (1982), Howard (1985) and Mowshowitz (1986) argue that organizations are most likely to computerize so as to deskill jobs, while Strassman (1985) and Forester (1987) argue that computerization almost universally upskills jobs. We believe that organizations computerize in ways that upskill some jobs and deskill other jobs. The bulk of available evidence supports the position that most jobs are upskilled, even if that is an unconscious byproduct of practice chosen for other reasons (Iacono & Kling 1987). A small fraction of clerical jobs may be deskilled. But because there are over 20 million clerical jobs in the United States, a small fraction can be a large number (e.g., 3% of the clerical jobs is 600,000 jobs, not a tiny number).

[9]The labor data in this paragraph and the next come from Ritzer 1977, p. 14. Percentages are rounded to the nearest point. Ritzer uses conventional Department of Labor occupational classifications, which we do not accept.

clerks, since clerks are a major occupational group in the U.S. Clerks grew from 3% of the national work force in 1900 to 18% in 1974—a 6-fold increase. In contrast, professionals grew from 4% of the work force in 1900 to 14% in 1974—a growth factor of about of 3.5. Managers grew from 6% of the work force in 1900 to 10% in 1974—a factor of about 1.6. In 1900, managers outnumbered clerks by two to one; in 1974, clerks outnumbered managers by 1.6 to 1. Clerical jobs formed about 25% of the white collar jobs by 1974. Information jobs are not the same as white collar jobs, but they are similar enough to suggest that clerks' work could form 20–30% of the information work force.

There are at least five kinds of criteria for ranking jobs from better to worse. *Economic criteria* focus on pay, benefits, security, and career opportunities. *Psychological criteria* focus on feelings, such as challenge, autonomy, boredom, and filiation with co-workers. *Social criteria* focus on prestige and power. *Health and safety criteria* focus on idiosyncratic features of jobs, such as fit with one's personal life, flexibility of schedules, and the time spent commuting to work. These characteristics are not fixed for all people in a specific occupation. Ranking of jobs by these criteria can depend on the specific preferences of particular employees. Particular jobs may be ranked at one extreme on one set of criteria, yet be mediocre or poor on other criteria. Some industries such as transportation and aerospace pay their workers more for comparable jobs than do banking and insurance. While we recognize these complexities, we sought a simple strategy for characterizing the quality of jobs and comparing them over time. Any classification scheme that places some occupations into a "better work" category and other occupations into a "worse work" category simplifies complex criteria by which people assess specific jobs.

Two different ways to characterize the quality of jobs were considered. We reviewed economic criteria, such as income, and social criteria, such as status, autonomy and related working conditions. We could not locate adequately detailed income data for each of the occupations in the information work force for 1900 to 1980 at the federal level. Therefore, we turned to social criteria for comparing the quality of jobs in the information sector.

We followed Porat's (1977) list of jobs in the information labor force (Table 2). We went beyond his seminal work by dividing the information sector occupations into five broad strata. (See Appendix A for details). We constructed four white collar occupational strata and one blue collar stratum. The white collar strata range from fully fledged professions at one extreme to clerks at the other. They do not include all white collar jobs (e.g., dentists), since we are examining the information sector rather than white collar work. We used standard sociological categories for professions and semiprofessions.[10] In addition, we identified one occupational stratum between clerks and semiprofessionals.

[10]The U.S. Department of Labor lists a set of diverse occupations under the labor *professional workers* athletes, engineers, librarians, lawyers, physicians, school teachers, vocational counselors, writers, etc. These groups have not all made an equally convincing claim on the label *professional*, even though many of their practitioners can make a convincing case that some occupational practices are more "professional" than others. We have divided these occupations into two groups: (1) higher status "professionals" who often have a legal monopoly over educating practitioners and licensing; and (2) "semiprofessionals" who have some of the characteristics of professional groups, but not all.

Professional Occupations

These include the 8 most highly professionalized jobs in the United States in the information work force, including accountants,[11] architects, lawyers, and physicians. The most highly developed professions have legal monopolies over legitimate practice and credentialling requirements. These are usually the most prestigious occupations, and many of these occupations pay relatively well, on average. Jobs within these occupations vary considerably along other criteria, such as stress.

Semiprofessional Occupations

These include 19 groups which have some professional standing and are not fully fledged professions. They include computer specialists, engineers, managers, school administrators, social workers, and teachers. Semiprofessional occupations are usually less prestigious and less well-paid, on average, than the full-fledged professionals. But, they are usually much more autonomous and prestigious than the occupations in the next lower stratum.

Supervisory and Upper-level Sales Occupations

These constitute a category whose status lies between that of semiprofessionals and that of clerks. It includes advertising agents, health technologists, insurance agents, office managers, purchasing agents, real estate agents, and stock brokers. (Some of these workers, especially sellers who work as independent agents, can be much better paid than many salaried semiprofessionals and professionals.) This is a complex stratum which lies between the moderately prestigious semiprofessional occupations and the less prestigious, less autonomous, and lower paid clerical occupations.

Clerical Occupations

These include clerical jobs of all kinds (including cashiers and sales clerks) We view clerical jobs as problematic because they usually pay poorly compared with other information jobs. Clerical jobs vary considerably in autonomy—from telephone operators to executive secretaries—but they are often fairly regimented, and they usually provide few opportunities for moving to much more autonomous or substantially better paying jobs.[12]

[11]The U.S. Department of Labor classifies accountants as a management-related specialty. We classify most managers in the semiprofessional stratum and treat accountants as a fully professionalized occupation.

[12]We see clerical jobs as poorer than the upper-level sales and supervisory jobs because they are relatively low paid and primarily consist of either routinized or delegated work, or both. Clerical work is not all of one kind. Secretaries, the aristocrats of the clerical work force, may have substantial discretion in the ways they choose to carry out their work, while billing clerks may have very little. Moreover, some clerical work is becoming more technically complex, and at times, more interesting. Despite these variations within clerical occupations and improvements in some elements of the job, clerical workers are less well-paid and can exercise less initiative than workers in other occupational strata. We do not believe that the majority of clerical jobs are becoming degraded or deskilled. We believe that they are simply poor jobs relative to others in the economy for many workers.

Blue Collar Occupations

These include technicians who install or repair communications, printing, and other information processing equipment.

We classified each occupation in the information sector into one of these five strata in Table 3 and report their employment levels in Table 4.

Optimistic and pessimistic theories about the quality of jobs in the information economy can be evaluated by examining how good and bad jobs are actually distributed across the five strata of the information work force. For example, the most optimistic stories suggest that the proportion of professional jobs (good jobs) should be much larger than the proportion of jobs in any other stratum. Further, the relative number of poor quality jobs should decline from one stratum to the next. This story, which we call *professional dominance* can be illustrated graphically (see Figure 1). We can compare the shape of the curve, which characterizes the actual empirical distribution of the relative size of the strata, with the professional dominance curve. We refer to the graphs associated with a particular story about the relative size of the strata as a *theoretical distribution.*

These theoretical distributions are static. Most stories of occupational change in the information labor force are dynamic; the mix of jobs changes over time. Consequently, we will examine the fit of theoretical distributions to empirical distributions over time. For example, no one argues that professional jobs dominated the information work force in 1900. But many authors imply that they do today. Thus we can examine whether the empirical distribution of jobs in the information work force has been moving toward professional dominance between 1900 and 1980.

In Figure 1 we graph three alternative theoretical distributions for the three stories, which are most commonly discussed in the literature about information work:

(1) Professional jobs dominate the information work force: Most information workers hold highly professionalized jobs for example, accountants, scientists, and lawyers; a smaller group holds semiprofessional jobs, such as engineers and school teachers.
(2) Middle level jobs dominate the information work force: Most information workers hold middle level jobs. We have portrayed the alternative where the most dominant middle level jobs are the sales and supervisory jobs. The other information occupations are less numerous than these occupations. A variation on this theme would place the bulk of information workers in the other "middle" cateogry— semiprofessional jobs such as engineers, school teachers, and social workers.
(3) Lower level jobs dominate the information work force: Most information workers hold lower level clerical jobs. The higher level occupational strata employ relatively fewer people, inversely proportional to their status.

Thus, these theoretical distributions range from optimistic portraits of an information sector that is characterized by generally good (professional) jobs to a pessimistic portrait of the same sector characterized by predominantly poorer (clerical) jobs. These distributions are static, but some of the theories describe information work as the end point of important "trends"—that the current distribution of information occupations is moving toward one of these three distributions. In the next section we examine how well the data about employment fit these three theories.

Table 4

Distribution of Occupational Strata Within the United States Information Sector 1900–1980*

Employment Levels by Sector

	Fully Professional	Semi-Professional	Sales & Supervisory	Clerks	Blue Collar	Total Workforce	Total Info. Sector
1900	280	1395	1557	1604	209	29030	5045
1910	338	2296	2126	2933	288	37291	7981
1920	437	2803	2586	4438	344	42206	10607
1930	595	3972	3469	5952	469	48686	14457
1940	687	4195	3773	6992	506	51742	16153
1950	1065	5473	4900	9508	786	59230	21732
1960	1338	7553	5803	12286	913	67990	27893
1970	2152	9995	6796	16600	1192	80603	36735
1980	3328	16997	8047	21583	1249	99303	50108

Occupational Strata as Percent of Information Workforce

	Fully Professional	Semi-Professional	Sales & Supervisory	Clerks	Blue Collar
1900	5.6	27.7	30.9	31.8	4.1
1910	4.2	28.8	26.6	36.8	3.6
1920	4.1	26.4	24.4	41.8	3.2
1930	4.1	27.5	24.0	41.2	3.2
1940	4.3	26.0	23.4	43.3	3.1
1950	4.9	25.2	22.5	43.8	3.6
1960	4.8	27.1	20.8	44.0	3.3
1970	5.9	27.2	18.5	45.2	3.2
1980	6.5	33.2	15.7	42.4	2.4

*1900–1970 data in this table come from Series D-182 through D-682, Bureau of the Census (1976:139–145). 1980 data come from Table B20, Bureau of Labor Statistics (1982:664–667) and Table 276 Bureau of the Census (1984) and are selected to match the smaller number of occupational categories from this time series. The resulting 1980 data does not match other tables, but is comparable with the data in this table.

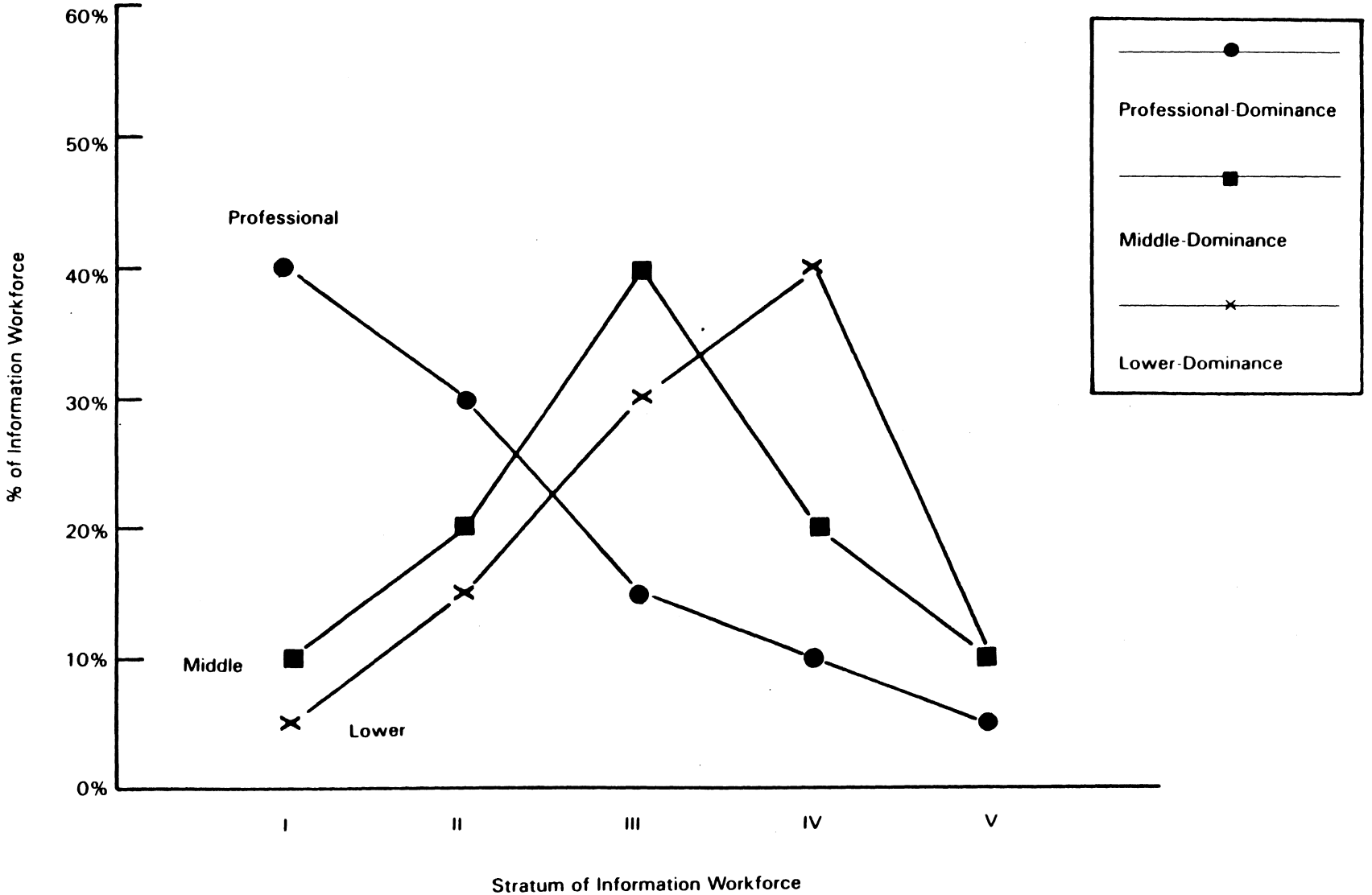

Figure 1. Graphic Illustration of "professional dominance" in distribution of occupations.

Scale, Growth, and Structure of the Information Work Force

The information occupations mushroomed in size from 17% of the United States work force in 1900 to over 50% in 1980 (Table 5). In this period, the United States moved from a dominantly agricultural economy to a service economy.[13]

Table 5 reports the percentage of workers in each stratum of the information work force at the federal level between 1900 and 1980. (See Appendix B for a discussion of the methods used.) Professional and semiprofessional workers have composed a remarkably stable proportion of the information work force between 1900 and 1970: 4–6% and 25–29%, respectively. Together, these professional strata formed a *minority of the information work force*—between 30% and 33%. Blue collar information workers slowly declined from about 4% in 1900 to 2% in 1960.

Since 1900, clerks have been the largest strata of information workers. They rose from 32% of the information work force in 1900 to about 42% in 1920. Clerical employment grew at slightly faster rate than overall employment in the information sector between 1920 and 1970, when it peaked at about 45%. Simultaneously, the higher level sales and supervisory stratum shrank from 31% to 19% of the information work force. These two lower white collar strata formed the majority of information workers, and the relative number of mid-level jobs has declined significantly since 1900, while clerical jobs have risen.

There are signs of a different pattern of occupational growth and decline between 1970 and 1980, although this shift should be identified as something less than a significant trend, since comparison of the data is problematic. As in the previous 70 years, the number of information workers continued to increase in all five strata. However, the relative size of some strata shifted in small but noticeable ways (Table 5). The proportion of highly professionalized and semiprofessional workers rose to about 40% of the information work force. Clerks declined somewhat in relative size to 42%,[14] although they continued to grow as a proportion of the total work force. In addition, the strata of supervisors and higher-level sales personnel continued to decline. And the blue collar strata continued to decline in relative size.

Overall, the information work force has mushroomed in the last 80 years to composed over 50% of the work force by 1980. Its lower level white collar workers outnumber professional workers. But this distribution has been masked by the steady growth of information sector jobs in the highly professional and professional strata, as well as clerical jobs. The occupational stratum between clerks and semiprofessionals—the supervisory and upper-level sales workers—has steadily declined in relative size. In 1900 it was twice as large, in relative size, as it was in 1980.

Two lower strata—clerks and sales and supervisory workers—account for 55% of the jobs in the information sector (Table 6). Semiprofessionals also account for a major fraction of the jobs—about 33%. But there is a large depression in the distribution of jobs across the three strata. The number of sales and supervisory jobs is about half the size of the semiprofessional stratum and less than half the size of the clerical stratum.

were employed in industry; and 31% were employed in services. By 1970, 3% of the labor force was employed in agriculture, fishing, and forestry; 31% were employed in industry; and 60% were employed in services (Ritzer 1977, p. 15).

[14]The *relative decline* of clerical workers is influenced by a substantial rise in the group of "all other professional and technical workers" in our data. However, a recent comprehensive study of computerization and clerical work also projects slower growth of clerical jobs between 1982–1995 (Hartman, Kraut, & Tilly 1986).

Table 5
Distribution of Occupational Strata Within the United States' Information Sector 1900–1980
Occupational Strata as Percent of Total United States' Workforce

	Fully Professional	Semi-Professional	Sales & Supervisory	Clerks	Blue Collar	Information as Percent of Total Workforce
1900	1.0	4.8	5.4	5.5	0.7	17.4
1910	0.9	6.2	5.7	7.9	0.8	21.4
1920	1.0	6.6	6.1	10.5	0.8	25.1
1930	1.2	8.2	7.1	12.2	1.0	29.7
1940	1.3	8.1	7.3	13.5	1.0	31.2
1950	1.8	9.2	8.3	16.1	1.3	36.7
1960	2.0	11.1	8.5	18.1	1.3	41.0
1970	2.7	12.4	8.4	20.6	1.5	45.6
1980	3.4	17.1	8.1	21.7	1.3	50.5

*1900–1970 data in this table come from Series D-182 through D-682, Bureau of the Census (1976:139–145). 1980 data come from Table B20, Bureau of Labor Statistics (1982:664–667) and Table 276 Bureau of the Census (1984) and are selected to match the smaller number of occupational categories from this time series. The resulting 1980 data does not match other tables, but is comparable with the data in this table.

Table 6
Size of Occupational Strata Within the United States Information Sector, 1980

Occupational Stratum	Number thousands	Percent of Information Work force
Professional	3,501	6.5
Semiprofessional	17,762	33.2
Sales & Supervisory	9,044	16.9
Clerical	21,130	39.5
Blue Collar	2,085	3.9
Total Information Work force	53,522[a]	53.9
Total Work force	99,303	

[a]The information work force total is larger than that reported in Table 1. See Appendix A for details.

three strata. The number of sales and supervisory jobs is about half the size of the semiprofessional stratum and less than half the size of the clerical stratum.

The relative size of the five occupational strata does not fit any of the three theoretical models we discussed above, that is, professional, middle, or lower level jobs dominating in a monotonic pattern. This distribution comes as a surprise. We expected that either middle or clerical strata dominated the information work force. We did not have strong expectations about trends in the relative size of strata. We were astounded by the stability of the relative size of these strata within the information sector between 1900 and 1970, were particularly surprised by the steady and precipitous decline in relative size of the sales and supervisory stratum. The kinked occupational distributions provide interesting evidence for segmentation in information labor markets (Berger & Piore 1980). An examination of the segmented character of information labor markets follows.

The Segmentation of Information Labor Markets

Information labor markets are divided into four relatively impermeable segments: (1) clerical work; (2) supervisory and higher-level sales jobs; (3) the two strata of professional jobs; and (4) blue-collar jobs. Our thinking has been strongly influenced by dual labor market theorists, even though their emphasis has often been very different. Dual labor market theorists have primarily focussed on the segmentation between jobs in the primary and secondary labor markets.[15] Most information sector jobs are primary sector

[15]There are several forms of dual labor market theory (Berger & Piore, 1980, p. 17). All of them divide the (national) labor market into two distinct sectors and hold that workers rarely move between the two sectors. One "primary" sector provides the most attractive and better paying jobs. The other, "secondary" sector, provides poorer jobs—jobs that are worse in pay, status, security, etc. Labor economists originally used dual labor market theories in the United States to help understand why the unemployment rate of urban blacks was relatively high and difficult to change.

jobs. Dual labor market theorists often mention that jobs in the primary labor markets are also segmented, but they rarely examine segmentation in the primary sector. For example, Berger and Piore (1980, p. 18) note that primary sector occupations are divided into upper and lower tiers. They identify the upper tier as jobs that are "managerial and professional" and the lower tier as jobs that are "blue collar" and "certain ones that are while collar." They place crafts jobs in a third intermediate tier. Montagna (1977) simply treats clerical jobs as secondary sector jobs.

The key element of segmentation patterns in labor markets is that significant *structural barriers* inhibit people's mobility from one labor market to another, or, in our case, one occupational stratum to another (Berger & Piore 1980).

Our arguments that the information labor markets are segmented are very simple. Most occupations in the professional and semiprofessional strata are segmented primarily by special education and licensing requirements. All of the occupations that we have listed as professions (Table 2) require specialized college or postgraduate degrees. Some, professions, such as law and medicine, impose stringent professional licensing requirements.

Many of the semi-professions have similar barriers that inhibit people from "moving up" into them, although some of them do not require formal training or licensing. Writers, artists, and entertainers are perhaps the most intriguing occupations, since theoretically, anyone can write, paint, or play. But managers and administrators account for the majority of semiprofessional jobs in the United States' economy.

Our data reveal a less apparent structural barrier that seal many women into clerical careers. Women who wish to rise from clerical jobs to "something better" often lack the special education and credentials required for fully professional and semiprofessional jobs. Management is the primary semiprofessional occupation that does not require college credentialling. Historically, managerial jobs have been male dominated, while many clerical specialties became female dominated by 1900. While managerial jobs have become more open to women in the last decade, they have remained male dominated (Taeuber & Valdisera 1986). Some structural barriers still limit women's mobility from clerical jobs to managerial jobs (Kanter 1977).[16]

The supervisory and higher level sales jobs are within reach for a larger number of clerks since they do not have significant educational and credentialling barriers. Some pay more than semiprofessional jobs; for example, some realtors and stockbrokers earn much more than school teachers and social workers. But they have steadily declined in relative proportion from approximately equal to the number of clerical jobs in 1900 to be approximately one-third the number of clerical jobs in 1980. Our argument is based on the relative number of slots for clerks in the next stratum: clerks who want to "move

[16]About 80% of clerks in the U.S. labor force are women. Specific clerical occupations vary considerably in the extent to which they are primarily female occupations, from 11% of mail carriers to 99% of secretaries. Most of the clerical occupations are over 70% female (Bureau of the Labor Statistics, 1982: Table B20; see also Taeuber & Valdisera 1986, p. 23; Hartmann, Kraut, & Tilly 1986, p. 20).

In my field studies of computerization and office work, I have met women who wish to find a "better job," but who have substantial problems in figuring out exactly what they might do. Sometimes they have taken computer classes with the hope that some technical skills would help open their career opportunities. Because they must support themselves financially while qualifying for an alternative career, few women in this predicament can afford to attend college for substantial periods of time. Some can, and do, take a sustained series of night courses. But these women are in a minority.

up" in the information sector will see a significantly smaller number of jobs they can qualify for.

Several questions might weaken this numerical argument. We do not believe that these counter-arguments have substantial force, but they are worth noting. We have no specific data about the occupational mobility of workers between these strata in 1900 or 1980 or at times in between. An argument that two occupational strata are segmented depends upon mobility data. Indirect evidence indicates that clerks often do not move into other kinds of careers (Kanter 1977). However, occupational mobility data would not reveal the number of clerks who sought jobs in higher level information sector strata but did not find them or were not recruited into them. Nor do we know the extent to which clerks would find the various jobs in the stratum attractive and would have sought them if they thought they were more readily available.

While sex discrimination in hiring has continued to impede women's access to certain professional and semiprofessional jobs, their conceptions of attractive jobs also influences where they work. The higher strata jobs were probably not equally desirable to clerks at all times between 1900 and 1980. Clerical perceptions have almost certainly changed between 1900 and 1980. In the early twentieth century, most clerks were men, and they may have viewed sales and supervisory jobs, which require more initiative than many clerical jobs, as acceptable, if not attractive. Traditional women, who dominated the clerical work force by the 1950s, may have found these higher-level sales and supervisory jobs less attractive. However, the women's movement has influenced women's conceptions of acceptable careers in the last 15 years; for example, many more women take degrees in traditionally male fields such as engineering, architecture, law, and business today than they did in 1967 (Taeuber & Valdiseral 1986; see also Burris 1983.) As a consequence, we suspect that more women clerks would find these jobs attractive today than in 1960, if they could move into them. However, these "better jobs" have been declining precisely during the time that they could become a move up for many clerks.

While the information work force became more segmented, access to many information jobs became more difficult. The educational and credentialling requirements for jobs at all strata in the information sector have generally tightened during this century. College degrees were once the prerequisites for only the most specialized and technical or most professionalized occupations. Since World War II there has been a form of credential inflation; bachelors (and sometimes graduate) degrees have become commonplace requirements for many semiprofessional jobs. Some employers are beginning to selectively hire people with college degrees into clerical jobs. Clerical work is probably the primary occupational opportunity for the majority of college-educated women with degrees in the liberal arts who do not acquire professional or graduate degrees.

Conclusions

We found that the information sector continues to provide a majority of jobs in the United States work force. Information sector jobs vary widely in quality. We have characterized the quality of jobs by one dimension: location in the status hierarchy of occupations. This simplified conception captures important aspects of pay, status, autonomy, and other working conditions. Relatively few information sector jobs are fully professional, and clerical jobs form the largest occupational stratum. When we examined the

growth of the various strata between 1900 and 1980, we found that clerical jobs became *more* not less dominant.

We do not have direct data about actual occupational mobility, but our data suggest that the mobility of clerks is significantly limited by structural features of the information sector. The information sector is internally segmented, not just differentiated. The information sector will grow somewhat in overall importance, and clerical jobs will continue to grow in absolute and relative size.

It is easy to represent the information worker as a male professional, such as an accountant, urban planner, or engineer. This representation misleads. A female clerk is more accurate, although no stratum is so dominant that the other strata can be ignored. Contrary to the argument that the information work force is becoming professionalized through the use of information technologies (Giuliano 1982), we have observed a steady growth in the relative size of the clerical stratum between 1900 and 1970. The growth of the semiprofessional stratum has been less marked. It was relatively stable between 1900 and 1970, compared with the other strata in the information sector, and it swelled disproportionately between 1970 and 1980.

It is ironic that clerical jobs are still expanding when the educational level of women, as measured by the number of college degrees awarded, is at an all time high.[17] Our own observations suggest that certain clerical jobs, for example, secretaries and bookkeepers, have usually become more varied as a byproduct of computer technologies and higher education.[18] In fact, some managers report quite happily that they are now recruiting college-educated women into clerical jobs, which formerly drew only high school or junior college graduates. However, other clerical jobs, such as cashiers and counter clerks may remain relatively routinized, even when they have automated support through specialized point of sales terminals.

We had not expected to find the information sector structured like a dual labor market for such a long period of time. Because we focus on the information sector, our data do not tell us about key aspects of dual labor markets, such as the employment of skilled craftsmen or even of mobility between other sectors and the information sector. Moreover, we do not have the kind of income data to definitely answer key questions about "the declining middle class" (Lerman & Salzman 1987). These questions were outside the scope of this study. Even so, our data lend support for the declining middle thesis. Moreover, our data cast doubt on arguments that office workers are becoming more paraprofessionalized and professionalized (Noyelle 1987). Based on our own field studies of computerization in white collar work, we believe that office work is becoming more skilled (Iacono & Kling 1987). Our data doesn't show substantially more job openings for office workers to enter semiprofessional and professional occupations (Table 4). These jobs normally require college degrees. Even the high skilled information jobs above the clerical stratum which do not require college degrees are in relatively short supply.

In a recent article, Robert Reich (1989) identifies three major segments of the

[17]Since 1981, women have received more bachelors and masters degrees annually than men. In 1960, they received about one-third of the bachelors degrees and less than one-third of the masters degrees.

[18]Some of the variety comes in the skills and practices needed to work around gaps in imperfect computer systems. See Iacono and Kling (1987). Our position differs considerably from Zuboff's (1988) argument that computerization has almost always lead to socially isolated jobs in which the abstractness of computerized data disorients workers.

United States labor force that parallel our own categories. His three segments account for about 75% of United States' employment: (a) symbolic analysts (lawyers, investment bankers, management consultants, research scientists, academics, etc.); (b) providers of routine production services (clerks), and (c) providers of routine personal services (barbers, retail sales personnel, cab drivers). He argues that the United States' location in international markets makes the jobs of symbolic analysts relatively valuable and well-paid. In contrast, providers of routine production services are often competing with low wage labor elsewhere in the world. However, providers of personal services have captive local markets, and can fare better than clerks. After all, one doesn't fly to Seoul just for a haircut or a cab ride, even if it is cheap! But a publisher may well have a book typeset in South East Asia, and thus displace clerical jobs in the United States. Reich's "symbolic analysts" parallels our professional and semiprofessional information workers. His loosely argued thesis suggests an important dynamism which may reinforce the dual structure of information labor markets. It certainly merits further investigation.

We have not addressed the question whether massive technological change, particularly computerization and the use of advanced telecommunications systems, will alter the structure of the information occupations. Some economists predict major declines in the size of the clerical work force. (For a review of the debates and detailed comparisons of several studies, see Hartman, et al. 1986.) But these projections rest on studies of efficiency gains on narrowly defined tasks and simple assumptions about the substitution of capital for labor.

As the information sector expanded, it took on many characteristics of the overall economy: jobs that vary significantly in terms of pay, status, and power. Moreover, its internal divisions reflect patterns of segmentation that have developed elsewhere in the society. Overall, the information sector has become sufficiently large that it is not an alternative to the dominant social order; it simply reproduces many of its features.

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Appendix A

Measuring the Scope of the Information Workforce

In his landmark study, which has provided the most widely used basis for defining and measuring the size of the information economy, Marc Porat realized that "[s]tating precisely who is an information worker and who is not is a risky proposition" (Porat 1977, p. 105). He identified information workers by asking, "[w]hich occupations are *primarily* engaged in the production, processing, or distribution of information as the output, and which occupations perform information processing tasks as activities ancillary to the primary function?" (Porat 1977, p. 105). An answer to this question yields a meaningful list of information jobs.

Our typology of information workers is based on Porat's. We began with his list of information occupations to produce a list that is substantially similar to his. Porat identifies 188 information occupations, while we appear to identify 83. This is only an indication of the finer occupational distinctions in Porat's list as many of our single occupational titles are composed of some combination of separate titles from his list.[1] We match Porat's list very closely. (We did not match 17 occupational titles on his list, but we estimate 6 of them from federal data.)

Porat's "Knowledge Producers" consists of "Scientific and Technical Workers" and "Private Information Services." We do not match Porat's occupation "Mathematical Scientists" or its subcategory "Actuaries," "Farm Management Advisors" and "Home Management Advisors." Porat's "Knowledge Distributors" are all matched to occupations on our list. "School administrators" are listed, but no numbers are provided for us. We match all of Porat's "Information Processors" with the exceptions of "Health Record Technicians" and "Railroad Conductors," which were not listed in our data. "Motion Picture Projectionists" is included in our data.

We match "Information Workers" except for "Sign Painters," which were not listed in our data, and "Data Processing Machine Repairers," which were listed. Note that "Radio Operators" is included in our count but in the noninformation sector under "Technicians, Except Health, Science and Engineering."

Porat (1977, p. 118) uses the alternative "restrictive" and "inclusive definitions of information workers. Basically, he believes that 28 of his 1988 listed occupations are "mixed" in nature and he is uncomfortable with including them as wholly information occupations. He thus allocates the "ambiguous" occupations proportionately to separate sectors. For example, he allocates 50% of "Physicians" to information and 50% to

[1]Porat's granularity is not quite as fine as others. For example, BLS data breaks the clerical stratum into 95 specific occupations (*Computer Chips and Paper Clips*, Table 3-18: p. 112). These distinctions are fine enough to distinguish between "desk clerks, bowling floor" and "desk clerks, except bowling floor." We found it unnecessary to make the distinctions about who was on the bowling floor and who was not. Rather, we combined occupation titles where possible, for example, our occupation title "Life and Physical Scientists" corresponds to the [sub] titles: "Agricultural Scientists," "Meteorologists," "Life Scientists" (further consisting of "Biologists" and "Medical Scientists"), "Chemists," "Geologists and Geophysicists" (including Oceanographers), "Physicists," and "Life and Physical Scientists, (nec)" The corresponding occupational titles under Porat's "Natural and Physical Sciences" are: "Agricultural Scientists," "Atmospheric, Space Scientists," "Biological Scientists," "Chemists," "Geologists," "Marine Scientists," "Physicists and Astronomers," and "Life and Physical Scientists."

service under his "inclusive" definition, and 100% to service under his "restrictive" definition. He does this even though he notes that "[t]ime budget studies of physicians' offices revealed that over 70% of a physician's time is spent [. . .] in information tasks" (Porat 1977, p. 118).

Porat (1977, p. 121) reports his data on the growth of the information work force exclusively in his [often reproduced] graph of the four sector aggregation of the U.S. work force 1860–1980 "using median estimates." These "median estimates" mean that the data points on the graph are the median of the "restrictive" and "inclusive" figures for the given year, the "median" being intuitively the "middle number" between the two numbers considered. Porat's estimation procedure is equivalent to counting the 28 "ambiguous" occupations as 25% information and 75% some other sector.

Our own approach to counting the number of information workers is more straightforward. We include Porat's 28 "ambiguous" occupations as information occupations without ambiguity. We believe it is reasonable to include them, for example, "Physicians" and "Registered Nurses" appear to be *primarily* information workers.[2] We also believe that "Sales Clerks" increasingly perform roles as information workers; for instance, as operators of "point of sale" terminals. Similarly, "Miscellaneous Clerical" workers (such as, general office clerks and medical insurance clerks) are generally employed to enter, file, or move information for their employers. We perceive the managerial occupations to be highly information oriented and allocate them as information occupations. In the blue collar stratum, we identify "Inspectors" and "Examiners" to be primarily information occupations as the titles imply.

Appendix B

Notes on Sources of Data and Methods

We drew our data from the following sources:

Bicentennial Edition, Historical Statistics of the United States, Colonial Times to 1970, Part 1. U.S. Department of Commerce, Bureau of the Census. Table: "Detailed Occupations of the Economically Active Population: 1900 to 1970," series D 233-682 (pps. 140–145). [For federal time series by occupation 1900–1970. We use it to carry through our information occupations by level 1900–1970.]

1980 Census of the Population, Detailed Population Characteristics, United States Summary, Section A: U.S.: Table 276: "Detailed Occupation of the Experienced Civilian Labor Force and Employed Persons by Sex: 1980 and 1970," pps. 1-166 to 1-175. [For federal employment data for 1970 and 1980.]

Labor Force Statistics Derived From the Current Population Survey: A Databook, Volume 1. U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2096, September 1982, Table B-20: "Employed Persons by Detailed Occupation, Sex, and Race, 1972–81," pps. 664–667. [For more federal occupational data for 1980.]

Statistical Abstract of the United States 1986, 106th Edition. U.S. Department of Commerce, Bureau of the Census, December 1985. [For data at the federal level on employment for 1970 and 1980.]

[2]One wonders if the information component of such occupations is growing with time. Computers are a nontrivial part of record keeping, expert systems, and therapy machines, and special knowledge is required to use them properly.

Occupational Comparisons: 1900–1980

In assembling our historical series of federal data for 1900–1980 displaying the 5 strata of the information work force, we relied primarily upon the *historical Statistics of the United States* (Series D-182 through D-682), but were forced to use data from other sources to fill in some unexplainable gaps in the series and to add data for 1980.[1] (For example, teachers and nurses are counted for all years except for 1970!) We also dealt with some apparent reclassifications of occupations across categories for given years.

Since our main focus is to track the proportions of workers *within* a given information occupation stratum, our job was simplified. Even if the job was reclassified with others, as long as they all remain within the same occupational stratum, the crucial total is correct. We explain key examples of our calculations below. We used *Historical Statistics of the United States* data for 1900–1970, unless otherwise noted. We used *Labor Force Statistics* as our source for 1980 data, unless otherwise noted.

In the professional stratum, there are no estimates for "Teachers, College and University" in 1970. We estimate employment for this year from *Statistical Abstract for the United States*. The estimates for "Physicians" from *Historical Statistics of the United States* include "Osteopaths" before 1960. They include "Chiropractors" and "Therapists and Healers" for 1900. "Life and Physical Scientists" are a combination of the *Historical Statistics of the United States* categories of "chemists" and "natural scientists, (nec)" for 1900–1970. The category "Operations and Systems Researchers" is not listed in *Historical Statistics of the United States*, but we obtained data from the *Census of Population* for 1970 and 1980.

In the semiprofessional stratum, the number of "All Other Managers and Administrators" had to be calculated from *Historical Statistics of the United States* by subtracting the number of all managerial occupations already included (10 in all) in our list from the total. "Teachers, Except College and University" were constructed analogously to "Teachers, College and University" above in the professional stratum. The category "All Other Professional and Technical" has no entry for 1970, and the data gave us no basis for estimate the size of this occupational category in 1970. We left it as 0. But we estimate the size of this occupational category for 1980 from *Labor Force Statistics* which includes not only "all other . . ." but also the semiprofessional categories "Research Workers" and "Vocational and Educational Counselors," which were not counted separately in the *Historical Statistics of the United States* data.

The "Writers, Artists, and Entertainers" category is a composite from both the *Historical Statistics of the United States* and *Labor Force Statistics* estimates. From the *Historical Statistics in the United States* tables, it consists of "Actors and Actresses," "Dancers and Dancing Teachers," "Entertainers, (nec)", "Artists and Art Teachers," "Authors," "Editors and Reporters," "Designers," "Musicians and Music Teachers," and "Photographers." From the *Labor Force Statistics* table we derive the figure from the difference of the "Writers, Artists, and Entertainers" and the excluded subcategory "Athletes and Kindred". The category "Computer Specialists" is not included in our *Historical Statistics in the United States* data. We estimate 1970 and 1980 employment from *Statistical Abstract for the United States* consisting of the sum of the estimates for "Computer Systems Analysts and Scientists" and "Computer Programmers".

[1]We will henceforth abbreviate the sources: *HISTORICAL STATISTICS of the UNITED STATES* as "HS": *Labor Force Statistics Derived from the Current Population* as "LFS": and *1980 Census of the Population* as "CP".

The "Sales Representatives" and "Sales Workers, (nom)" (clerks and low-level sales) are matched in the *Historical Statistics in the United States* data with "Salesmen and Sales Clerks (nec)"; manufacturing *and* wholesale, and "Salesmen and Sales Clerks (nec)"; retail, respectively. Sales representatives are upper-level sales workers and sales workers are clerical workers, yet the occupations are aggregated into one occupation as "salesmen and sales clerks, nec." for 1900–1940. We estimate their proportions by the ratio from 1950 and enter the data separately.

The "All Other Clerical" category comes from "Clerical and Kindred Workers (nec)" in the *Historical Statistics of the United States* data. We carefully calculated an *Labor Force Statistics* figure by subtracting the sum of all other clerical counts (17 of them) that were included from the total clerical figure.

Estimates of the Number of Clerks

Our "clerical" stratum of information occupations differ from the usual list of clerical occupations. In trying to capture the lower end of the white collar information jobs, we include the low-level sales workers, such as sales clerks (who are usually counted in other grosser categories, such as "sales workers"). This category is large in size relative to the others. For example, the Bureau of Labor Statistics (1980) reported about 2.4 million sales clerks in 1980. This produces a significant difference in the reported size of the "clerical" work force. For example, compare Table 3-18 in *Computer Chips and Paper Clips*, p. 112. We count about 3 million more clerical workers in 1980 than the 18.7 million that they count for 1982. Our larger count is almost entirely due to our inclusion of sales workers.)

Another explanation for possible differences between our count and other counts is the differing data sources. We were surprised (and unfortunately enlightened) to find disparities in different data sources for single occupational titles of some large magnitude. For example, we first noticed a figure for "receptionists" for 1982 reported in *Computer Chips and Paper Clips*, Table 3-18 (BLS data) to be 381,100. We found that in the BLS publication *Labor Force Statistics Derived from the Population* reports a figure of 644,000 for 1980! There is clearly a difference in definition or method of measurement. Other anomalies exist between official federal data sources, which cite the Bureau of Labor Statistics, that we cannot readily explain.