Overview

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H. Allan Hunt and Timothy L. Hunt
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There is widespread concern about clerical employment trends today, largely because of the fears of office automation. Some are concerned about the employment impacts of office automation because they are impressed by the potential labor displacing capabilities of the new technologies. Others are worried about any threat that the new office technologies may pose for women's employment opportunities. If office automation eliminates these traditionally female jobs, there may be even greater problems ahead for women in the labor market.

Actual trends in clerical employment in the first half of the 1980s fueled these concerns. At roughly the same time that microprocessor technology was capturing the public imagination, clerical employment began to decline. Was this a coincidence? Do the new word processors, enhanced telephone capabilities, electronic mail and dictation systems represent revolutionary technological change for the office? What do these new technologies portend for clerical employment in the future?

The decline in clerical employment and the growing interest in office automation occurred at the same time that the economy suffered through the deepest recession since the 1930s. Unemployment levels rose to unprecedented postdepression levels. Are these events causally related?
Which is cause and which is effect? Are clerical workers going the way of farm workers, becoming so productive that they worked themselves out of their jobs?

Clerical jobs are important because they are the most numerous occupational group in the economy. They are also important because they present entry opportunities for young workers, disadvantaged workers, or those reentering the labor force after an absence of some kind. Over the years, one of the most productive training outlets for employment and training programs for disadvantaged Americans has been clerical work. Are these entry channels to be choked off now by machines that replace clerical workers?

This monograph reviews trends in clerical employment over the last 30 years in a search for indirect evidence of the impact of changes in process technology on clerical employment levels. The indirect approach to studying technological change is necessary because the information required to conduct a more rigorous investigation is unavailable. In the absence of data on capital inputs or clerical output, existing employment data are carefully analyzed to provide a picture of clerical employment changes through time.

Specifically, clerical employment trends from 1950 to 1980, and from 1972 to 1982 will be examined. The intent is to secure some understanding of the clerical employment impacts of technological change during the first computer revolution of the 1960s and 1970s. This should aid in assessing the likelihood of significant technological displacement among current clerical workers accompanying the new microprocessor-based office technologies of the 1980s.

The monograph also investigates the broad economic determinants of recent clerical employment changes. The influence of industry occupational structure and industry
employment trends on clerical employment totals is examined. Changes in occupational employment patterns within particular industries are examined for possible association with technological changes. Evidence of the direct impact of technological change on office employment levels is sought for the finance and insurance industry, reputedly the most advanced user of office automation systems and the heaviest employer of clerical workers in the economy.

A review of prominent forecasts of clerical employment is also offered. The obvious purpose is to provide information about other researchers' expectations about clerical employment trends. It also provides an opportunity to examine the way in which assumptions about technological change and its employment impacts for the future have shaped those employment forecasts.

The monograph does not try to assess the influence of other important factors that will determine future labor market outcomes for clerical workers. In particular, there is no consideration of future supply issues. If female labor force participation rates continue to rise as they have in the past, the issue of job creation for women will be of even greater significance. On the other hand, if women increase their penetration of nontraditional female occupations, the number of females seeking clerical positions in the future may decline. Whether men are more likely to begin to look to clerical positions for career opportunities in the future presumably depends on labor market developments for clericals, as well as the job outlook in more traditional male occupations.

Clearly these considerations are crucial to understanding whether the supply and demand of clerical workers will be in approximate balance in the labor market of the future, but this question is beyond the scope of the present volume. We seek only to (1) illuminate past trends in clerical employ-
ment, (2) investigate the causes behind those trends, with particular attention to technological change, and (3) critically evaluate existing clerical employment forecasts. It is hoped that this review will help to narrow the range of uncertainty about the probable future impact of technological change on the demand for clerical employment.

This first chapter will provide an overview of the issues. Questions will be raised about the causes of recent trends in clerical employment. A discussion of the meaning of clerical automation will also be offered. Possible employment impacts of technological change will be outlined and offsetting tendencies considered. The chapter will conclude with some cautions about the comparisons that must be made between dissimilar data sources.

Chapter 2 presents the best available data on the historical employment patterns of clerical workers. It begins with a discussion of some of the difficulties in measuring occupational employment. Then the chapter presents the data base on occupational employment for clerical workers. The number and types of clerical jobs are discussed, as is the demographic makeup of the clerical workforce. The long-term trend in employment from 1950 to 1980 is presented first. It is followed by a brief discussion of more recent trends using annual data from 1972 to 1982. Finally, the trends in demographic characteristics of clerical workers are described.

Chapter 3 describes the employment trends for individual clerical occupations in some detail. The clerical occupations are divided into relatively homogeneous subgroups and both long-term and recent trends are reviewed, together with the demographic composition of the occupation and speculation on the past impacts of technological change. Chapters 2 and 3 are complementary in the sense that they both examine the same basic data. Chapter 2 concentrates on overall trends
while chapter 3 takes individual clerical occupations as the focus of attention.

Chapter 4 investigates the determinants of clerical employment. It concentrates on clerical employment by industry and the role that industry growth trends play in explaining the expansion of clerical employment. The industry staffing ratio is developed as a tool to aid in this analysis. Then the specific question of technological change in the office and its impact on clerical employment is explored. Chapter 4 concludes with an analysis of the contributions that general economic growth, differential rates of industry growth and changes in occupational staffing ratios have made to overall clerical employment trends.

Chapter 5 reviews the major recent forecasts of clerical employment levels in the future. The national occupational projections program at the Bureau of Labor Statistics is examined, and other noteworthy forecasting efforts are also considered. The focus is on the way in which assumptions about technological change impact the employment projections for clerical workers over the next decade. In the concluding chapter, the findings are reviewed and more global interpretations are offered of the determinants of clerical employment levels, both past and future.

**Overview of Clerical Employment Trends**

Clerical jobs are the largest single occupational group in the economy; they are also one of the most diverse. Generally, people use the term "clerical workers" to refer to the traditional office occupations. Secretaries, typists, stenographers, file clerks, office machine operators and receptionists do make up a large proportion of all clerical workers. But bookkeepers and bank tellers are also clerical workers, according to the U.S. Bureau of the Census, as are
bill collectors, insurance adjusters, postal clerks, expediters, dispatchers, and teachers' aides. While this listing is not exhaustive, it is indicative of the great variety among clerical jobs throughout the economy.

The tremendous growth in the number of clerical workers in the U.S. is well known, but the true magnitude of this expansion cannot be appreciated without comparing it to the growth in total employment. Figure 1.1 shows that the proportion of clerical workers to total employment has doubled in the last 40 years. In 1940, just under one employee in ten was a clerical worker. By 1980, this proportion had risen to one in five.\(^1\) One of the most stimulating questions about future employment is whether this trend will continue. Such questions derive naturally from early disappointment with labor market results of the 1970s and early 1980s, but they are driven primarily by the developments in office technology of the last few years.

The first "computer revolution" in the 1960s was expected to impact clerical work adversely as well. Despite the fact that the dire consequences predicted by some for clerical worker employment in the 1960s did not materialize, these fears have been aroused again in the 1980s.\(^2\) Those who are convinced that this time the fears are well founded base their case primarily on the introduction to the office of microprocessor-based technologies. The incredible reductions in the cost of computing power, combined with the reductions in bulk made possible by microprocessor technology, may possibly constitute a new revolutionary development.

Those who expect that automation will stop the long-term growth in clerical employment cite the apparent reduction in the rate of increase in the proportion of clerical workers. This can be seen in figure 1.1 as well. While the clerical proportion of all employment rose almost linearly from 1940 to
Figure 1.1

CLERICAL EMPLOYMENT PROPORTION

CENSUS DATA, 1940 TO 1980

CLERICAL PROPORTION

0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0

1940
1950
1960
1970
1980
1970, there is a slight reduction in the rate of increase between 1970 and 1980. Is this the beginning of the end of clerical employment growth?

Figure 1.2 helps illuminate the cyclical component in employment movements and shows how this can confuse the issue of the secular trend in clerical employment. Figure 1.2 indicates the growth in both clerical and total employment annually from 1958 to 1984. Employment figures are reported in the form of index numbers to facilitate comparison between the two series. Using 1958 employment as the base, the index numbers indicate the growth in clerical and total employment over the levels in the base year.

The more rapid rise in clerical employment over most of this period is readily apparent in figure 1.2. However, the similarity in the employment trends since the last cyclical employment peak in 1979 is also indicated. Still, the absolute decline in clerical employment from 1981 to 1982 is the only time this has happened in the last quarter century (discounting the 1971 data anomaly). Generally, in recessionary periods production worker employment declines but clerical employment only slows in growth. Total employment movement then depends primarily on the severity of the change for production workers. In the 1975 recession, for instance, total employment declined while clerical employment continued to rise, although at a slower rate.

Figure 1.3 shows the proportion of clerical employment to total employment on an annual basis from 1958 to 1984, thus reflecting both the trends shown in figure 1.2. When total employment declines and clerical employment rises, the clerical proportion rises very rapidly as indicated in figure 1.3 for 1975. It is obvious in figure 1.3 that the rate of increase of clerical workers relative to all employment was much slower in the 1970s than it was in the 1950s.
Figure 1.2
CLERICAL AND TOTAL EMPLOYMENT TRENDS
CPS DATA, 1958 TO 1984

Employment Index (1958 = 100)

- TOTAL EMPLOYMENT
- CLERICAL EMPLOYMENT

Legend:
- □ TOTAL EMPLOYMENT
- + CLERICAL EMPLOYMENT

Graph shows the trend of clerical and total employment from 1958 to 1984.
Figure 1.3

CLERICAL EMPLOYMENT PROPORTION
CPS DATA, 1958 TO 1984
What is even more apparent is the stagnation in the proportion of clerical workers since 1980. Clearly, clerical workers did not fare as well in the last recessionary period as they did earlier. It is less clear what the downturn in the clerical proportion in 1984 means. Such a decline has been typical of recovery periods in the past (as in 1976-77) when the number of production workers rises rapidly to restore the prerecession balance between production and nonproduction workers (including clericals). Whether the trend of the early 1980s is something different remains to be seen.

Figure 1.4 shows the employment ratio of clerical workers to managers and administrators reported in the Current Population Survey (CPS) from 1958 through 1982. Since these are aggregate figures, it would be risky to attach any particular importance to the actual numerical value of the ratio, but the trends are very suggestive. Figure 1.4 shows that the ratio of clericals to managers in the entire economy rose dramatically through the 1960s, reaching a plateau by the end of the decade. This ratio held very nearly constant through the 1970s (ignoring the 1971-72 distortion caused by conversion to Census benchmarks). However, the ratio has fallen slightly since the beginning of the recessionary period in 1979-80. This evidence is certainly not inconsistent with the hypothesis of a significant change in the employment trends of clerical workers in the last few years.

The last issue to be discussed in this overview is the extent to which clerical jobs are also female jobs. Is it a coincidence that the expansion of clerical employment occurred simultaneously with the expansion of female labor force participation rates? To what extent have female job opportunities been linked to the expansion of the clerical workforce?

Figure 1.5 shows that the overwhelming majority of clerical workers are in fact female, and that this is even more
RATIO OF CLERICALS TO MANAGERS
CPS DATA, 1958 TO 1982

Figure 1.4
true today than it was 30 years ago! From just over 60 percent female in 1950, the proportion grew to nearly 80 percent by 1980. A closer examination of individual occupations later will show that this reflects the relative growth trends among clerical jobs as well as the increasing supply of female labor. But it is clear that clerical jobs are more than ever women's jobs.

With this introduction to clerical employment trends, let us turn to the issue of clerical automation and the question of whether automation may cause the future of clerical jobs to look much different from the past.

**What is Office Automation?**

It is necessary to develop a workable definition of office automation to explore its impacts on clerical workers. In manufacturing, it is common to describe automation as the performance by a machine of a work task previously done by a human worker. The key point is that the machine has eliminated the worker entirely from the process rather than simply extending the capability of the worker. Thus, mechanical transfer devices move parts from one workstation to another without human intervention, and automatic feeders are capable of inserting parts into a machine for processing without the aid of a human operator.

Applying this notion of automation from manufacturing, office automation would then be the elimination of clerical work tasks through the utilization of capital equipment. In fact, in the past 40 years or so hundreds of thousands of clerical jobs have been eliminated through automation, telephone operators replaced by automatic switching units, stenographers by office dictation equipment, and so on. More recently, computer software is being used to determine the appropriate price for an insurance policy, a job task
which was once done manually by a clerical specialist called a rater, and automatic mail sorting devices are reducing the need for mail clerks. There is no doubt that automation is eliminating some kinds of clerical jobs.

Although this notion of office automation provides a useful beginning and certainly constitutes one aspect of office automation, it is much too narrow a perspective. In broader terms automation is the process of substitution of capital for labor, which ultimately results in higher labor productivity. From an analytical viewpoint there appears to be no justification to limit the idea of office automation to fully automatic devices. As one example, word processors do not eliminate the manual keystrokes entered by a human operator. However, they may improve the efficiency of the process and thereby eliminate the need for some clerical workers, all other things equal.

In this monograph, office automation will be interpreted broadly as any technological change which enhances the productivity of clerical workers. There are many reasons for utilizing such a broad definition of office automation. First, clerical jobs encompass a wide variety of positions, many of which are not located in offices. This implies a tremendous number of different kinds of capital equipment that may be used by clerical workers as a group. Therefore, it would be a mistake to define office automation narrowly, in terms of particular machinery. Clerical jobs and the machinery and equipment that are used in those jobs are very diverse.

Second, this broad definition of office automation facilitates the examination of the overall results which have been achieved by the utilization of office hardware. This approach is the most consistent with the historical review of employment trends in clerical occupations. It will be seen later that precious little hard data are available on office automation equipment, so it is extremely important to make
the maximum use of the employment data which are available. The broadest possible perspective on office automation is therefore encouraged.

Finally, even if detailed data were available on office automation, it would still be critical to examine actual outcomes rather than intentions or the technical potential of the equipment. Many clerical jobs tend to be relatively unstructured, and there is no reason to think that the absolute technical potential will be realized. It is also well known that vendors and those responsible for implementation decisions within firms have a self-interest in being optimistic about the capabilities of office automation.6

Technological change in the office has been occurring for a long time and has involved numerous types of capital equipment. Nevertheless, an assessment of the overall trends in clerical employment should reveal the impacts of recent improvements in office automation, provided they are sufficiently dramatic and adequately diffused. If this technology is truly revolutionizing the productivity of the office, some employment impacts should be apparent in the last few years. According to one survey, nearly one-fourth of secretaries may have had direct access to a word processor by late 1982, while just over one-sixth may have had access to a personal computer in the office.7 Clearly the continued diffusion of office automation equipment since 1982 should have begun to impact employment levels significantly if such dramatic effects actually exist.

The popular press is full of the wonders of current office automation technologies. Taking some of these treatments at face value, the “paperless” office is just around the corner. Fully automatic correspondence systems that can take raw dictation and turn it into finished text, properly formatted and polished, seem only a matter of months away. In fact,
the capabilities of current office automation are impressive, but nowhere near what the futurists would have us believe.

There are two key aspects of today's office automation systems: computing power and communications. At the heart of these systems is the computer, including the peripheral devices for input and output as well as the software which makes the system operate. The computer is not a new piece of technology, but it has become radically smaller and more powerful over the years and definitely much less expensive. Thus, in contrast to the mainframe computer revolution of the 1960s, the excitement today is about the minicomputers and microcomputers which are invading both our offices and homes. There is no doubt that the diffusion of computers beyond centralized data processing centers is putting enormous computational power in the hands of more and more people.

Adequate data on computer sales, as in other areas of office automation, are hard to come by. Some consulting firms maintain such data bases. But the reliability of the data is unknown, it tends to be expensive to access, and even when access is granted, the user is generally not permitted to publicly disseminate the data for proprietary reasons. Another potential source of data on computers is the current industrial reports program of the U.S. Department of Commerce. They maintain data on computer sales but it is limited to the shipments of domestic manufacturers.

The ideal data base on computers would contain information about the actual population of computers in use by industrial sector within the U.S. Unfortunately, that type of data is not available at all. The Computer and Business Equipment Manufacturers Association (CBEMA) does publish data about the domestic consumption of computers. The data are maintained separately for microcomputers, minicomputers, and mainframe computers, where the
distinctions are a function of price and computational power. Microcomputers are those priced from $1,000-$20,000, minicomputers from $20,000-$250,000, and mainframes $250,000 and above. Although the specific computational power parameters are not reported and the reliability of the data is unknown, the CBEMA data appear to be the best available for our purposes.

The domestic consumption of micro-, mini-, and mainframe computers from 1960-1984 is reported in table 1.1. Domestic consumption includes all sales, foreign and domestic, made to U.S. users. It attempts to capture import sales of foreign firms but excludes the export sales of U.S. manufacturers, i.e., it is the U.S. market for computers. The data are reported in unit terms rather than dollar terms because that may be the best indicator of the impact of computers on the workforce.

According to table 1.1, the growth of mainframes (price of over $250,000) has averaged a little under 8 percent per annum for the entire 24-year period. It is interesting to note that this category of computer, which remains the backbone of the industry, has proven quite susceptible to the vagaries of the business cycle. Unit sales declined in 11 of the 24 years. There were peak years in 1967, 1973, and 1981. Moreover, the absolute sales of 14,000 units in 1972 outdistanced the 1981 peak of 10,700 units by some 30 percent.

In contrast, the sales of minicomputers (priced from $20,000 to $250,000) have increased in every year that CBEMA reports the data except 1983. The annual growth rate exceeds 33 percent. However, the decline in 1983 certainly seems to demonstrate the cyclical sensitivity of minicomputer sales as well. But it is the sales of microcomputers (priced under $20,000) that have been truly astounding. The annual growth in unit sales from 1975 to 1984 was just under 100 percent. Of course, that growth rate is partly a
result of the small base of micros in 1975. Nonetheless, the overall sales gain from 1981 to 1984 was still a very healthy 77 percent annually, bringing the size of the total market to 2,140,000 units. It is not known how many of these microcomputers were sold to business firms and how many to the home market.

The data in table 1.1 raise the interesting question of the susceptibility of the microcomputer market to the business cycle. This may be important in terms of office automation because it is these smaller, cheaper computer systems which are the focus of the current interest in office automation. This question is extremely apropos today because the popular media currently are rife with reports about the slowdown in computer sales. In fact, one popular business magazine expects that 1985 sales of computers to business firms will exceed 1984 sales by a meager 3 percent, and it is projecting 1986 sales growth of only 5 percent (Fortune 1985).

There are no hard data about which sectors of the computer market are being affected by the current slowdown in sales, but it appears that the slowdown is relatively broad-based. According to the CBEMA data, mainframe sales began to decline in 1982 and minicomputers dropped in 1983. A firm such as Wang, which has specialized in the office automation market, actually furloughed workers for the first time in corporate history in 1985. Obviously, it is extremely difficult to hazard a guess about how long the slowdown will last. As early as May 1984, one consulting firm (Stanford Research International 1984) released a study that suggested the long-term market for microcomputers in business had been vastly exaggerated.

Since 1984 and 1985 have been reasonably good years in terms of economic growth generally, this slowdown in computer sales, whatever its magnitude, is occurring during the
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<th></th>
<th></th>
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<th></th>
<th></th>
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Table 1.1
Domestic Consumption of Micro-, Mini-, and Mainframe Computers, 1960-1984
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<th>Year</th>
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<th>Mainframes</th>
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<th>Sales</th>
<th>Change</th>
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<td>58,500</td>
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<td>44,100</td>
<td>6.4</td>
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<td>72,130</td>
<td>58.8</td>
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NOTE: Micros, $1,000-$20,000; Minis, $20,000-$250,000; Mainframes, $250,000 and above.

NR - Not reported.
recovery phase of the business cycle. It is happening exactly when most computer industry optimists had expected an explosion in computer and office automation sales. The current situation certainly does not give much credence to the position that the microcomputer revolution is impervious to economic conditions.

The current slump in the computer market demonstrates once again the natural tendencies of firms and individuals to be overoptimistic about the possibilities for and the capabilities of new technologies. It seems that only through experience do we modify our overoptimistic expectations about the future. The lack of hard data and the limited experience with the new technologies also contribute to wide swings in our expectations about these systems.

The second key aspect of office automation technologies today is communications. Within an individual computer system the goal is to be able to input commands, data, or text by voice or by optical scan devices. These changes would, obviously, significantly reduce the keying of data. Across computer systems, the goal is to achieve effective, flexible communications. Users would be able to easily talk with mainframes and access the large data bases which are maintained on those systems. Ideally, users would also be able to interact with other users, regardless of hardware or software selection.

The problem with communications technologies today is that only part of these systems are available now and their capabilities tend to be limited. For example, voice input devices are still in the experimental stages, except for a few specialized applications. Voice input systems can be constructed today that understand a very limited vocabulary, but may only recognize one individual's voice. Today's voice input systems would be particularly inappropriate for the office with its myriad interactive tasks and people. Obviously,
it is very difficult to talk about diffusion of systems which are still experimental

Computers today are being interconnected in what are known as local area networks (LANs). That is the buzzword in the trade press in 1985. These systems are not yet very flexible, however. They enable certain makes of computers to communicate with each other, perhaps a micro to a mainframe to access some particular data base or software package, but there is a bewildering array of incompatible computer hardware and software on the market which is hindering these changes. LANs may also support communication between workstations by using electronic mail, but the system may be limited by the lines of text that can be transmitted and it is not likely that it will accept graphics. It should also be remembered that even this level of communication becomes impossible if one is trying to access another computer not on the hard-wired LAN. That is not meant to deny the existence of long distance communication using modems and ordinary telephone lines. These communications are primitive and restrictive, however, compared to the capabilities required to gain wide acceptance by the business community.

It is fair to conclude that the diffusion of the newer communications systems is currently lagging the diffusion of micros and minis by a wide margin. In fact, one of the explanations being offered for the current slowdown in computer sales is that firms are trying to determine how they are going to tie together dissimilar hardware and software systems that were purchased before the potential for interconnectivity was recognized. It remains to be seen when LANs will reach the level of acceptance of the ubiquitous personal computer.

It should not be surprising that some optimists are trumpeting the new communications technologies as finally
heralding the paperless office of the future. Others are not so certain. In any event, there seems to be no doubt that thus far computers have created a veritable mountain of paper reports. It is also clear that we have required a growing army of clerical workers to cope with the paper avalanche.

**Potential Employment Impacts of Office Automation**

Technological change is frequently classified as either a change in process or product technology. Process technology refers to the machinery and equipment and the associated production techniques which are used to produce individual goods and services. Product technology, on the other hand, is that technology which is embedded in the final good or service itself. Thus a given change in knowledge might be applied to changing the nature of the final product, or to changing the way in which the product is produced.

In many cases the distinction between process technology and product technology is artificial. Changes in the nature of a product frequently have important implications for the process used to create it. And changes in the method of manufacture also generally lead to changes in the product itself. These issues are even more complex when dealing with office automation, since the product (office output) is not normally sold on a market. Nevertheless, the distinction is useful analytically.

Office automation is like other process technological change in that it is designed to enable workers to produce more output in a given amount of time (higher labor productivity). When the productivity of labor rises, however, there are a number of possible outcomes with very different consequences for employment levels. The specific outcome is determined by the nature of the technological change itself, but also by the conditions in the firm and industry where the change occurs, the labor market conditions when the
technology is applied, the overall economic and regulatory climate, and other factors.

For example, if a new process technology is introduced that significantly increases labor productivity while total output is constrained to a fixed quantity for any reason, obviously some redundancy has been created in the labor input. The desired output can be produced with fewer than the current number of workers. Under these circumstances, one can expect to see workers displaced from these jobs (laid off). However, if the normal voluntary turnover of workers occurs more rapidly than the redundancy created by the technological change, there would be no necessity for displaced workers. Of course, the number of job opportunities in the aggregate might be reduced, but none of the current employees would have to leave their jobs against their will.

On the other hand, output is rarely fixed in an absolute sense either at the firm or industry level. Thus the situation is usually much more complicated than the simple example above. The question of employment impact then depends partly upon the strategy of the firm and the conditions in the market in which the firm's output is sold. If it turns out that the new technology reduces the costs of production (not always obvious), the firm adopting the new technology has derived an advantage over its competitors.

The firm then faces a choice between producing the old output level at lower cost and higher unit profit, or trying to expand output to gain a larger share of the market. If the firm chooses to expand output in a competitive market, it will likely have to either lower the price or in some way offer more value for the same price as other firms. In either circumstance, the firm's profit margin per unit would decline, but the firm would hope to sell enough extra units to more than make up the difference.
If the firm chooses to lower the price and produce more output, clearly the number of workers needed will rise. This will mitigate the original displacement effect of the technological change. Whether more workers or fewer workers are required on balance depends in part on the price elasticity of demand for the output of the firm. If demand is relatively inelastic (not very responsive to price changes), there may still be displaced workers even though the firm's output expands. If demand is elastic, the net effect on employment depends on the relative sizes of the productivity impact and the quantity of output impact. Of course, normal labor turnover still plays a role in determining how likely previous employees are to lose their jobs.

If the firm chooses to try and make its product more attractive in quality or tries to differentiate its product in some way (nonprice competition), the situation is much the same. The number of workers required will rise, although they may not be of exactly the same occupation or skill level if they are producing different products or services. For instance, if the firm chooses to raise the quality of the product, they may require more supervisors, more inspectors, or more highly skilled production people. On the other hand, if they are successful in increasing the demand for their product, the number of workers needed to produce the basic output will rise once again. As before, the net effect depends on whether the productivity impact dominates the output impact.

This general conceptual framework is shown in figure 1.6. Changes in process technology are presumed to lead to increased labor productivity. The net impact on labor input levels is conditioned by changes in the quantity of output, the quality of output, and product changes. Even if there is a net reduction of labor input, the possibility of involuntary layoffs is mediated by normal (voluntary) turnover, and also
Figure 1.6

POTENTIAL EMPLOYMENT IMPACT OF OFFICE AUTOMATION

changes in process technology

increased labor productivity

quality of output

quantity of output

product changes

reduction of labor input? (net)

induced turnover

involuntary layoffs

voluntary turnover
by the possibility of policy initiatives such as early retirement bonuses (induced turnover). Thus the final labor displacement impact (layoffs) of changes in technology are not obvious from the productivity impact.

If a technological innovation confers a substantial economic advantage on the firm, its competitors will adopt the new technology as well. So it is necessary to move up to the industry level to analyze the probable employment impacts in the longer run. At the industry level, the employment level is less affected by interfirm competition than by economic fundamentals. If the average price for the industry is reduced by a process technological innovation, total output can be expected to increase since consumers in the aggregate generally purchase more at a lower price. This is because there are usually opportunities to substitute among different products in competition for the consumer's dollar (the substitution effect). In addition, there is the obvious impact of having more real income if prices decline (the income effect).

But there is another reason to expect that demand for the output of the industry, and therefore employment levels, may increase. Since consumers' incomes tend to rise through time with general economic growth (from rising labor productivity), there is a natural growth in the demand for the output of the industry from income increases. These changes are summarized in the income elasticity of demand for the product. Some types of goods and services tend to have very high income elasticity of demand; that is, the quantity of goods sold rises more rapidly than income. Other kinds of products have low income elasticity of demand and do not increase significantly in sales when incomes rise. Of course, any output increase from rising incomes would also tend to ameliorate the labor displacing effects of technological change in the industry.
A number of these concepts are important in evaluating the probable employment impacts of office automation technology. As discussed in the previous section, office automation can be regarded as the general substitution of capital for labor in the production of office output. Under the assumption that office automation has the potential to significantly increase the productivity of office workers, what employment effects can be expected?

First, it is clear that in the office, output is very hard to measure. Clerical workers do a number of different tasks, and many of them are sufficiently abstract or irregular that it is not a simple matter to count how much was produced at the end of the day. So it is possible that part of the potential increase in labor productivity may simply be lost to task indivisibilities, increased leisure on the job, or other inefficiencies.

Second, quantity of output changes are especially likely in the case of increases in office productivity. The demand for office output appears to be highly elastic, based on the last 25 years of expansion in demand. There is no obvious reason why the microprocessor revolution should not produce the same increased demand for information that has accompanied the mainframe revolution.

Third, quality of output changes are also very likely with new office technologies. This is partly because the relevant decisions are diffused throughout the organization and partly because of the difficulties in measuring output. For example, many organizations have found that word processing technology leads to an increase in the quality standard for typographical errors in routine correspondence.

Fourth, it also seems that the application of new process technology to the office has the potential to change the product substantially. Microprocessor capability in the form of
a personal computer may change the nature of office output by putting spreadsheet analysis in the hands of secretaries. The possibility of including graphics and spreadsheets in letters and memos through the use of integrated software may also significantly change the type of correspondence that leaves the office.

In the final analysis, increases in labor productivity made possible by new office technologies will be manifested in higher quality output and in office product changes, as well as in increases in the quantity of output that result from lower costs. The net impact of office automation on the level of clerical employment is very uncertain. This is particularly apparent since the last 25 years appear to demonstrate that the elasticity of demand for information is rather high. As will be shown, clerical employment has grown very rapidly through the first quarter century of the computer age. It is not yet obvious that current office automation initiatives based on microprocessor technology will reverse this pattern.

Problems with Different Data Sources

There is a rather serious data problem that should be discussed before launching into the examination of detailed findings in this book. The problem is that there are a number of data sources that will be used to develop the empirical picture of clerical workers and their employment patterns, and they are not totally consistent with one another.

When the number and type of clerical jobs are described in chapter 2, the 1980 Census will be the primary source of data. As will be shown, because of a massive reorganization of the occupational classification system, the 1980 Census employment data are almost totally incompatible with Census measurements in the past. Thus, adopting the 1980 Census as a base for the description would automatically rule out
consistent time series comparisons. When the desire is to show the long-term trends in the employment of clerical workers from 1950 to 1980, the 1970 Census is chosen as the base because that facilitates the translation of dissimilar Census data into roughly comparable terms.

For recent trends in clerical employment, it is necessary to use the Current Population Survey as a data source. This is generally consistent with Census observations, since it is bench-marked to the decennial Census, but that also means that there will be a break in the time series at least every 10 years. For example, there are consistent data available on occupational employment from the CPS from 1972 to 1982, but the change to the 1980 Census occupational classification system in 1983 renders the data noncomparable at that point. This problem is explored in chapter 2. If there are changes in definitions or procedures in the interim, the data are even more problematical, of course.

In chapter 4, when attention turns to the industries in which clerical workers are employed, it is necessary to utilize still another data source from the Bureau of Labor Statistics to maximize the detail that is available. Finally, when the forecasts of future clerical employment levels are evaluated in chapter 5, the special Occupational Employment Statistics (OES) data base developed to support the BLS occupational forecasting effort will be employed.

The intent of this monograph is to describe what is happening to clerical employment and, to the extent possible, why. The goal is not to analyze the sufficiency of the statistics. However, it is important to carefully explain the problems with the data so that the reader can fully appreciate the limitations and reservations that they impose on any conclusions that can be drawn. It is critical that the data not be pushed beyond their capability or it is no longer possible to tell what is fact and what is conjecture.
For the reader who is already steeped in occupational employment data and the problems and uncertainties associated with them, this approach may be tiresome. However, some readers will need the limitations spelled out in detail. Our hope is that this has been done sufficiently well that the reader takes away not only an understanding of what has been happening to clerical employment in recent decades, but also an appreciation for how fragmentary the data are and how difficult it can be to piece together a consistent, accurate picture of clerical employment trends in the face of these limitations. With these introductory thoughts in place, let us get on with the task at hand.

NOTES

1. These data have been adjusted rather extensively for consistency. Thus the figures reported here do not correspond exactly with Census figures from other sources. This issue will be addressed in chapter 2.

2. See Bowen and Mangum (1966) for the policy resolution of the questions raised in the early 1960s.

3. These data from the Current Population Survey are not adjusted for all changes in definitions of occupations over the years. In particular, the change-over to 1970 Census definitions in 1971 shows up as an anomalous absolute decline in clerical employment in 1971. While data for 1983 and 1984 have been adjusted to reflect some changes in Census definitions, this adjustment is not complete. It is not possible to make a complete adjustment of CPS occupational employment due to insufficient detail in published figures. A full explanation of this problem is offered in chapter 2.

4. Again, the apparent drop in 1971 should be ignored as it reflects the conversion to new Census codes rather than any actual change in clerical employment levels.
5. The Panel on Technology and Women's Employment of the National Research Council has been examining these issues for the last two years. Their report, *Technology and Women's Employment*, will be available in 1986.

6. Salerno (1985) for example suggests that computer vendors have so aggressively promoted their products that they have significantly exaggerated their capabilities.


8. This is not to deny the incredible increases in computing power over the last 25 years. But prices have come down so rapidly that a unit sales figure gives a better picture of the diffusion of computers in general. There also are no price indices available that correspond to the CBEMA definitions.

9. For an example of the media reporting, the interested reader may wish to look at the cover story entitled "The Computer Slump," *Business Week*, June 24, 1985.

10. To the best of our knowledge, there are no formal estimates of either price or income elasticity of demand for office output.

11. See Hunt and Hunt (1985) for an assessment of the data available to study the employment effects of technological change.