

Chapter One

Introduction

The transition is incomplete. Once the most powerful industrial nation, the United States is in the midst of a difficult transition from a manufacturing to a service economy. Key traditional industries that sustained America's middle class throughout the twentieth century are in decline. Skilled blue-collar jobs in steel, rubber, and automotive industries that provide good pay and benefits plus opportunities for upward mobility are dwindling. The new service sector is sharply divided between high-skill professional pursuits and low-skill service occupations; between software designers on the one hand and people grilling hamburgers on the other. While the standards of living for the upper and working classes continue to diverge, middle-class lifestyles are increasingly confined to dual-earner families. Amid this transformation to a new industrial order, the public optimism of the postwar years has been replaced with caution, doubt, and uncertainty. In this changing context, it is important that researchers chart and understand emerging forms of social stratification.

The increasing economic polarization of the U.S. population has been well documented by economists and sociologists.¹ Poverty rates in the 1980s have increased across the country. The middle class has been described as "shrinking." A recent wave of corporate mergers in the wake of industrial deregulation suggests that wealth is becoming more concentrated. The optimistic prognostications of postindustrialists like Daniel Bell about job and skill upgrading continue to be challenged by researchers in the tradition of Harry Braverman who focus on deskilling and degradation of work.² To understand the increasing gap between the affluent and the plebeian that characterizes the 1980s, sociologists and economists alike are turning to structural theories that look beyond the characteristics of individuals. Popular in an

age of economic growth and affluence, individualistic theories of income determination and aggregate income inequality have given way to perspectives that can account for individual failures despite high skill levels, high motivation, and extensive work experience. The characteristics of individuals—their human capital and social distinctions—are increasingly understood to operate within a complex and variable mosaic of industrial, market, occupational, and organizational contexts.

One piece of this mosaic and its consequences for economic inequality are the foci of this book. High technology is a single industrial sector that employs at best 10 percent of the U.S. labor force. Nonetheless, high-tech industries are for the most part expanding rapidly as we approach the end of the century. More importantly, high technology is an industrial sector that many hope will be the basis for a new national economy that elevates the United States back to its former dominance in the international marketplace. A sector on which so many hopes are pinned deserves close scrutiny.

High technology's work structures—industrial, occupational, and organizational—have important implications not only for workers in that sector, but for those in other sectors of the economy linked to particular high-tech industries. What do these work structures portend for stratification and inequality inside high-tech industries as well as outside the sector? We begin to answer this question by attempting to clarify what we mean by high-tech industries. As it turns out, in developing a definition for this sector it is necessary to raise several issues.

HIGH TECHNOLOGY: DEFINITIONAL ISSUES³

Though there is much discussion of high tech in the media, the term has diverse meanings. There is a conventional definition of high technology used by a number of labor-force researchers that we opt to use for reasons outlined below. Still, there are a number of issues that we considered in settling on this definition. One difficulty in defining high technology is that the term is relative to time and place. Industrial capitalism is dynamic, and development within it is frequently uneven. This means that what is considered high tech at one point in time or in one place may not be considered high tech at some other time or place. In the South, the use of electronic knitting machines, electronically controlled looms, and robots in the textile industry is considered high-tech production.⁴ Yet these techniques are deemed

quite commonplace in regions where textile manufacturing has advanced more rapidly.

A second definitional problem is the considerable confusion in the literature over the appropriate unit of analysis. Is high tech embodied in a job, an occupation, an industry, or a firm? The most common unit of analysis used by researchers is that of industry. Industry is attractive because of the standard industry coding schemes available on data files for firms and individuals. Moreover, industries can be grouped into an intuitively appealing high-tech sector that can be contrasted with other industrial sectors. Drawbacks include the fact that a broadly defined industrial category may include the production of both technologically sophisticated products and rather simple things. Telephones and satellites, for instance, are both included under the communications equipment industry category which is treated as a high-tech industry in most schemes.

While an industry's products may be technologically complex, the process by which they are produced may be very simple and involve little skill. Boards for personal computers are very sophisticated technological items, but their production is highly routinized and standardized. The most skilled production task is soldering certain components onto the board. Yet, this task is increasingly being done by machines. Workers involved in the production of computer boards operate machines, tend equipment, and manually clip wires off of individual components. The important issue here is whether high technology refers to *products* or *processes* by which products are made. That is, should the high-tech label be reserved for cutting-edge industries with large research and development components? Or, should high technology also encompass the use of standardized production processes to manufacture technologically sophisticated products? This is a distinction that some previous researchers have not maintained.⁵

A related issue is whether high-tech industry classifications should include only manufacturing industries or be broadened to encompass certain technologically sophisticated service industries such as computer software. These different approaches are exemplified on the one hand by the commonly employed Bureau of Labor Statistics definition which is limited to manufacturing industries.⁶ On the other hand, a definitional scheme suggested by Edward Malecki includes both high-tech manufacturing and services.⁷ The inclusion of services seems warranted, given the increasing importance of this sector in national and global economies. High-tech service industries provide employment in some of the fastest growing high-tech occupations and facilitate production in other industrial sectors.

Alternative units of analysis such as firms and occupations also present problems. Firms in which high-tech production takes place tend to be diversified; some products may be technologically complex and others may not. More pragmatically, data on firms are hard to find, and high-tech firms are particularly notorious for resisting data collection on their operations.⁸ Occupation as an indicator of high tech is problematic because occupational categories do not necessarily take into account organizational and industrial contexts. Surely the computer programmer working on the Strategic Defense Initiative is more plausibly characterized as a high-tech worker than a temporary programmer configuring a database system for a law office. From an analytic standpoint, it is important to consider occupational distributions as consequences of particular types of high-tech industrial development. This precludes using occupation as the sole defining characteristic of high technology for certain research questions, including some we pose in this book.

A third type of definitional issue involves the different conceptions of high technology employed by various constituencies. The goals and concerns of academicians, industrial developers, and policymakers may be quite different, and a single definition may not suit the purposes of these different factions. Industrial development boards and chambers of commerce tend to employ very broad definitions of high technology, disregarding definitional problems associated with products, production processes, and units of analysis. Researchers frequently disagree with policymakers on what constitutes high-tech industries. Malecki, for example, contends that developers need to limit their definitions to only those truly innovative industries on the cutting edge of technology.⁹ He notes that attracting high-tech manufacturing firms that employ standardized production techniques may run contrary to most policymakers' high-tech development goals. Instead of building an enclave of well-paid engineers and technicians, local officials may find themselves with a low-wage, high-tech equivalent of a textile mill.

Despite these definitional problems, we must at some point simply decide on a definition that is most useful in view of theoretical and practical considerations. The high-technology definition used throughout this book follows closely the Bureau of Labor Statistics' definition and is industry-based (i.e., product versus process oriented).¹⁰ Following Malecki, however, the definition includes both service and manufacturing industries.¹¹ This results in a broad industrial scheme that encompasses industries that most developers and policymakers consider high technology. In the final analysis, it is these prac-

tioners who are attempting to create high-tech communities across the nation and who may well shape the development of a high-tech economy for the twenty-first century.

As suggested by Malecki, our definition includes the following industries which can be readily identified on the census data files we employ:

Manufacturing: Guided missiles and spacecraft, radio and TV receiving equipment, communications equipment, electronic components, aircraft and parts, office and computing machines, ordnance and accessories, drugs and medicines, industrial inorganic chemicals, professional and scientific instruments, engines and turbines, plastic material and synthetics.

Service: Computer programming, data-processing, and other services; research and development laboratories; and management consulting.

With a working definition of high technology in hand, we now briefly introduce some of the promise and potential problems of high-tech industries that will be developed throughout the remainder of the book.

HIGH TECHNOLOGY: THE PROMISE

The importance of advanced technology for economic growth and progress has been expounded by social thinkers representing diverse theoretical orientations. Mainstream theorists like Bell and Lenski argue that technology brings progress and that the industrialization it fosters will ultimately lessen economic inequalities.¹² Radical theorists like Smith and Mandel see technology as an instrument of capital used to overcome crises in capitalist development and provide a basis for the expansion and ultimate survival of a capitalist economy.¹³ Inequalities resulting from the uneven expansion of capital are seen as permanent and endemic features of capitalism.

Policymakers and regional and local industrial developers view technological progress as fundamental to economic growth and the survival of the American economy. The rapid growth in high-tech industries and enterprises that has occurred with particular intensity over the last two decades is a major manifestation of this philosophy. Fueled by a seemingly permanent war economy, the development of space- and defense-related industries has burgeoned in the postwar

era. A quiet mill town of 25,000 people—Huntsville, Alabama—has been quickly transformed into a high-tech center of 200,000 inhabitants, many of whom work directly or indirectly for defense and other government contractors. The computer revolution has produced Silicon Valley and the Route 128 area near prestigious research universities like Stanford and MIT. Similarly, petrochemical processing has spawned community growth all along the Gulf Coast. In the Midwest, firms producing aircraft, engines, and electronic equipment are thriving in the midst of a regional employment tailspin.

In the wake of declining key industries like steel, aluminum, rubber, and automobiles, high-tech industries promise new jobs, higher wages, and growing markets to secure the U.S. economy of the twenty-first century. As intense interarea competition for business and economic growth continues, the high-tech mystique has inspired the imaginations of developers in large and small communities in metropolitan and nonmetropolitan areas alike. The U.S. economy is undergoing a dramatic transformation of its industrial base, and high-technology industries are viewed as important in facilitating this transition and in establishing a new economic regime.

HIGH TECHNOLOGY: POTENTIAL PROBLEMS

While many tout the promise of high-tech industrial development, others have argued for a critical assessment of its implications.¹⁴ First, the reality of some high-tech work is that it entails very menial and tedious manual labor. Not all production is on the cutting edge, nor are all products produced with sophisticated production processes. Some high-tech work is no more glamorous than work in a textile mill. Second, high-tech industries are often characterized by a two-tier occupational structure. Managers, engineers, researchers, and technical personnel occupy the higher skill and wage levels while low-skill, low-wage production workers fill the lower occupational tier. These workers have very different work experiences and are controlled by very different managerial strategies.

Third, the nature of the high-tech sector and the organization of work in its lower tier make production jobs vulnerable and unstable. Capital mobility and automation are constant threats, and job security is a major problem for high-tech workers. Firms that find cheaper overseas labor more profitable may have little commitment to U.S. localities. Uncertainty can prevail in the upper tier of high-tech industries as well. In an era that is witnessing profound political and eco-

conomic change in Eastern Europe, U.S. engineering and technical positions funded by defense and other government contracts are vulnerable to cutbacks.

A final reason to conduct a critical assessment of high-tech industrial development is that not all areas are attractive to high-tech industries. The stringent demands of high-tech employers cannot be met by many communities, and this results in an uneven development process within the sector and between high-tech and other industries. As we will detail below, these demands can include proximity to air transportation, related firms, and suppliers for increasingly prevalent just-in-time production processes that do not require large inventories on hand, but in the vicinity.

It is our view that distinctive patterns of stratification and inequality result from uneven development of high-tech industries, two-tier occupational configurations, and differences in types of workers recruited for various jobs within the high-tech sector. Moreover, the economic polarization of the U.S. economy may be exacerbated by the inequality patterns that prevail in high-tech industries. With high-tech industries increasingly sought to provide a foundation for economic restructuring, it is important to compare and contrast high-tech stratification patterns and organization of work with that of other industrial sectors.

In this book, we demonstrate both the promise and potential problems of high technology. We examine various divisions of labor that exist within this industrial sector and demonstrate the varied economic experiences of high-tech workers. We also illustrate the diversity of industries, occupations, labor markets, and labor forces that exists within the high-tech sector. We examine the economic consequences of high-tech industrialization for inequalities within and between high-tech areas in different regions of the country. The consequences of working in high-tech industries for racial and ethnic groups and women are of particular interest. Through these analyses, we hope to depict the current state of work in high-tech industries.

PLAN OF THE BOOK

Our theoretical framework links three major concepts for the study of high-tech industries and employment. These concepts are: flexibility, divisions of labor, and inequality. The first, flexibility, pertains to the organization of production in high-tech firms and their efforts to survive and succeed in this environment. High-tech employers perceive

intense demands for flexibility from product markets, the nature of high-tech products, and the social and political environments in which the firms operate. Flexibility in the face of rapidly changing technologies and markets is thought to be the key to survival and prosperity. There are several ways in which flexibility is built into management strategies for high-tech firms, and each has its own consequences for the ways in which labor is organized, i.e., who does it, how it is done, and where it is done.

These issues form the basis of the second important concept for this study: divisions of labor. The concept of divisions of labor is important throughout our analyses of high-tech industries because these divisions are fundamental for understanding socioeconomic inequality among workers. While we typically think of the division of labor in *technical* terms—i.e., occupationally differentiated tasks that are necessary for the production of goods and services—there are other divisions of labor that are important as well. Marxist theory emphasizes *social* divisions of labor that involve possession of differential amounts of power, authority, and control. Similarly, labor segmentation theorists have noted the divisions within labor markets along racial, ethnic, and gender lines. Economic geographers have been very active in identifying the *spatial* division of labor that distributes work across locales within and between different industries and sectors.

These divisions of labor form a basis for inequalities in the determination of wages and the extraction of surplus value from the labor process. Moreover, the particular configurations of these divisions of labor are not the same for all sectors of the economy. In our analyses we demonstrate that the high-tech sector exhibits both traditional and distinctive divisions of labor which affect the socioeconomic outcomes of high-tech workers in several ways.

The final concept, inequality, is in part the result of the strategies for flexibility and resulting divisions of labor in high-tech work. We show that the patterns of inequality produced in the high-tech sector reflect and exacerbate trends in inequality among U.S. workers as a whole. In this way, the study of high-tech industries can provide a glimpse of the larger issues of inequality that are emerging in the economic transformation of American society. Through the application of these conceptual tools, we provide such a depiction in the chapters that follow.

The second chapter discusses the nature of flexibility sought by high-tech firms, alternative strategies for attaining flexibility, and their implications for the resulting divisions of labor. We focus on two

types of flexibility: static and dynamic. Our review of research on work organization in high technology leads us to conclude that high-tech industries in the United States tend to borrow managerial strategies from more traditional industrial sectors. Even in the presumably progressive high-tech sector, these strategies result in the type of flexibility we characterize here as static. However, we note the potential for high-tech firms in the United States to employ more dynamic strategies, as have some of their international competitors.

The third chapter is the setting for an analysis of the labor force consequences of the emergence of the high-tech sector and accompanying strategies for flexible production. Using national samples of workers from 1970 through 1987, we trace the development of both technical and social divisions of labor in the high-tech sector and compare them to divisions of labor in other sectors. We explore variations in divisions of labor within the high-tech sector that are associated with different strategies for flexibility. Special attention is given to the distinctive intersection of the technical and social divisions of labor in high-tech industries. We shall see that labor is divided in such a way that minority labor force participants negatively experience the brunt of measures designed to make production more flexible, particularly when static flexibility is the managerial strategy.

High-tech development and the resulting spatial division of labor within the high-tech sector are examined in the fourth chapter. National, regional, and local high-tech industrialization policies are discussed. Theoretical perspectives that link the flexibility strategies of individual firms are reviewed as well. Then, through an analysis of census data, we identify high-tech centers in regions throughout the United States. Regional and local patterns of industrial and occupational mix are ascertained, and high-tech workers in these technology centers are compared to workers in other local industries. We report considerable heterogeneity among high-tech industries in the spatial distribution of employment opportunities.

In the fifth chapter, we continue the empirical study of high-tech workers as a national labor force and in different locales. We examine the socioeconomic implications of high-tech work and contrast it to other industries through analyses of earnings and earnings inequality. Regional comparisons of workers in high-tech centers are followed by comparisons of workers located in labor markets that do not have a large high-tech industry presence. The economic effects of local labor market contexts and different types of local economies on high-tech workers and their non-high-tech counterparts are assessed. Perhaps our most striking finding is that earnings inequality due to race,

gender, and ethnicity is greater in the high-tech sector than in other industries. This holds for the national labor force as well as within local labor market settings.

In the final chapter of the book we summarize our research on the contemporary U.S. high-tech sector and then sketch some future scenarios for high-tech industries. This sector of the contemporary national economy could have important implications for the economy of the next century. Decisions about future courses of high-tech sector development ought to be made with full knowledge of implications for the economy and the social organization of work.