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Corporate Governance and Sustainable Prosperity

Edited by
William Lazonick and Mary O'Sullivan

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Preface

The essays collected in this book are the products of a project, funded by the Jerome Levy Economics Institute, to understand the behavior of US corporations and to place the performance of the US economy in comparative and historical perspective. Additional funding for this project came from the University of Massachusetts Lowell Committee on Industrial Theory and Assessment, STEP Group (Oslo, Norway), the Center for Global Partnership of the Japan Foundation, the National Science Foundation, the Targeted Socio-Economic Research Programme (TSER) of the European Commission, and the European Institute of Business Administration (INSEAD). Most of the research included in this volume was carried out under the auspices of the Center for Industrial Competitiveness (CIC) of the University of Massachusetts Lowell. Four of the seven contributors to this volume – Robert Forrant, William Lazonick, Philip Moss, and Chris Tilly – are University of Massachusetts Lowell faculty members in the Department of Regional Economic and Social Development (RESD). Mary O'Sullivan, a CIC research associate, began working on this project as she was finishing her Ph.D. dissertation in economics at Harvard University. She has continued her contributions to this effort while in her current faculty position at the INSEAD, where she teaches on innovation, strategy and corporate governance. Lazonick and O'Sullivan are currently co-directing a TSER project, centered at INSEAD, on corporate governance, innovation and economic performance. Beth Almeida, who is completing a Ph.D. dissertation at the University of Massachusetts Amherst on the jet engine industry, is also a CIC research associate and has been a research associate at INSEAD. Michael Handel worked with Chris Tilly on the medical diagnostics industry while on a research fellowship at the CIC funded by the Levy Institute. The editors would like to thank Michèle Plu of INSEAD for assistance in getting the final manuscript to press.

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Corporate Resource Allocation and Employment Opportunities in the United States

William Lazonick and Mary O'Sullivan

Problematic prosperity

By many measures of economic performance, in the last half of the 1990s, the American economy looked like a winner. A high-technology revolution was in full swing, inflation was tamed, the stock market was booming, government budgets were under control, and the unemployment rate was the lowest for the nation since the beginning of the 1970s. In the late 1990s, tight labour markets and low inflation resulted in real-wage increases for some of those toward the bottom of the income distribution (Katz and Krueger, 1999).

Yet even in the midst of the boom, a nagging problem persisted in America's economic performance: a distribution of national income that had been worsening since the mid-1970s. The United States had the worst income distribution among the world's advanced economies (Atkinson et al., 1995). Households in the lowest quintile received 4.3 percent of aggregate income in 1978, but only 3.6 percent in 1998, whereas those in the highest quintile received 43.7 percent in 1978 and 49.2 percent in 1998. The real incomes of the top fifth of US families increased by 36.1 percent between 1978 and 1998 and the top twentieth by 59.7 percent. The incomes of the middle fifth rose by 7.5 percent, and those of the second-highest fifth by 13.5 percent. But the real incomes of the lowest fifth rose only 0.3 percent over this period, and those of the second-lowest fifth by 5.8 percent. Throughout most of the 1990s the real incomes of the bottom 40 percent in the household distribution of income were lower than those that had prevailed for this group in 1978 (US Bureau of the Census, 1999, Table H-3; Danziger and Reed, 1999).

The problem, therefore, is not just that incomes have been growing more unequal. A substantial proportion of the population experienced real-income declines during the last quarter of the twentieth century, while the sustainability of the prosperity that the US economy experienced in the late 1990s is not at all clear. Yet over this period, real GDP per capita in the American economy grew by an annual average of almost 1.5 percent (US Department of Commerce, 1998, Table 722).

The long-run worsening of the US income distribution raises questions about the sustainability of prosperity in the United States. Is the American economy developing and utilizing productive resources in ways that can augment the real incomes of more and more people over a prolonged period of time? Beginning with the Full Employment Act of 1946 through the War on Poverty of the 1960s, Americans expected their economy to hold out this promise of sustainable prosperity. Indeed, in historical perspective, the failure of the US economy to generate sustainable prosperity since the 1970s is a reversal of the improvement of the US income distribution that occurred in the quarter century after World War II (Danziger and Gottschalk, 1996).

In the 1990s the US economy has achieved low unemployment rates relative to those that prevail in the advanced economies of Western Europe. But the superior employment performance of the US economy relative to Western Europe has been at the cost of inferior real-wage performance (Thygesen et al., 1996). The relative inflexibility of labor costs in many Western European economies and concomitant high rates of unemployment pose their own problems for sustainable prosperity in those nations. But to focus on the achievement of low unemployment while ignoring stagnating if not declining standards of living for substantial proportions of the population is to run the risk of failing to understand the particular vulnerabilities of the US economy in a global economy characterized by intense industrial competition and unprecedented financial interdependence.

In the 1990s much of that industrial competition continued to come from Japan, particularly in high-technology, high-value-added industrial activities that enabled it to generate large trade surpluses even when the yen was extremely strong. As a result of its successful industrial development, during the 1980s Japan replaced the United States as the world's international creditor. Despite Japan's crisis in its financial sector during the 1990s, the nation's unemployment rate has remained low over the decade and its already relatively equal distribution of income has remained stable (see Lazonick, Chapter 8, this volume).

As a creditor nation, moreover, Japan maintains significant autonomy from the demands of global capital markets in determining how to reallocate its resources to improve its economic performance. While Japanese households continue to save about 14 percent of their disposable incomes, by 1997 the savings rate of American households had declined to well under 4 percent (US Department of Commerce 1998; Table 724). What is more, for US households to maintain adequate incomes has increasingly required not only that two adults (if present) engage in paid labor but also that they work overtime or in second jobs. As a result, during the 1990s the average number of hours that Americans work surpassed that of the Japanese (Olson, 1999).

Americans should, therefore, take care in trumpeting the prosperity of the late 1990s as sufficient proof of the ultimate superiority of an economy that emphasizes the mobility of labor and capital via markets, or what might be called 'the new market economy.' Rather, it is precisely in the presence of prosperity that Americans should begin thinking about its sustainability. Moreover, policy makers in Europe, Asia and elsewhere who are attracted to the promises of 'the new economy' should be sure that they understand its prospects for sustainability before they take steps to imitate it in their own nations and regions.

The purpose of this book is to offer a perspective on the sustainability of American prosperity that can shed light on a phenomenon that, for most economists, has remained a puzzle: the causes of the persistent worsening of the income distribution in the United States. The papers in this book explore the possibility that the worsening of the US distribution of income has something to do with the behavior of US-based corporate enterprises, especially in relation to their decisions to allocate resources to what economists call 'investments in human capital.' This work is integral to an ongoing effort to develop a theory of innovative enterprise as the core of a theory of economic development that can comprehend the historical and comparative experiences of the advanced economies.

A relatively small number of major corporations control the vast majority of industrial assets in the United States. For example, in 1995, the 1324 US manufacturing corporations with $250 million or more in assets held 71 percent of all manufacturing assets in the US economy (US Department of Commerce, 1998, Table 865). Once one recognizes the importance of corporate enterprises to the allocation of national economic resources, there is an intuitive appeal in the proposition that, in the aggregate, their behavior and performance can have a significant impact on the distribution of national income, especially within the industrial sector.

Since around 1980, most major US corporations have been engaged in a process of restructuring their labor forces in ways that have eroded the quantity of jobs that offer stable employment and good pay in the American economy. During the first half of the 1990s, rates of job loss increased to about 14 percent, even higher than the quite substantial rates of about 10 percent in the 1980s. More educated employees experienced lower rates of job loss than those less educated, but in the 1990s saw their rates of job loss increase at a faster rate. On average, displaced workers, when re-employed, receive real weekly earnings that are some 13 percent lower than before they lost their original jobs (Farber, 1997; see also Schultze, 1999).

One indicator of the decline in the quantity of stable and remunerative employment in the United States is the reduction in the proportion of US employees who hold jobs that provide benefits for sickness and old age benefits. For example, in 1981, 62 percent of US employees had jobs that gave them access to group health plans; in 1998 only 53 percent (US Department of Commerce, 1997, p. 434; US Bureau of the Census, 1999, Table 4).

There are many reasons why a particular company might permanently reduce the size of its labor force, and in many cases such a restructuring of enterprise employment may better enable the enterprise to contribute to the sustainable prosperity of a smaller number of employees. During the post-World War II decades, many, if not most, US industrial corporations grew too big as autonomous units of strategic control – a phenomenon that we call 'corporate overextension' and that we discuss in the US context in the first essay in this book. But in many cases, corporate downsizing may reflect a strategic failure on the part of top management to retrain its employees and reallocate their capabilities in ways that can generate new sources of innovation.

A general argument that we make in the first essay of this book is that, in historical perspective, corporate downsizing in the 1980s and 1990s may well have been an outcome of corporate overextension in the 1950s and 1960s. From this perspective, the decade of the 1970s was a critical period of transition characterized by increasing pressures from financial interests in the United States to generate higher returns to holders of corporate securities. In the 1980s changes occurred in the financial system that enabled holders of corporate bonds to generate higher real returns. Then from the last half of the 1980s, and with increasing intensity in the 1990s, corporate stock became the prime source of higher returns, with the boom in stock prices being supported by higher levels of dividends and systematic stock repurchases on a scale unprecedented in the history not only of the United States but also of advanced economies more generally. In the 1980s and 1990s, 'the creation of shareholder value' as the paramount, if not only, goal of the corporation became a mantra of American management.

There is no doubt that the past two decades have seen a marked shift in US corporate behavior away from a strategy of retaining both people and money within the company to distributing both people and money from the company to labor and capital markets. In general, in their allocations of corporate resources and returns, US corporations shifted from a 'retain-and-reinvest' strategy to a 'downsize-and-distribute' strategy. Given the employment security that corporations provided to both white-collar and blue-collar workers during the post-World War II decades when the income distribution was improving and given the unequal distribution of financial assets among US households, there are grounds for postulating a relation between the shift in corporate behavior and the worsening of the distribution of income. But an apparent correlation does not constitute a demonstrable explanation of the relation between corporate resource allocation and the distribution of income. Nor does such a correlation in and of itself provide us with an analysis of why the shift to the downsize-and-distribute strategy took place and what this shift in corporate behavior portends for the future performance of the US economy.

The CIC–Levy Institute project

It was to understand the historical changes and cross-national differences in the institutions that are influencing corporate resource allocation, and the implications of these changes and differences for national economic performance, that we undertook the project on corporate governance and sustainable prosperity. The project was carried out under the auspices of the Center for Industrial Competitiveness of the University of Massachusetts Lowell with financial support from the Jerome Levy Economics Institute of Bard College. The Levy Institute also published the project working papers and three public policy briefs (Lazonick and O'Sullivan, 1997; Lazonick, 1998; O'Sullivan, 1998). Our approach has been to focus on the microeconomics of corporate investment behavior, especially as reflected in what we call investments in integrated skill bases, and the macroeconomics of household saving behavior, especially as reflected in intergenerational dependence that requires that society find ways to support an aging population. The papers that we have gathered together in this book represent the products of this research effort, while at the same time helping to formulate both a methodology and an agenda for future research (see http://www.insead.edu/cgep).

In Chapter 2, William Lazonick and Mary O'Sullivan provide a historical analysis of the rise of shareholder value as a principle of corporate governance in the United States, tracing the transformation of US corporate strategy from an orientation toward retention of corporate earnings and reinvestment in corporate growth through the 1970s to one of downsizing of corporate labor forces and distribution of corporate earnings to shareholders over the past two decades. The explanation for this transformation, they argue, lies in a combination of corporate overextension, skill-based international competition and the growth of intergenerational dependence. In the 1990s, the prolonged boom in the US stock market and the more recent boom in the US economy fostered widespread belief in the economic benefits of the maximization of shareholder value as a principle of corporate governance. Lazonick and O'Sullivan consider the sources of growing instability and inequity in the US economy of the 1990s, and raise questions about the sustainability of economic prosperity based on a corporate governance regime that has the goal of maximizing shareholder value.

The following five papers focus on changes in the quality and quantity of employment opportunities in the United States in the 1980s and 1990s. These papers pay particular attention to the effects of international competition and US corporate responses to investments in 'skill bases' that can engage in collective and cumulative learning. In Chapter 3, Lazonick analyzes the importance of the organizational integration of functional specialists with shop-floor workers to the ability of Japanese industrial enterprises to challenge US enterprises in the mass production industries that the Americans had dominated at the start of the 1970s. He argues that the manufacturing industries in which the US economy has been most severely challenged by high-wage foreign competition are those in which innovation and sustained competitive advantage demand investments in broader and deeper skills bases – that is, skill bases that require greater functional and hierarchical integration than was previously the case.

In Chapter 4, Robert Forrant analyzes the Japanese challenge to American industry since the 1970s in the development of computer numerically controlled machine tools. He shows how the integration of shop-floor workers into the process of developing 'mechatronics' provided the foundations for Japanese success in this critical capital-goods industry. On the basis of this analysis, Forrant then asks what types of organizational integration and financial commitment will be required to regenerate the American machine tool industry.

In Chapter 5, Beth Almeida delves into the changing international division of labor in the manufacture of jet engines, an industry in which two US-based companies – Pratt & Whitney and General Electric – are world leaders. She shows, however, that world leadership as a systems integrator is not the same as world leadership in production capabilities, and provides evidence that, in this high-technology, high-wage industry, broad and deep skill bases that are central to the manufacture of jet engines are increasingly being built outside the United States. She concludes that jet engines is a sector in which US-based corporations could help generate more and better employment opportunities on a sustainable basis if they could be encouraged to focus more on the challenges of investing in integrated skill bases and less on the riskiness of investments, given financial hurdle rates and purported unfair trade practices.

In Chapter 6, Chris Tilly explores the same set of issues looking at another high-technology sector – diagnostic imaging equipment – in which the United States (and within the United States, General Electric) has also traditionally been a world leader. He documents the intensification of international competition in the 1990s in the different modalities of diagnostic imaging equipment, and asks how the major companies in the industry based in the United States, Japan and Europe are responding in terms of the skill bases in which they are choosing to invest. While Tilly recognizes the need for more detailed enterprise-level data to document fully how the skill bases being developed in the United States compare with those being developed abroad, his careful analysis of the available evidence (including interviews with personnel in major enterprises in the industry) raises a number of questions about whether the leading US-based producers are continuing to invest in the development of the integrated skill bases that can permit the United States to maintain its leadership in the development of medical equipment that is both high quality and low cost.

From a perspective that recognizes the possibility that the distribution of income may be significantly affected by changes in the corporate allocation of resources to broad and deep skill bases, Chapter 7 reviews the literature that seeks to explain the problem of the persistent increase in income inequality in the United States since the 1970s.

Philip Moss argues that the inability of the US economy to generate more and better employment opportunities cannot be understood simply as the response of corporate enterprises to exogenous, and hence inexorable, market and technological forces. Instead, he seeks to show how the analysis of the distribution of income could benefit from an understanding of the institutions that influence how and to what extent corporations invest in integrated skill bases that can contribute to the development and utilization of productive resources.

The last two papers place the analysis of corporate governance and sustainable prosperity in cross-national comparative perspective. In Chapter 8, Lazonick outlines the system of corporate governance in place in the 1990s that, thus far at least, has led Japanese enterprises to pursue a 'retain-and-reinvest' strategy rather than a 'downsize-and-distribute' strategy. He focuses on the origins, functions and persistence of lifetime employment and cross-shareholding as the social foundations of Japanese corporate governance. Lazonick shows that, faced with the banking crisis and recessionary conditions of the 1990s as well as a growing problem of intergenerational dependence, Japanese corporations have been trying to work within the framework of lifetime employment and cross-shareholding to find new sources of flexibility in the allocation of labor that will enable them to keep people employed for more years of their lives.

In Chapter 9, O'Sullivan shows how a combination of employment institutions and financial institutions evolved in Germany during the post-World War II decades to support the nation's outstanding economic performance as a 'social market economy.' She also describes how, despite the broad and deep skill bases that have been the basis for the success of Germany in the manufacture of high-quality products, the German model has come under increasing pressure in the 1980s and 1990s from a combination of international competition that can generate higher-quality products at lower unit costs and growing intergenerational dependence that is making the support of those in retirement an ever-increasing burden on those in employment. O'Sullivan documents how, in the 1990s, Germany came to a crossroads in the reform of its institutions of corporate governance, with the nation's prospects for regenerating sustainable prosperity hanging in the balance.

These papers show the value of cross-national studies of employment and financial institutions and detailed analyses of investments in innovation in particular industrial sectors for addressing the issue of corporate governance and economic performance. Taken as a whole, the research presented in this book raises serious questions about the sustainability of prosperity of the US economy in the twenty-first century, and especially about whether America's corporate employers are making investments in the broad and deep skill bases that will be required if the benefits of economic growth are to be shared by a growing proportion of the population over the next generation. The work presented in this book is by no means definitive on these issues; indeed the search for definitive answers will inevitably be frustrated by the rapidity of economic change in a highly uncertain world. But to act in the face of these changes in ways that do more good than harm requires a perspective on the influences of national institutions and business organizations on economic performance. We hope that the work presented here will help to illuminate such a perspective and will provide a stimulus to the vast amount of in-depth and up-to-date research that remains to be done.

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Maximizing Shareholder Value: A New Ideology for Corporate Governance

*William Lazonick and Mary O'Sullivan**

Introduction

Over the past two decades the ideology of shareholder value has become entrenched as a principle of corporate governance among companies based in the United States and Britain. Over the past two or three years, the rhetoric of shareholder value has become prominent in the corporate governance debates in European nations such as Germany, France and Sweden. Within the past year, the arguments for 'maximizing shareholder value' have even achieved prominence in Japan. In 1999 the OECD issued a document, *The OECD Principles of Corporate Governance*, that emphasizes that corporations should be run, first and foremost, in the interests of shareholders (OECD, 1999).

But what does 'maximizing shareholder value' mean? Is it an appropriate principle for the governance of corporations in the advanced economies in the twenty-first century? Does the implementation of this principle improve the competitive performance of corporate enterprises? Would the reform of the continental European and Japanese systems of corporate governance based on the principle of maximizing shareholder value bring sustainable prosperity to these economies?

In the so-called Anglo-Saxon economies of the United States and Britain, the exclusive focus of corporations on shareholder value is a relatively recent phenomenon, having risen to prominence in the 1980s as part and parcel of the Reaganite and Thatcherite revolutions. The decade-long boom in the US stock market and the more recent boom in the US economy have impressed European and Japanese corporate executives with the potential of shareholder value as a principle of corporate governance, while American institutional investors, investment bankers and management consultants have been incessantly promoting the virtues of the approach in Europe and Japan.

There is, however, both in Europe and Japan, considerable misinformation about why shareholder value has become so prominent in the governance of US corporations over the past two decades and about the actual impacts of its implementation on the performance of US corporations and the US economy. Therefore, as a precondition for considering the arguments for 'maximizing shareholder value' in those nations in which it is not yet an entrenched principle of corporate governance, it is imperative that we understand the evolution and impacts of the quest for shareholder value in the United States over the past two decades. Such is the purpose of this chapter.

The origins of 'shareholder value'

The arguments in support of governing corporations to create shareholder value came into their own in the United States in the 1980s. As had been the case throughout the twentieth century, in the 1980s a relatively small number of giant corporations, employing tens or even hundreds of thousands of people, dominated the US economy. On the basis of capabilities that had been accumulated over decades, these corporations generated huge revenues. They allocated these revenues according to a corporate governance principle that we call 'retain and reinvest'. These corporations tended to retain both the money that they earned and the people whom they employed, and they reinvested in physical capital and complementary human resources. Retentions in the forms of earnings and capital consumption allowances provided the financial foundations for corporate growth, while the building of managerial organizations to develop and utilize productive resources enabled investments in plant, equipment and personnel to succeed (Ciccolo and Baum, 1985; Hall, 1994; Corbett and Jenkinson, 1996).

In the 1960s and 1970s, however, the principle of retain and reinvest began running into problems for two reasons, one having to do with the growth of the corporation and the other having to do with the rise of new competitors. Through internal growth and through merger and acquisition, corporations grew too big, with too many divisions in to too many different types of businesses. The central offices of these corporations were too far from the actual processes that developed and utilized productive resources to make informed investment decisions about how corporate resources and returns should be allocated to enable strategies based on retain and reinvest to succeed. The massive expansion of corporations that had occurred during the 1960s resulted in poor performance in the 1970s, an outcome that was exacerbated by an unstable macroeconomic environment and by the rise of new international competition, especially from Japan (Lazonick and O'Sullivan, 1997; O'Sullivan, 2000b, ch. 4).

Japanese competition was, of course, particularly formidable in the mass production industries of automobiles and consumer electronics and in the machinery and electronic sectors that supplied capital goods to these consumer-durable industries. Yet these had been industries and sectors in which US companies had previously been the world leaders and that had been central to the prosperity of the US economy since the 1920s.[1] Japan was able to challenge the United States in these industries because its manufacturing corporations innovated through the development and utilization of integrated skill bases that were broader and deeper than those in which their American competitors had invested (Lazonick, 1998). Compared with American practice, Japanese skill bases integrated the capabilities of people with a broader array of functional specialties and a deeper array of hierarchical responsibilities into processes of organizational learning. In particular, the hierarchical integration of Japanese skill bases extended from the managerial organization to shop-floor production workers and subsidiary firms that served as suppliers and distributors. In contrast, US companies tended to use their managerial organizations to develop and utilize technologies that would enable them to dispense with shop-floor skills so that 'hourly' production workers could not exercise control over the conditions of work and pay. US companies also tended to favor suppliers and distributors who would provide goods and services at the lowest price today, even if it meant that they were not engaged in innovation for tomorrow (Lazonick and O'Sullivan, 1997).

As, during the 1970s, major US manufacturing corporations struggled with these very real problems of excessive centralization and innovative competition, a group of American financial economists developed an approach to corporate governance known as agency theory. Trained, as virtually all American economists are, to believe that the market is always superior to organizations in the efficient allocation of resources, these economists were ideologically predisposed against corporate – that is, managerial – control over the allocation of resources and returns in the economy. Agency theorists posited that in the governance of corporations, shareholders were the principals and managers were their agents. Agency theorists argued that, because corporate managers were undisciplined by the market mechanism, they would opportunistically use their control over the allocation of corporate resources and returns to line their own pockets, or at least to pursue objectives that were contrary to the interests of shareholders. Given the entrenchment of incumbent corporate managers and the relatively poor performance of their companies in the 1970s, agency theorists argued that there was a need for a takeover market that, functioning as a market for corporate control, could discipline managers whose companies performed poorly. The rate of return on corporate stock was their measure of superior performance, and the maximization of shareholder value became their creed (see, for example, Ross, 1973; Jensen and Meckling, 1976; Fama and Jensen, 1983; Jensen, 1986; Scharfstein 1988; Baker et al., 1988).

In addition, during the 1970s the quest for shareholder value in the US economy found support from a new source – the institutional investor.[2] The transfer of stockholding from individual households to institutions such as mutual funds, pension funds and life insurance companies made possible the takeovers advocated by agency theorists and gave shareholders much more collective power to influence the yields and market values of the corporate stocks they held. During the 1950s and 1960s, there were legal restrictions on the extent to which life insurance companies and pension funds could include corporate equities in their investment portfolios, while mutual funds played only a limited, although growing, role in the mobilization of household savings. In the 1970s, however, a number of changes occurred in the financial sector that promoted the growth of equity-based institutional investing. Partly as a consequence of Wall Street's role in the buying and selling of companies during the conglomeration mania of the 1960s, from the early 1970s there was a shift in the focus of Wall Street financial firms from supporting long-term investment activities of corporations (mainly through bond issues) to generating fees and capital gains through trading in corporate and government securities. To expand the market for securities trading, Wall Street firms persuaded the Securities and Exchange Commission (SEC) to put an end to fixed commissions on stock exchange transactions. At the same time, developments in computer technology made it possible for these firms to handle much higher volumes of trade than had previously been the case.

Meanwhile, the oil-induced inflation of the 1970s created a problem for US financial institutions in managing their financial assets to generate adequate returns, thus leading to the financial deregulation of the American economy. As investors in stocks and bonds, mutual funds had advantages over other institutional investors such as life insurance companies and pension funds in generating higher returns on household savings because they were not subject to the same stringent regulations concerning the types of investments that they could make. Moreover, even without the mutual funds as competitors, the inflationary conditions of the 1970s meant that, under current regulations, pension funds and insurance companies could no longer offer households positive real rates of return. The regulatory response was ERISA – the Employee Retirement Income Security Act (1974) – that, when amended in 1978, permitted pension funds and insurance companies to invest substantial proportions of their portfolios in corporate equities and other risky securities such as 'junk bonds' and venture funds rather than just in high-grade corporate and government securities.

During the 1970s the US banking sector also experienced significant deregulation. With the inflationary conditions boosting the nominal rates of interest on money-market instruments, through a process that became known as 'disintermediation' money-market funds emerged to offer savers much higher rates of returns than could the regulated banks. Beginning in 1978, the government sought to help the banks compete for depositors by deregulating the interest rates that commercial banks and savings banks could pay to depositors and charge on loans. In this deregulated environment, however, savings and loans institutions (S&Ls), a type of savings bank whose assets were long-lived, low-yield mortgages, found that, unless they could invest in higher-yield assets, they could not compete for household deposits. The regulatory response was the Garn-St Germain Act of 1982 that permitted the S&Ls to hold junk bonds and to lend to inherently risky new ventures, even while the government continued to guarantee the accounts of S&L depositors.

From 'retain and reinvest' to 'downsize and distribute'

The stage was now set for institutional investors and S&Ls to become central participants in the hostile takeover movement of the 1980s. An important instrument of the takeover movement was the junk bond – a corporate or government bond that the bond-rating agencies considered to be below 'investment grade.' In the early 1970s, the main sources of junk bonds were 'fallen angels' – previously investment-grade bonds the ratings of which had been downgraded – or 'Chinese paper' – low-grade bonds that had been issued as part of the conglomerate mania of the 1960s – as distinct from newly issued bonds (Taggart, 1988; Bruck, 1989, pp. 27, 37–8, 44). The innovation of

Michael Milken, an employee at the Wall Street investment bank of Drexel, Burnham, and Lambert, was to create a liquid market in junk bonds by persuading financial institutions to buy and sell them (Bruck, 1989, ch. 1). In the early 1970s, when Milken began the creation of this new financial market, it was mainly the mutual funds, faced by a slumping stock market, that were willing and able to become players. But, over the next decade, financial deregulation brought, first, pension funds and insurance companies and, then, S&Ls into the junk bond market as well. From the late 1970s, it became possible to issue new junk bonds, most of which were used at first to finance management buyouts of divisions of corporations, a mode of undoing the errors of the conglomerate movement of the 1960s that left the new independent companies with huge debt burdens. By the early 1980s, and especially after the Garn-St. Germain Act of 1982 enabled S&Ls to enter the market, it became possible to use junk bonds to launch hostile takeovers of even the largest corporations (Gaughan, 1996, p. 302). Milken orchestrated most of these hostile takeovers by gaining commitments from institutional investors and S&Ls to sell their shareholdings in the target company to the corporate raider and, when the target company was taken over, to buy newly issued junk bonds that enabled the company to buy the raider's shares.

The result was (until, beginning in late 1986, the arbitrageur Ivan Boesky and then Milken as well as others were indicted and eventually imprisoned for insider trading) the emergence of a powerful market for corporate control – something of which the agency theorists of the 1970s had only dreamed. The ideology of the market for corporate control lent powerful support to the claim that such takeover activity was beneficial to the corporations involved and indeed to the US economy as a whole. Takeovers, it was argued, were needed to 'disgorge the free cash flow' from companies (Jensen, 1989). The exchange of corporate shares for high-yield debt forced liquidity on the acquired or merged companies. These takeovers also placed managers in control of these corporations who were predisposed toward shedding labor and selling off physical assets if that was what was needed to meet the corporation's new financial obligations and, indeed, to push up the market value of the company's stock. For those engaged in the market for corporate control, the sole measure of corporate performance became the enhanced market capitalization of the company after the takeover.

If the attempts to engage in corporate governance reform on the principle of creating shareholder value had been confined to the takeover movement of the 1980s, the rise of shareholder value as a principle of corporate governance might have met a rapid demise in the US with the stock market crash of 1987. Instead the US stock market made a rapid recovery, and since that time has had the longest bull run in its history. During the 1990s, it appeared that US corporations were extremely adept at 'creating shareholder value.'

Increasingly during the 1980s, and even more so in the 1990s, support for corporate governance on the principle of creating shareholder value came from an even more powerful and enduring source than the takeover market. In the name of 'creating shareholder value,' the past two decades have witnessed a marked shift in the strategic orientation of top corporate managers in the allocation of corporate resources and returns away from 'retain and reinvest' and toward 'downsize and distribute.' Under the new regime, top managers downsize the corporations they control, with a particular emphasis on cutting the size of the labor forces they employ in an attempt to increase the return on equity.

Since around 1980, most major US corporations have been engaged in a process of restructuring their labor forces in ways that have eroded the quantity of jobs that offer stable employment and good pay in the US economy.[3] Hundreds of thousands of previously stable and well-paid blue-collar jobs that were lost in the recession of 1980–82 were never subsequently restored. Between 1979 and 1983, the number of people employed in the economy as a whole increased by 377 000 or 0.4 percent, while employment in durable-goods manufacturing – which supplied most of the well-paid and stable blue-collar jobs – declined by 2 023 000, or 15.9 percent (US Congress, 1992, p. 344).

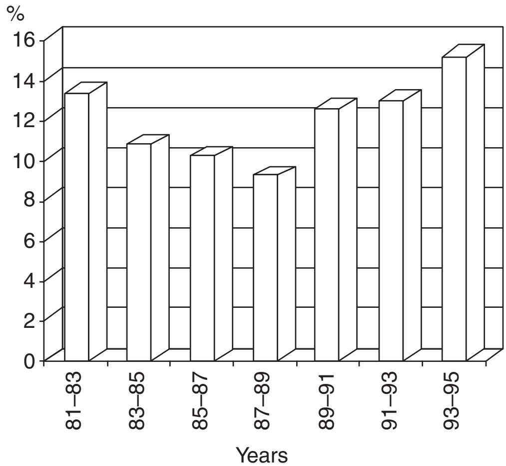
Indeed, the 'boom' years of the mid-1980s saw hundreds of major plant closings. Between 1983 and 1987, 4.6 million workers lost their jobs, of which 40 percent were from the manufacturing sector (Herz, 1990, p. 23; more generally, see Staudohar and Brown, 1987; Patch, 1995). The elimination of these well-paid and stable blue-collar jobs is reflected in the decline of the proportion of the manufacturing labor force that is unionized from 47.4 percent in 1970 to 27.8 percent in 1983 to 18.2 percent in 1994 (US Department of Commerce, 1975, p. 375; 1995, p. 444; US Bureau of the Census, 1976, p. 137).

Not only blue-collar workers were affected by the mounting predilection of US corporate managers toward downsizing during the 1980s and 1990s. The 'white-collar' recession of the early 1990s saw the elimination of the positions of tens of thousands of professional, administrative, and technical employees – salaried white-collar workers who were considered to be members of 'management'. Even in this recession, however, it was blue-collar workers who bore the brunt of displacement.

Overall, the incidence of job loss in the first half of the 1990s was, at about 14 percent, even higher than the quite substantial rates of about 10 percent in the 1980s. The rate of job loss for 1981–83, a period with a slack labor market, was about 13 percent. As the labor market tightened during the mid-1980s, the job loss rate fell. As the economy went into recession from 1989, the job loss rate increased again to a level similar to the recession of the early 1980s, notwithstanding the fact that the recession of the late 1980s was much milder. Moreover, even as the economy moved into a recovery from 1991, the job loss rate rose to ever-higher levels, a trend that continued through 1995, despite an acceleration of economic expansion (see Figure 2.1) (Farber, 1997).

Leading the downsizing of the 1980s and 1990s were many of America's largest corporations. In the decades after World War II, the foundations of US economic development were the willingness and ability of the nation's major industrial corporations to allocate their considerable financial resources to investment strategies that created the good jobs that many Americans began to take for granted. In 1969, the 50 largest US industrial corporations by sales directly employed

Figure 2.1 Rate of job loss in the US, 1981–95 (annual average number of jobs lost as a proportion of the labor force)

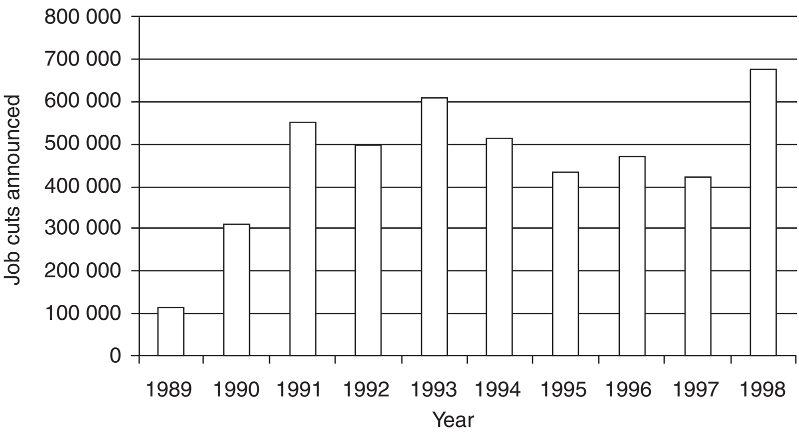


Source: Farber (1997).

6.4 million people, equivalent to 7.5 percent of the civilian labor force. In 1991, these companies directly employed 5.2 million people, equivalent to 4.2 percent of the labor force (Lazonick and O'Sullivan, 1997, p. 3). And since 1991 the downsizing of these companies has gone forward at a steady pace. By the early 1990s even US firms known for their no-layoff commitments – IBM, DEC, Delta – had undergone significant downsizing and layoffs of blue- and white-collar workers (Weinstein and Kochan, 1995, p. 16).

The American Management Association (AMA) conducts a survey every year of layoffs by major US companies.[4] A striking finding of this survey is that job elimination has continued to be pervasive among US corporate enterprises, and to result in substantial reductions in their workforces, notwithstanding the considerable improvement in the business cycle as the 1990s unfolded. Moreover, notwithstanding the downward trend since 1994–95 in the proportion of companies reporting job elimination, the most recent Challenger, Gray and Christmas estimates of announced staff cuts by major US corporations suggests that another upsurge in layoffs by US corporations is in the offing (Figure 2.2). The AMA survey shows, moreover, that job cutting is much more prevalent among larger employers than smaller ones. Almost 60 percent of companies that employed more than 10 000 people laid off some of their workforce in 1996–97 (American Management Association surveys, various years). In the boom year of

Figure 2.2 Announced staff cuts by major US corporations, 1989–98



Source: Challenger, Gray, and Christmas.

1998 the number of announced staff cuts by major US corporations was greater than for any other year in the 1990s.

The costs of job loss to displaced workers have been substantial. They have a large probability – around 35 percent on average – of not being employed two years after displacement. On average, displaced workers, when re-employed, receive real weekly earnings that are some 13 percent lower than before they lost their original jobs (about 9 percent for workers displaced from full-time jobs who are re-employed on full-time jobs) (Farber, 1997). And these are estimates of the wage effects only of losing a job.

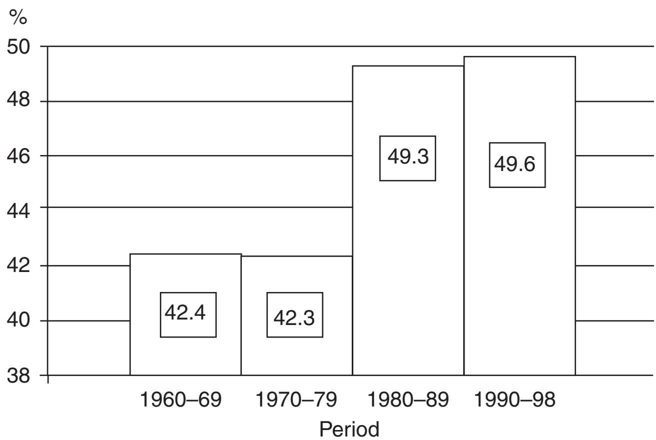
There are, of course, other costs to workers of downsizing. Prominent among them is growing worker insecurity at the prospect of losing a job, and the anxiety that these expectations breed. A commonly used, although imperfect, proxy for a change in job security is a change in job tenure. From 1983 to 1998 there was a slight decline in the median years of tenure of employed wage and salary workers with their current employer from 5.0 years to 4.7 years. But the average for male and female workers masks significant differences by gender. For male workers aged 25 years and over, median tenure fell from 5.9 years to 4.9 years from 1983 to 1998. A decline in tenure was particularly pronounced for men aged 55 to 64, falling from 15.3 years to 11.2 years between 1983 and 1998. That these overall declines were registered, notwithstanding the general trend towards an aging of the male workforce, is especially striking. Among men, in all age groups, the fall in tenure was sufficiently great to outweigh the positive impact of aging on tenure. In contrast, women aged 25 years and over enjoyed an increase in median tenure from 4.2 years to 4.4 years, although some of this effect was a result of the aging of the female workforce. Most age groups within the female working population experienced the increase in median tenure, with the notable exception of women aged 55 to 64 years, whose median tenure fell from 9.8 years in 1983 to 9.6 years in 1998.

As proxies for job security, job tenure figures must be used with caution. With layoffs occurring on a large scale, the proportion of workers with long tenure could rise, not because workers as a group are enjoying greater employment security, but because workers with lower seniority are being laid off. In the aircraft and parts industry, for example, a sharp rise in median tenure from 6.3 in 1991 to 9.6 in 1998 at a time of widespread layoffs seems to be, at least partly, attributable to this effect (US Bureau of Labor Statistics, various years).

While US corporate managers became focused on downsizing their labor forces in the 1980s and 1990s, they also became focused on distributing corporate revenues in ways that supported the price of their companies' stocks. During the 1950s, 1960s and 1970s, payout ratios – the ratio of dividends to after-tax adjusted corporate profits – varied from a low of 37.2 percent in 1966 (when increases in dividends lagged increased profits) to a high of 53 percent in 1974 (when profits fell by 19 percent while dividends went up by 8 percent). But averaged over any five-year period during these three decades, the payout ratio stayed remarkably stable, never going above 45.9 percent (1970–74) and never falling below 38.8 percent (1975–79). The stability is even greater over ten-year periods – 47.9 percent for the 1950s, 42.4 percent for the 1960s and 42.3 percent for the 1970s (see Figure 2.3). These payout ratios were high by international standards, manifesting the extent to which US corporations returned value to stockholders even before the rise of the institutional investor.

Compared with the 1960s and 1970s, an upward shift in corporate payout ratios occurred in the 1980s and 1990s. In 1980, when profits went down by 17 percent (the largest profits decline since the 1930s),

Figure 2.3 US corporate payout ratio, 1960–98 (corporate dividends as a percentage of corporate profits after tax with inventory valuation and capital consumption adjustments)



Source: US Congress, *Economic Report of the President* 1992, p. 403; *Economic Report of the President*, 1999, p. 431.

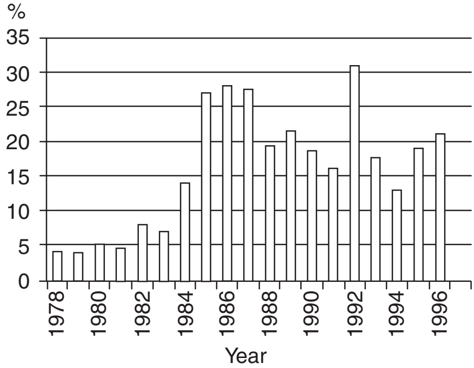
dividends rose by 13 percent, and the payout ratio shot up 15 points to 57 percent. Thereafter, from 1980 through 1998, the payout ratio only descended below 44 percent twice, in 1984 and 1985, and even then not because dividends fell but because the increase in dividends did not keep up with the increase in profits. There was no five-year period within the period 1980 to 1998 during which the payout ratio did not average at least 44 percent, and over the 19 years it averaged over 49 percent (O'Sullivan, 2000, Figure 6.4; US Congress, 1999, p. 431).

Since the mid-1980s, moreover, increases in corporate dividends have not been the only way in which corporations have distributed earnings to stockholders. Before the 1980s, during a stock-market boom, companies would often sell shares on the market at inflated prices to pay off debt or to bolster the corporate treasury. In general, although equity issues have never been an important source of funds for investment in the development and utilization of the productive capabilities of US corporate enterprises, they tended to issue more equities than they repurchased. But during the 1980s, the net equity issues for US corporations became negative in many years, largely as a result of stock repurchases.

In 1985, when total corporate dividends were $84 billion, stock repurchases were $20 billion, boosting the effective payout ratio from under 40 percent, based on dividends only, to 50 percent with the addition of stock repurchases. In the quarter following the stock market crash of 1987, there were 777 announcements by US corporations of new or increased buybacks ('The Buyback Monster,' *Forbes*, 17 November 1997). In 1989, when dividends had risen to $134.4 billion, stock repurchases had increased to over $60 billion, increasing the effective payout ratio to over 81 percent. With close to $70 billion in stock repurchases in 1994, the effective payout ratio was about 66 percent. In 1996, stock repurchases were $116 billion, for an effective payout ratio of 72 percent ('The Hidden Meaning of Stock Buybacks,' *Fortune*, September 1997). Although for any one year the announced buyback plans tend to be lower than actual repurchases, the continuing high levels of announced buyback plans since 1996 suggest that US corporate enterprises continue to favour buybacks as a respectable use for their cash; US corporations announced plans to buy back $177 billion of stock in 1996, $181 billion in 1997 and $207 billion in 1998 (Figure 2.4) (Securities Data Corporation).

For many major US corporations stock repurchases have now become a systematic feature of the way in which they allocate revenues and a critically important one in terms of the amount of money

Figure 2.4 Buybacks as a share of US corporate profits, 1978-96



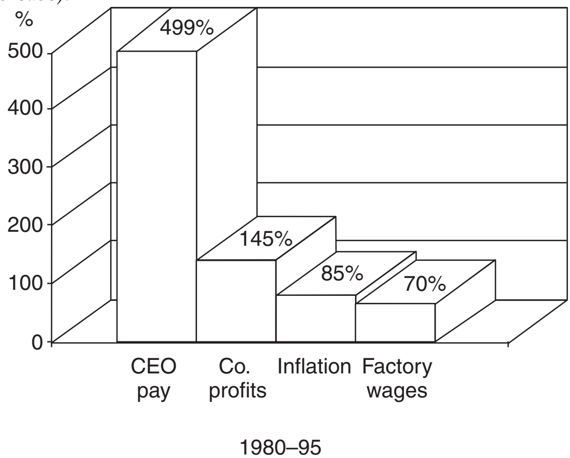
Source: Securities Data Corporation.

involved. General Electric is a good example. From 1994 to 1998, its cumulative dividend growth was 84 percent compared with 29 percent for the population of Standard & Poor's 500 firms. Moreover, during the same period, the cumulative amount of cash that GE spent on share repurchases at $14.6 billion rivaled the $15.6 billion paid out in cumulative dividends. Together these two outflows of cash amounted to an extraordinary 74.4 percent of GE's cumulative cash from operations from 1994 to 1998. Notwithstanding the enormous amounts that the company has already spent on repurchases, in December 1997, GE's board of directors increased the authorization to repurchase company stock to a massive $17 billion (GE, 1998). It is perhaps not coincidental that since 1981, when the current CEO, Jack Welch, took office, GE has set the tone for downsizing among corporations.

Why and how did this shift in the orientation of top managers from retain and reinvest to downsize and distribute occur? When corporate governance was based on the strategy of retain and reinvest, as had essentially been the case for most US corporations from their emergence in the late nineteenth and early twentieth centuries through the 1970s, top managers tended to be integrated with the business organizations that employed them and governed the corporate enterprises that they controlled accordingly. One condition that supported this integration of top managers into the organization was the separation of share ownership and managerial control. In the absence of hereditary owners in top management positions, career employees who worked their way up and around the managerial hierarchy could realistically hope to rise to top management positions over the course of their careers. Into the 1970s the salaried compensation of top managers was largely determined by pay structures within the managerial organization.

Forces were at work from the 1950s that increasingly segmented top managers of US corporations from the rest of the managerial organization. Top managers of many US corporations began receiving stock options in 1950, after tax changes made this form of compensation attractive. During the 1950s and 1960s, with the stock market generally on the rise, gains from the exercise of these options and the holding of stock became increasingly important components of the incomes of top managers. When in the early 1970s, the stock market turned down, many corporate boards transformed worthless stock options into increases in salaried remuneration, on the grounds that these managers could not be blamed for the general downturn in the stock market. In effect the *expectations* of gains from stock options that had been formed during the general rise in the stock market in the 1950s and 1960s came to be considered, along with salaries, as part of the basic compensation of top managers. Thus began a trend that during the 1970s favored the pay of top managers over the pay of everyone else in the corporation (see Figure 2.5). During the 1980s and

Figure 2.5 CEO pay versus factory wages in major US corporations, 1980–95 (percent increase).

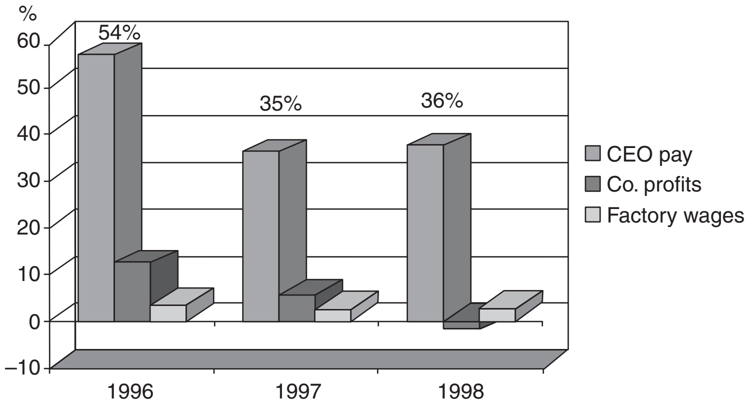


Source: http//www.aflcio.org/paywatch

1990s the explosion in top management pay has continued unabated, with stock-based rewards playing an ever-more important role (Hall and Liebman, 1997). On average, the pay packages of CEOs of US corporations were 44 times those of factory workers in 1965 but 419 times in 1998 (see Figure 2.6).

From the 1950s, therefore, US corporate managers developed an ever-growing personal interest in boosting the market value of their companies' stock. Yet even though US companies had relatively high payout ratios by international standards in the 1950s, 1960s and 1970s, during these decades US top managers remained oriented toward a strategy of retain and reinvest rather than simply using corporate revenues to increase dividends or repurchase stock to boost stock prices. The fact is that, given the dominance that these corporations exercised over many of their product markets, the pursuit of retain-and-reinvest strategies permitted many different stakeholders to gain. Workers could get paid higher wages and have better employment stability and working conditions; suppliers and distributors could make more profits, some of which could potentially be passed on to their workers; consumers could get lower prices on the goods that they purchased; the dividends to stockholders could be maintained or even increased; and there could still be substantial funds left over for the corporation to reinvest either within the United States or, as was increasingly the case in these decades, abroad.

Figure 2.6 CEO pay versus factory wages in major US corporations, 1996–98 (percent increase).



Source: http//www.aflcio.org/paywatch; *Business Week* 20 April 1998; 19 April 1999.

Such was the happy situation facing US corporations in their era of unchallenged dominance in the post-World War II decades. It was this environment of growth that spawned the belief among many top managers of US corporations that a good manager could manage anything – a belief that the major business schools of the time were happy to propound and that provided a rationale for the conglomeration movement of the 1960s. In the much more difficult economic environment of the 1970s and early 1980s, this belief in the omnipotence of top management began to be crumble. Indeed, the overextension of the corporate enterprises into too many different lines of business had helped to foster the strategic segmentation of top managers from their organizations. At the same time, the innovative capabilities of international competitors made it harder to sustain the employment of corporate labor forces, unless the productive capabilities of many if not most of these employees could be radically transformed. Under these conditions, US corporate managers faced a strategic crossroads: they could find new ways to generate productivity gains on the basis of retain and reinvest, or they could capitulate to the new competitive environment through corporate downsizing.

If the changed competitive environment of the 1970s and 1980s made it more difficult for top managers of US corporations to be successful through a strategy of retain and reinvest, their increased segmentation from their own organizations made it more difficult for them to understand what type of innovative strategies they should pursue or the capabilities of their organizations to implement these strategies. In addition, by the 1980s the deregulated financial environment and the rise of the institutional investor as a holder of corporate stocks encouraged top managers to align their own interests with external financial interests rather than with the interests of the productive organizations over which they exercised control. Manifesting this alignment was the explosion in top management pay, while the other side of the same paycheck was the shift in the strategic orientation of top management from retain and reinvest to downsize and distribute. With the cooperation of top corporate managers, shareholder value had by the 1990s become a firmly entrenched principle of US corporate governance.

Shareholder value and economic performance

Shareholders and top managers have certainly benefited under the rule of shareholder value (Table 2.1). But how has the US economy as a

Table 2.1 US corporate stock and bond yields, 1950–99 (percent, annual averages)

	1950–59	1960–69	1970–79	1980–89	1990–99
Real stock yield	17.7	8.3	–1.7	11.7	15.0
Stock price yield	14.8	7.5	1.4	12.9	15.5
Dividend yield	4.9	3.2	4.1	4.3	2.5
Change in CPI	2.1	2.4	7.1	5.6	3.0
Real bond yield	1.3	2.7	1.2	5.8	4.7

Source: US Congress, *Economic Report of the President*, 1992, pp. 366, 378, 397; *Economic Report of the President* 2000, Tables 6-62, B-71, B-93.

whole performed? Again, as in the case of hostile takeovers and the market for corporate control, financial economists, versed in theories of the inherent economic superiority of market resource allocation over corporate resource allocation, have provided the theoretical rationale for corporate governance in the interests of shareholders with its emphasis on downsize and distribute.[5] Financial economists contend that when the corporate enterprise maximizes shareholder value, everyone – workers, consumers, suppliers and distributors – will, as a result, be better off. These financial economists posit that shareholders are the 'owners' or 'principals' in whose interests the corporations should be run. They recognize, however, that in the actual running of the corporation, shareholders must rely on managers to perform certain functions. The proponents of shareholder value have argued, often with justification, that the managers who control the allocation of corporate resources and returns are self-serving in the exercise of this control. As a result, such managers do not adequately 'create value for shareholders.' When corporations are run to maximize shareholder value, these financial economists argue, the performance of the economy as a whole, not just the interest of shareholders, can be enhanced. In making this claim, advocates of maximizing shareholder value rely on arguments that portray any residual revenues – profits – that the corporation generates as rewards for critical economic functions that, allegedly, shareholders perform and that without which these residuals would not be possible. In one version of the argument, shareholder returns are regarded as incentives for waiting and risk bearing; in another version, as rewards for shareholder monitoring of managers.

According to the logic of shareholder value theory, if corporate managers cannot allocate resources and returns to maintain the value of the shareholders' assets, then the 'free cash flow' should be distributed to shareholders who can then allocate these resources to their most efficient alternative uses. Since in the modern corporation, with its publicly listed stock, these shareholders have a market relation with the corporation, the economic argument for making distributions to shareholders is an argument concerning the efficiency of the replacement of corporate control over the allocation of resources and returns with market control.

Shareholder value advocates, moreover, point to the stock market boom throughout the 1990s and the prosperity of the US economy in the late 1990s as proof positive of the economic benefits that the pursuit of shareholder value has delivered. Theory, they argue, has been borne out by practice. Specifically, proponents of 'creating shareholder value' through downsize and distribute argue:

- US corporations that have engaged in such restructuring have become more efficient, as reflected in enhanced profitability and higher market valuations of their assets.
- The release of labor and capital from major corporations has provided, moreover, the basis for the flourishing of new ventures in industrial districts such as Silicon Valley based on the highly dynamic and internationally competitive US information technologies sector.
- In effect, the dismantling of corporate control over the allocation of resources and returns in the economy has enabled labor and capital markets to reallocate those resources to start-up companies that are fast, flexible and innovative and that are driving the current boom in the US economy.
- In cross-national comparative perspective, such restructuring of existing corporations and the creation of such dynamic new ventures are precisely what is missing in Japan and the advanced nations of Europe.
- Nothing could do more to jump-start these economies than to import American-style institutional investing and corporate restructuring so that the mechanisms of the market can redirect the allocation of labor and capital to their most profitable uses.

The current boom conditions in the US economy, and the undoubted success of Silicon Valley in the information technology sector, would seem to provide powerful support to those who argue that the pursuit of shareholder value is the path to sustainable prosperity. Besides the booming stock market, it is common to cite the relatively low rates of unemployment that the United States has achieved in the late 1990s, with an emphasis on the fact that in February 1999, for the first time since the early 1950s, the official US unemployment rate was lower than the official Japanese unemployment rate.

There are, however, many problems with this rosy view of the power of shareholder value in reshaping corporate governance and, indeed, the organization of the economy to deliver sustainable prosperity. In both theory and practice, the arguments for maximizing shareholder value ignore significant problems of US economic performance in the era of downsize and distribute as well as important historical foundations of the current stock market and economic booms. A consideration of these problems of economic performance and foundations of the current booms raises serious questions about the future sustainability of US prosperity in a shareholder value regime.

Problems of US economic performance

The declining employment security, falling job tenures, and significant costs of job loss that many, if not most, Americans have experienced in the 1990s reflect a longer-run trend, dating back to the 1970s, toward a persistent worsening of the distribution of income in the United States. The flexibility of US labor markets may have enabled the US economy to achieve reasonable rates of unemployment in the 1990s, but only at the cost of creating an economy based on low wage rates and incomes for most of the working population. To make ends meet, moreover, most families need incomes from two adults who have to work long hours. Indeed, during the 1990s, the yearly working hours of the average American surpassed those of the average Japanese.

The problem of income inequality in the United States reflects not only significant differences in levels of wages and salaries but also significant inequalities in the distribution of wealth, among which is the distribution of stockholdings. While the top 0.5 percent of all US households in terms of the size of their stockholdings owns, directly or through institutional investors, almost 37 percent of all outstanding corporate equities, 80 percent of US households own less than 2 percent (Poterba and Samwick, 1995, p. 328). The high rates of returns on corporate stocks that have been achieved in the era of shareholder value have only served to exacerbate income inequality in the United States.

During the 1980s and 1990s, while US financial economists have been confidently advocating the creation of shareholder value, US labor economists have been unable to explain the worsening income distribution. In our view, the impacts of the tendency of US corporations to downsize and distribute are only part of the story of the worsening income distribution. Even corporations that *favor* a strategy of downsize and distribute must, if they are to persist, also engage in strategies that require them to retain and reinvest. Another part of the story of worsening income inequality is what we call the 'skill-base hypothesis': the strategic focus of *innovative* US corporations on those types of activities in which innovation can be generated by investing in 'narrow and concentrated' skill bases of highly educated personnel. In the post-World War II era that extended through the 1970s – decades when US corporate governance favored strategies of retain and reinvest – US blue-collar or 'hourly' workers were well paid and provided with stable employment, even though by world standards they were poorly educated and trained. During this period there was a general improvement in the distribution of income that contrasts with the worsening of the income distribution since that time. The corporations that employed these workers had achieved market dominance by developing managerial organization and fostering managerial learning, and shared some of the gains of this dominance with production workers, whose cooperation was required on the shop floor.

But in the 1970s and 1980s, the lack of investment in shop-floor skills proved to be the Achilles heel of US corporations in international competition, and especially in competition with Japanese companies that had innovated by investing in broader and deeper skill bases than US companies. In response to the historical legacy of the US economy to neglect investment in shop-floor skills and competitive challenges from abroad, the retention-and-reinvestment strategies of US corporations in the 1980s and 1990s have focused on activities in which they can innovate and compete by investing in the capabilities of only the most highly educated personnel. Indeed, in engaging in these activities and investing in these employees, US corporations are able to draw on an international pool of highly educated labor that comes to the United States in search of high-paid employment, often by way of one or more university degrees from world-class universities and departments in the US system of higher education. The skill-base bias of US corporate investment and the ready availability of a well-educated international labor supply that US corporations can employ have meant, moreover, that corporate America has had little interest in upgrading the quality of education available to most Americans, as evidenced by the highly unequal and, by international standards, generally inferior system of mass education in the United States.

Foundations of the current prosperity

It was common in the late 1990s for Americans to tout the innovation and prosperity of Silicon Valley as an outcome of the corporate restructuring of the previous two decades that made both capital and labor free to move into new ventures. This view, however, ignores historical accumulations of resources and capabilities in districts such as Silicon Valley that have made the current prosperity possible. In effect, the prosperity of Silicon Valley in the 1990s owes more to the postwar 'military–industrial complex' in which 'retain-and-reinvest' corporations such as IBM, Hewlett Packard, Motorola, and Xerox were central than it does to a resurgence of entrepreneurship – something that has always been in abundant supply in the United States. The success of these corporations in developing and utilizing technologies was in turn highly dependent on massive government procurement contracts and research initiatives. In historical perspective, the current reallocation of labor and capital to new ventures in the United States is, therefore, just the most visible tip of the military–industrial complex – a developmental iceberg that took the American economy decades to put in place. Given the focus of US corporations on downsize and distribute, as well as the US government's retreat from investments in basic research, there are questions about whether the American economy is currently generating the new technological infrastructure that can provide foundations for sustainable prosperity in the twenty-first century.

If there are questions about the foundations and future of productive investment in the United States, there are also questions about the sources and availability of American savings. Corporate policies of downsize and distribute have provided the underlying impetus to the stock market boom of the 1990s, but the sustained and rapid rate of increase in stock prices is the result of a massive flow of funds into the stock market through equity-based mutual funds. Since the 1960s US households have been increasing the proportion of their financial assets that are invested in pension and mutual funds. From 1982 to 1994 pension and mutual funds alone accounted for about 67 percent of the net growth of the total financial assets of households (Edwards, 1996, pp. 16–27).

Reflecting their growing importance in managing the savings of US households, pension and mutual funds' shares of corporate equities have increased dramatically. Pension funds held 24.0 percent of US corporate stock in 1997, with private pensions accounting for 13.8 percent and public pensions for 10.2 percent, compared with 0.3 percent in 1945. Over the same period, mutual funds increased their share of US corporate stock from 1.5 percent to 16.2 percent. A substantial proportion of the recent upsurge in the share of mutual funds is attributable to their growing popularity for pension provision; at the end of 1996, retirement plan assets represented 35 percent of all mutual fund assets. In contrast to the growing importance of institutional investors, the share of corporate stocks held directly by individuals has fallen from 93 percent in 1945 to 42.7 percent in 1997 (US Board of Governors, various years). Institutional share ownership is even higher in the largest US corporations than in the population of corporate enterprises as a whole. In 1987, the institutional share of the equity of the top 1000 US corporations was 46.6 percent; by 1995 it had increased to 57.2 percent (Brancato, 1997).

The shift of stockholdings to institutional investors had by no means exhausted itself by the mid-1990s. During the last half of the 1980s, the net new cash flow into equity mutual funds ranged from a high of about $21.9 billion in 1986 to a low of minus $16.2 billion in 1988. During the early 1990s, however, the flow of new money into mutual funds picked up speed, and during 1993–95 net additions to mutual funds averaged about $125 billion per year. In 1996 and 1997 the net additions to equity mutual funds rose to the unprecedented levels of $217 billion and $227 billion respectively. In the first seven months of 1998, the pace of inflows remained vigorous. However, in conjunction with the downturn in the US stock market in August 1998, the inflow of cash slowed down sufficiently to bring the net inflow for the year to $159 billion, which represented a 30 percent fall compared with 1997. Yet, as the market regained its vigor in late 1998 and especially in early 1999, inflows revived again (Investment Company Institute).

The origins of all of this 'new' money are not well documented. What is clear, however, is that the savings rate of US households, already low by international standards in the 1980s, has plunged further in the 1990s. An older generation of Americans – the ones who were able to accumulate significant savings, pensions and other assets during the era of retain and reinvest – appear to be reallocating their financial resources to capture the returns of the booming stock market. But what if, as appears to be the case, the younger generations, living in an era of downsize and distribute, will not have the same opportunities as the older generations for the accumulation of financial assets? And, indeed, what if the returns to the financial assets of older generations, who have become increasingly reliant on the stock market for returns on their savings to fund their consumption expenditures, cannot be sustained?

Is the current prosperity sustainable?

We must consider the possibility that the US stock market boom is encouraging US households to live off the past while corporations have less incentive to invest for the future. The current consumption-driven boom seems to be closely tied to the stock market boom. For the first time in US history, the returns to the savings of American households are directly dependent on the sustainability of high yields on corporate stock. What will happen to US consumption, and to the US (and world) economy, if the US stock market should turn down, and stay down?

Yet the stock-market boom has not made capital available to industry. The persistent and massive flow of funds into stock-based mutual funds in the 1990s has bid up stock prices, increasing the market capitalizations of corporations. But, as we have seen, net corporate equity issues have been negative over the course of the 1990s because of corporate stock repurchases, while the main impact of the stock market boom on capital markets has been to raise consumption.

No one knows the 'real' limits to the current stock market boom. What we can say is that, unlike the speculative stock market booms that occurred in the late 1920s in the United States, and in the late 1980s in Japan, in which corporations sold stock at high price–earnings ratios to increase their cash reserves or pay off debt, the current US boom is being supported by corporate cash distributions. What is the continuing capacity of US corporations to support stock prices through 'downsize-and-distribute' strategies?

A proponent of shareholder value would argue that vibrant new ventures are replacing the stodgy old corporations that are being downsized. But even if one were to accept the claim that the stock market boom has induced entrepreneurs to set up new ventures with their eyes on the prospect of not-too-distant and very lucrative initial public offerings, are new ventures sustainable if they are governed by the principle of shareholder value? One important effect of the stock-market boom on new ventures has been to make them dependent on the performance of the stock market even before these enterprises themselves have gone public. Most new ventures finance themselves by the willingness of employees to accept shares in the company in lieu of immediate remuneration. But should the stock market turn down, and with it the expectations for gains on the sale of shares in a successful IPO, many new ventures will find that the financial commitment required to secure the personnel to develop and utilize the enterprise 's productive resources are beyond their financial means or those of the venture capitalists who support them.

Indeed, it is not just new ventures that are looking to stock market gains to pay employee compensation. In 1998, for example, the widespread use of stock options to attract and reward employees meant that Intel spent more than twice as much on stock repurchases than on R&D (Intel, 1999). During the same year, Microsoft's stock repurchases were almost equal to its in-house spending on R&D (Microsoft, 1999). We have no precedent for examining how, given such remuneration schemes, strategically central corporations such as these would be affected by a stock market collapse. But it is worth remembering that Intel and Microsoft were once new ventures that transformed themselves into going concerns by establishing themselves as key suppliers to IBM – a US corporation that epitomized governance according to the principles of retain and reinvest – and that became dominant in their sectors by governing themselves according to the same principles of retain and reinvest. The experience of the United States suggests that the pursuit of shareholder value may be an appropriate strategy for running down a company – and an economy. The pursuit of some other kind of value is needed to build up a company and an economy.

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Notes

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1. An important analysis of US loss of competitive advantage in a number of major industries can be found in Dertouzos et al. (1989).
2. The following paragraphs on the transformation of the US financial sector are based on Lazonick and O'Sullivan (1997); see also Lazonick (1992) and O'Sullivan (2000b), ch. 5.
3. The following paragraphs on downsizing of labor and distribution of earnings are drawn from O'Sullivan (2000b), ch. 5.
4. The AMA survey is sent to human resources managers in AMA member companies every year. AMA's corporate membership consists of 9500 organizations which together employ 25 percent of the American workforce. Over 85 percent of surveyed firms gross more than $10 million annually, which puts them among the top 5 percent of US corporations.
5. For an elaboration of shareholder theory and a critique, see O'Sullivan (2000a).

3

Organizational Learning and International Competition: The Skill-Base Hypothesis*

William Lazonick

The skill-base hypothesis

Since the 1970s a persistent feature of the US economy has been increasing income inequality, to the point where the United States now has the most unequal distributions of income among the advanced industrial economies (Atkinson et al., 1995). Sustainable prosperity – the spreading of the benefits of economic growth to more and more people over a prolonged period of time – appears to have become an elusive objective. At the same time, in the late 1990s, after more than two decades of intense competitive challenges, the United States retains international leadership in a range of science-based industries such as computer electronics and pharmaceuticals as well as in service sectors related to such things as finance and food. The US economy appears capable of innovation, but incapable of sustainable prosperity.

Are innovation and equality inherently in opposition to one another? Mary O'Sullivan and I have hypothesized that the coexistence of innovation and inequality in the US economy in the 1980s and 1990s reflects a systematic bias of major US corporations against making innovative investments in broad and deep skill bases (Lazonick and O'Sullivan, 1998). Rather, these corporations, which exercise significant control over the allocation of resources and returns in the economy, are choosing to invest, and are best able to innovate, in the production of goods and services that use narrow and concentrated skill bases to develop and utilize technology.

Why are 'skill bases' important to the economy? They form the foundations on which people engage in collective and cumulative – or organizational – learning, which is in turn central to the process of economic development. Case-study evidence suggests that the manufacturing industries in which the US economy has been most severely challenged by high-wage foreign competition – industries such as automobiles, consumer electronics, machine tools, and commodity semiconductors – are those in which innovation and sustained competitive advantage demand investments in broader and deeper skill bases. If the 'skill-base hypothesis' is valid, then it may well be that innovation and equality can go hand in hand. From a policy perspective, the relevant issue is how business enterprises can be induced to make innovative investments in broad and deep skill bases.

The skill-base hypothesis adds an important dimension to American debates on the relation between investments in 'technology' and sustainable prosperity. On one side have been those who stress the weakened innovative capabilities of the US economy in international competition (Cohen and Zysman, 1987; Dertouzos et al., 1989; Tyson, 1992). They have called for the US government and businesses to allocate more resources to education, training, research and cooperative investment projects that can support the United States in making a competitive response. These arguments assume, often more implicitly than explicitly, that these innovative responses will promote sustainable prosperity in the United States.

On the other side have been those who argue that income inequality cannot be blamed on international competition. The volume of world trade, they argue, is not large enough to have a significant impact on the distribution of income in the United States. Rather they attribute growing inequality to the employment impacts of 'new technology' (Krugman and Lawrence, 1994; Krugman, 1997). If the United States has problems keeping people employed at high wages, it is because, for a given level of investment, technologies of the computer age do not create the same quantity and quality of employment opportunities for Americans as did the technologies of the past. Income inequality has grown, they argue, because new technologies displace employment opportunities that used to be well paid. Pay attention to raising the levels of both investment and relevant skill in the US economy, and the income distribution will improve.

The skill-base hypothesis views both international competition and technological change as important determinants of the distribution of income. But the hypothesis is embedded in a theory of innovation and economic development in which the impacts of international competition and technology on income distribution depend on corporate investment strategies. Across US industrial corporations, these strategies, and the investment in skill bases that they entail, are in turn influenced by American institutions of corporate governance and corporate employment. The rise of powerful international competition based on investments in broader and deeper skill bases may lead US corporations to seek to remain innovative by investing in technologies that only require investments in narrow and concentrated skill bases.

Powerful support for the skill-base hypothesis can be found in the experience of Japanese–US industrial competition over the past few decades. Japan has taken on and surpassed the United States in many industries in which it was the previous world leader. The foundations of Japanese success in international competition, I shall argue, were investments in broad and deep skill bases to generate organizational learning. The problems of both innovation and equality in the United States in the 1980s and 1990s have not been inherent in technology. Rather the problems derive from corporate strategies to develop and utilize technology.

US corporations, I contend, have been investing in narrow and concentrated skill bases in a world of international competition in which innovation has increasingly come from investing in broad and deep skill bases. If the skill-base hypothesis is correct, the problem of reversing the trend toward income inequality in the United States goes much deeper than growth policies or industrial policies. It requires transformation of the way industrial corporations are governed and the way people are employed.

Organizational integration

Almost all of the major industrial corporations in the US economy in the post-World War II era made investments in managerial learning from the early decades of the twentieth century, if not before. Many of the productive and competitive advantages of these investments in managerial organization still accrued to these corporations decades after the particular individuals involved in these collective learning processes had left the corporate scene.

In comparative international perspective, US industrial corporations were not unique in building their managerial organizations into formidable sources of sustained competitive advantage. What made US industrial corporations unique among their counterparts in the advanced economies was their dedication to a strategy of taking skills, and hence the possibilities for craft learning – much less corporate learning – off the shop floor (Lazonick, 1990; Lazonick and O'Sullivan 1998). This process of transforming skilled craft work into 'semi-skilled' operative work was a prolonged one, constrained as it was by the development of new technology through managerial learning. But, as reflected in the distinction between 'salaried' and 'hourly' personnel, the strategy of relying exclusively on the managerial organization for the development of new productive capabilities has been, throughout the twentieth century, a distinctive characteristic of US industrial development.

The American corporate strategy of confining organizational learning to those employed within the managerial structure enabled the United States to become the world's leading industrial power during the first half of the twentieth century (Lazonick and O'Sullivan, 1998). On the basis of this leadership, US industrial corporations were able to provide high pay and stable employment to not only managerial employees but also shop-floor workers, whether they were skilled or semi-skilled.

Over the past few decades, however, powerful international competitors have arisen who have developed productive capabilities by integrating managers and workers into their organizational learning processes. The *hierarchical segmentation* between managers and workers that the American 'managerial revolution' entailed became a major institutional barrier to making investments in organizational learning required to sustain prosperity in the US economy. In an era of intense international competition in which sustained competitive advantage went to those enterprises and nations that made investments in, and integrated, the organizational learning of both managerial and shop-floor personnel, the investment strategies of most US industrial corporations that focused only on managerial learning fell short.

The competitive problem that has faced US industrial corporations is that, over time for a particular product, the innovation process, of which the organizational learning process is its social substance, has become increasingly *collective* and *cumulative*. Organizational learning has become increasingly collective because innovation – the generation of higher-quality, lower-cost products – depends on the integration of an ever-increasing array of specific productive capabilities based on intimate knowledge of particular organizations, technologies and markets. Organizational learning has become increasingly cumulative because the collective learning that an organization has accumulated in the past increasingly forms an indispensable foundation for the augmentation of organizational learning in the present and future.

The increasingly collective and cumulative character of organizational learning means that, for a particular product, an innovative investment strategy is one that entails investments in *broader and deeper skill bases* – divisions of labor that extend further down the organizational hierarchy and involve more functional specialties. The investments in skill bases are not simply investments in the learning of large numbers of individuals performing a wide variety of functions. For these investments in broader and deeper skill bases to generate higher-quality, lower-cost products requires *organizational integration,* a set of social relations that provides participants in a complex division of labor with the incentives to cooperate in contributing their skills and efforts toward the achievement of common goals.

At any point in time, the technological possibilities and organizational requirements of the innovation process vary markedly across industries in terms of the extent of the skill base in which the innovating enterprise must invest. In industries such as pharmaceuticals, in which value-added comes mainly from research, design and marketing, *narrow and concentrated skill bases* of scientists, engineers and patent lawyers remain sufficient for generating higher-quality, lower-cost products. In such industries, US industrial enterprises have been able to remain world leaders. But in industries such as automobiles, where value-added comes mainly from manufacturing processes that combine a complex array of physically distinct components, international competitive challenges have been based on investments in broader and deeper skill bases. The investments in organizational learning occur not only within corporate management structures but also on the shop floor and in the vertical supply chain. In those industries in which international competition demands investments in such broad and deep skill bases, once-dominant US industrial enterprises have lost substantial competitive advantage.

In the US automobile industry, American-based companies have regained some of the markets they have lost – or at least have stemmed the loss of market share. The skill-base hypothesis posits that they have done so by investing in broader and deeper skill bases than was previously the case. In responding to these competitive challenges, moreover, the organizational problem that has faced US industrial enterprises over the past few decades has gone beyond the hierarchical segmentation between managers and workers. Even within the managerial structure – the traditional locus of organizational learning in US enterprises – organizational integration appears to have given way to *functional* and *strategic* segmentation.

Compared with both the integrated organizational structures of foreign competitors and the integrated managerial structures that characterized the most successful US companies in the past, organizational learning within the managerial structures of US enterprises has been limited by the *functional segmentation* of different groups of technical specialists from one another. Specialists in marketing, development, production and purchasing may be highly skilled in their particular functions, but relative to their counterparts abroad, in US enterprises they tend to respond to incentives that lead them to learn in isolation from one another. Functional segmentation makes it difficult, if not impossible, for such isolated specialists to solve complex manufacturing problems that require collective and cumulative learning.

In addition, in comparative and historical perspective, a distinctive characteristic of US industrial enterprises since the 1960s has been the *strategic segmentation* of those top managers who control enterprise resources from those lower down the managerial hierarchy on whom the enterprise has relied for organizational learning. In allocating vast amounts of resources, top managers of major US industrial corporations have increasingly lost the incentive to remain cognizant of the problems and possibilities for organizational learning within the enterprises over which they exercise control. Within a particular enterprise, tendencies toward hierarchical, functional and strategic segmentation may be mutually reinforcing, thus making it all the more difficult for an enterprise, or group of enterprises, to invest in organizational learning once they have embarked on the organizational-segmentation path.

The skill-base hypothesis seeks to test these propositions concerning the growing importance of hierarchical, functional and strategic integration for attaining and sustaining competitive advantage, and the increasing tendency toward organizational segmentation along these three dimensions in US industrial corporations in historical and comparative perspective. The skill-base hypothesis, and the theoretical perspective on innovation and economic development in which it is embedded, derives from our historical and comparative analyses of the role of organizational integration in shifts in international competitive advantage (Lazonick, 1991, ch. 1; O'Sullivan, 1996; Lazonick and O'Sullivan, 1996, 1998). The empirical evidence required to test the hypothesis must be derived from in-depth analyses of the investment strategies, organizational structures and competitive performance of particular companies based in different nations that have engaged in head-to-head competition in particular industries.

The purpose of this paper is to motivate such a research agenda by drawing on some of the findings of a now vast range of literature on the interaction of organization and technology in US–Japanese industrial competition. This evidence, much of it deriving from the experiences of management consultants and case studies by business academics, provides substance to the skill-base hypothesis. In this paper, I shall focus on differences in hierarchical integration and organizational learning in Japanese and American enterprises. I shall argue that understanding hierarchical integration of technical specialists and production operatives forms an indispensable foundation for understanding the functional integration of technical specialists themselves – a subject that now dominates much of the management literature on technological competition. Absent from this paper will be a discussion of strategic integration and segmentation, a subject that, in relation to the skill-base hypothesis, has been treated at length elsewhere, and that provides the analytical interface between issues of corporate governance and organizational learning (O'Sullivan 1996; Lazonick and O'Sullivan, 1997a, 1997b, 1998). In what follows, therefore, I shall be concerned with the social structures that generate organizational learning rather than with the social structures that allocate resources to building different types of skill bases.

Organizational learning

If there is one nation that has challenged the United States for international industrial leadership in the last half of the twentieth century, that nation is Japan. In 1950 Japan's GDP per capita was only 20 percent of that of the United States; in 1992 it was 90 percent (Maddison, 1994, p. 22). The Japanese challenge has come, moreover, not in those industries in which American companies were weak or that they had neglected. On the contrary, the challenge has been in industries such as automobiles, electronics and machine tools, in which the United States had attained a seemingly invincible position as the world's leading mass producer.

Since the 1980s much has been written about the institutional and organizational sources of Japanese competitive advantage. Social institutions such as lifetime employment and cross-shareholding and organizational practices such as total quality management and consensus decision making have been critical elements in Japan's phenomenal rise from the ashes of defeat after World War II. But these institutions and organizations would not have generated the so-called economic miracle in the 1950s and 1960s had Japan not already possessed in the immediate aftermath of the war an accumulation of technological capabilities.

Japan had been accumulating capabilities in mechanical, electrical and chemical technologies since the late nineteenth century when the Japanese 'managerial revolution' had begun. At the time of the Meiji Restoration in 1868, Japan had little in the way of modern industrial capabilities (Morris-Suzuki, 1994). Under the slogan 'Rich Nation, Strong Army,' the Restoration government implemented a strategy for industrial development that was heavily dependent on borrowing knowledge, technologies and even institutions from abroad (Westney, 1987; Samuels, 1994). In the first half of the 1870s, private and public interests set up institutions of higher education – most notably Keio University, the Institute of Technology (later part of Tokyo Imperial University), and the Commercial Law School (which became Hitotsubashi University) – to supply key personnel to an innovative industrial economy (Hirschmeier and Yui, 1981, p. 166; Hunter, 1984, p. 47; Abe, 1996). By the 1880s Japan had a steady supply of both indigenous graduates and teachers (Yonekawa, 1984, pp. 193–218; Iwauchi, 1989; Uchida, 1989).

Large numbers of university graduates were lured into industry, with the zaibatsu (including their affiliated industrial enterprises) taking the lead (Yonekawa, 1984). From 1900 to 1920, for example, the employment of graduate engineers increased from 54 to 835 at Mitsui and from 52 to 818 at Mitsubishi (Uchida, 1989, p. 108). These highly educated personnel were not only eagerly recruited but also well paid by the companies that employed them. In addition, companies often incurred the considerable expense of sending these employees abroad for varying lengths of time to acquire more industrial experience (Hirschmeier and Yui, 1981, p. 154; Iwauchi, 1989, p. 99).

During the interwar period the overall development strategy of the Japanese economy became increasingly dominated by the investment requirements of militarization and imperial expansion. Relying heavily on the zaibatsu, Japan devoted considerable resources to building capabilities in mechanical, electrical and chemical engineering. In the immediate aftermath of World War II, as the Allied Occupation engaged in the dissolution of the once-powerful zaibatsu (Adams and Hoshii, 1972; Bisson, 1951; Hadley, 1970), Japanese scientists and engineers organized to seek new ways to develop and utilize their capabilities.

In 1946 they formed the Japanese Union of Scientists and Engineers (JUSE), an association devoted to promoting the nation's technological development through education, standard setting and the diffusion of information. Influenced by US occupation officials versed in statistical quality control (SQC) techniques that the United States had used for military production during the war, JUSE focused on the application of quality control in an economy based on production for commercial markets. In 1949 JUSE established the Quality Control Research Group (QCRG), which included participants from academia, industry and government.

The following year JUSE sponsored an eight-day seminar on SQC by Dr W. Edwards Deming, a physicist who had been working for the US government developing the sampling methods for SQC (Ishikawa, 1985, p. 16). These techniques were used to monitor mass-produced output for systematic deviations from 'quality' standards as a prelude to controlling (identifying and correcting) quality problems. Deming's lectures were well received, as was the volume of these lectures that JUSE promptly published. The author donated the royalties from the book to JUSE, which in turn used the funds to establish the now-famous Deming Application Prize, awarded annually since 1951 to an industrial company for its achievements in the application of quality control (QC) methods (Nonaka, 1995).

One of the key figures in applying QC methods to Japanese industry was Kaoru Ishikawa, an engineering professor at the University of Tokyo. Starting in 1949, under the auspices of QCRG, Ishikawa began teaching the QC Basic Course to industrial engineers, using translated British and American texts. 'After conducting the first course,' Ishikawa recalled,

> it became clear to us that physics, chemistry, and mathematics are universal and are applicable anywhere in the world. However, in the case of quality control, or in anything that has the term 'control' attached to it, human and social factors are strongly at work. No matter how good the American and British methods may be, they cannot be imported to Japan as they stand. To succeed, we had to create a Japanese method.
>
> (Ishikawa, 1985, 16–17)

Ishikawa, along with others, developed the Japanese method in the 1950s through their direct involvement with Japanese manufacturing companies, particularly in the fledgling automobile industry (Mizuno, 1984; Nonaka 1995, p. 143).

What was different about Japanese conditions that made it necessary to 'create a Japanese method'? And how by the 1970s and 1980s did the Japanese method that was created become the world's most powerful manufacturing approach for setting new standards of high quality and low cost? In particular, how did Japanese manufacturing for mass markets differ from the system that Americans had previously developed in the first half of the twentieth century when US industry established itself as the world's leading mass producer?

The fundamental difference between the Japanese and American organization of mass production was on the shop floor. The American system of mass production that dominated the world economy by the mid-twentieth century was based on the production of long runs of identical units by expensive special-purpose machines tended by 'semi-skilled' operatives (Hounshell, 1984). The transformation of the high fixed costs of these mass production technologies into low unit costs of final products required the cooperation of these shop-floor workers in the repetitive performance of narrow manual functions needed to maintain the flow of work-in-progress through the interlinked mechanical system.

The American machine operatives themselves were not involved in either monitoring the quality of work-in-progress or searching for solutions to quality problems in the manufacturing process. By design, they were excluded from the process of organizational learning that generated the American system of mass production (Lazonick, 1990, chs 7–9). Reflecting the American practice of confining organizational learning to the managerial structure, and developing technologies that displaced the need for skill on the shop floor, quality control evolved in the United States as a strictly managerial function.

Leading American mass producers were willing and able to provide greater employment security and higher wages to shop-floor workers to ensure their cooperation in keeping pace with the expensive high-speed, special-purpose machinery. These companies, that is, established incentives to gain the cooperation of operatives in the *utilization* of technology. But the managers of these companies were unwilling to grant these operatives any role in the development of technology. Rather they confined such organizational learning to the managerial structure. Indeed, in the American companies considerable managerial learning was devoted to organizing work and developing mass production technologies (Lazonick, 1990, chs 7–10; Lazonick, 1992, pt two).

In the post-World War II Japanese automobile industry, companies like Toyota and Nissan did not have the luxury of long runs. Reflecting Japan's low level of GDP per capita, in 1950 the entire Japanese automobile industry produced 31 597 vehicles, which was about the volume that US companies produced in one and a half days (Cusumano, 1985, pp. 75, 266). In that year, Nissan accounted for 39 percent of production and Toyota 37 percent, while for the industry as a whole 84 percent of the vehicles produced were trucks (ibid., p. 75). As production increased over the course of the 1950s, with cars becoming a larger proportion of the total, Nissan or Toyota had to produce an increasing variety of vehicles to survive. In responding to these demand-side conditions, therefore, these companies had no possibility of achieving low unit costs by simply adopting American mass production methods.

On the supply side, over the course of the twentieth century Japanese industry had developed capabilities that could now enable companies like Toyota and Nissan to develop and utilize technology in a profoundly different way. These companies could draw on a sizable supply of highly educated and experienced engineers. Many Toyota employees, for example, had accumulated relevant technological experience over the previous decades working for the enterprise group when it was Japan's leading producer of textile machinery (Mass and Robertson, 1996). In addition, the automobile industry was able to attract many engineers who had gained experience in Japan's aircraft industry before and during the war (Wada, 1995).

Before the war, moreover, many Japanese companies had integrated foremen into the structure of managerial learning so that they could not only supervise but also train workers on the shop floor. Whereas in the United States, the foreman, as 'the man in the middle,' served as a buffer between the managerial organization and the shop floor, in Japan the foreman was an integrator of managerial and shop-floor learning. From the late nineteenth century, a prime objective of US managerial learning had been to develop machine technologies that could dispense with the skills of craft workers on the shop floor. In contrast, with an accumulation of such craft skills lacking in Japan, the problem that had confronted technology-oriented managers from the Meiji era had been to develop skills on the shop floor as part of a coordinated strategy of organizational learning.

The rise of enterprise unions in the early 1950s both reflected and enhanced the social foundations for this hierarchical integration. During the last half of the 1940s, dire economic conditions and democratization initiatives gave rise to a militant labor movement of white-collar (technical and administrative) and blue-collar (operative) employees. The goal of the new industrial unions was to implement 'production control': the takeover of idle factories so that workers could put them into operation and earn a living (Moore, 1983; Gordon, 1985, p. 343; Hiwatari, 1996). As an alternative to the 'production control' strategy of militant unions, leading companies created enterprise unions of white-collar and blue-collar employees. In 1950, under economic conditions deliberately rendered more severe by the Occupation's anti-inflationary 'Dodge line,' companies such as Toyota, Toshiba and Hitachi fired militant workers and offered enterprise unionism to the remaining employees. The post-Korean War recession of 1953 created another opportunity for more companies to expel the militants and introduce enterprise unionism. The continued and rapid expansion of the Japanese economy in the 'high-growth era' ensured that enterprise unionism would become an entrenched Japanese institution (Gordon, 1985, ch. 10; Cusumano, 1985; Halberstam, 1986, pt 3; Hiwatari, 1996).

The prime achievement of enterprise unionism was 'lifetime employment,' a system that gave white-collar and blue-collar workers employment security to the retirement age of 55 or 60. Foremen and supervisors were members of the union, as were all university-educated personnel for at least the first ten years of employment before they made the official transition into 'management.' Union officials, who were company employees, held regularly scheduled conferences with management at different levels of the enterprise to resolve issues concerning remuneration, work conditions, work organization, transfers and production (Shimokawa, 1994, ch. 3; Nakamura, 1997).

These institutional conditions supported the integration of shop-floor workers into a company-wide process of organizational learning. Top managers had ultimate control over strategic investments, and technical specialists designed products and processes, typically on the basis of technology borrowed from abroad. But, given these managerial capabilities, the unique ability of Japanese companies to transform borrowed technology to generate new standards of quality and cost depended on the integration of shop-floor workers into the process of organizational learning.

Through their engagement in processes of cost reduction, Japanese shop-floor workers were continuously involved in a more general process of improvement of products and processes that, by the 1970s, enabled Japanese companies to emerge as world leaders in factory automation. This productive transformation became particularly important in international competition in the 1980s as Japanese wages approached the levels of the advanced industrial economies of North America and Western Europe. During the 1980s and 1990s, influenced as well by the impact of Japanese direct investment in North America and Western Europe, many Western companies have been trying, with varying degrees of success, to implement Japanese high-quality, low-cost mass production methods.

Especially since the 1980s a huge English-language literature has emerged on Japanese manufacturing methods, much of it written by industrial engineers with considerable experience as employees of, or consultants to, manufacturing companies in Japan and the West. In addition, there is a growing body of academic research on the subject, although it tends to focus more on functional integration than on hierarchical integration. My purpose here is to summarize this body of evidence to make the case that, in comparison with the once-dominant American mass producers, a fundamental source of Japanese manufacturing success has been the hierarchical integration of shop-floor workers in the process of organizational learning. I shall also indicate how, within Japanese companies, hierarchical integration contributed to the generation of higher-quality, lower-cost products as part of a process of organizational learning that included integration across specialized functions.

In a comprehensive account of Japan's manufacturing challenge, Kiyoshi Suzaki (1987), a former engineer at Toshiba who then turned to consulting in the United States, contrasts the operational and organizational characteristics of a 'conventional' (traditional American) company and a 'progressive' (innovative Japanese) company in the use of men, materials and machines in the production process (see Table 3.1).

In the generation of higher-quality, lower-cost products, the integration of Japanese shop-floor workers into the process of organizational learning contributed to (a) the more complete utilization of machines, (b) superior utilization of materials, (c) improvements in product quality, and (d) factory automation. In summarizing the ways in which hierarchical integration contributed to these innovative outcomes in Japan,

Table 3.1 Operational and organizational characteristics of American and Japanese manufacturing

	American company	*Japanese company*
Operational characteristic		
Lot size	Large	Small
Setup time	Long	Short
Machine trouble	High	Low
Inventory	Large	Small
Floor space	Large	Small
Transportation	Long	Short
Lead time	Long	Short
Defect Rate	High	Low
Organizational characteristic		
Structure	Rigid	Flexible
Orientation	Local optimization	Total optimization
Communication	Long chain of command	Open
Agreement	Contract-based	Institution-based
Union focus	Job-based	Company-based
Skill base	Narrow	Broad
Education/training	Low quality	High quality
Training	Insignificant	Significant
Supplier relations	Short-term/many competitors	Long-term/selected few

Source: Adapted from Suzaki (1987), p. 233.

I shall indicate how and why Japanese practice differed from the hierarchical segmentation of shop-floor workers that was, and still largely remains, the norm in American manufacturing.

Utilization of machines

In the decade after the war, the Japanese pioneered in cellular manufacturing – the placement of a series of vertically related machines in a U-shape so that a worker, or team of workers, can operate different kinds of machines to produce a completed unit of output. Used particularly for the production of components, cellular manufacturing requires that workers perform a variety of tasks, and hence that they be multi-skilled.

The Japanese system differed from the linear production system used in the United States in which shop-floor workers specialized in particular tasks, passing the semi-finished unit from one specialized worker to the next. Historically, this fragmented division of labor resulted from the successful strategy of American managers in the late nineteenth century to develop and utilize mechanized technologies that could overcome their dependence on craft contractors who had previously controlled the organization of work (Montgomery, 1987). To better supervise the 'semi-skilled' workers who operated the new mechanized technologies, American managers then sought to confine adversarial shop-floor workers to narrow tasks. After the rise of industrial unionism in the 1930s, shop-floor workers used these narrow job definitions as a foundation for wage-setting, thus institutionalizing this form of job control in collective bargaining arrangements.

The prevalence of adversarial bargaining and job control only served to increase the resolve of most US corporate managers to keep skill and initiative off the shop floor in the decades after World War II. Meanwhile, developing and utilizing the capabilities of the multi-skilled shop-floor worker in a myriad of ways, Japanese companies created new standards of quality and cost. This continuous improvement, which the Japanese called kaizen (Imai 1986), enabled Japanese companies to outcompete the Americans, even in their own home markets, even as Japanese wages rose and the yen strengthened in the 1980s and 1990s.

With the need to use mass production equipment to produce a variety of products in the 1950s, Japanese companies placed considerable emphasis on reducing setup times. Long setups meant excessive downtime, which meant lost output. Once set in motion, the search for improvements often continued over years and even decades. For example, in 1945 the setup time for a 1000-ton press at Toyota was four hours; by 1971 it was down to three minutes. A ring-gear cutter at Mazda that took more than six hours to set up in 1976 could be set up in ten minutes four years later (Suzaki, 1987, p. 43).

By the 1980s the extent of the market that Japanese manufacturers had captured meant that small-batch production was no longer the necessity it had been 30 years earlier. But the ability of these companies to do what the Japanese call 'single-digit' (under ten minutes) setups enabled them to use the same production facilities to produce a wide variety of customized products. Single-digit setups had become a powerful source of international competitive advantage.

The reduction of setup times involved the redesign of fixtures, the standardization of components and the reorganization of work. Shop-floor workers had to be willing and able to perform as much of the setup operations as possible for the next product batch while machines were producing the current product batch. The reorganization of work needed to reduce setups represented another productive activity that could take advantage of the incentive and ability of Japanese shop-floor workers to engage in a variety of tasks. The broader knowledge of the production process that these workers possessed was in turn used to find new ways to reduce setup times.

In the United States, in contrast, the problem of reducing setup times was neglected in part because of long runs and in part because of the unwillingness of American management to invest in shop-floor skills. In Japan a dynamic learning process was set in motion in which the learning of shop-floor workers was critical. In the United States, hierarchical segmentation meant that, when the production of long runs of identical output was no longer a viable competitive strategy, corporations had not developed the skill bases required for reducing setup times.

If shop-floor skills can prevent downtime through quick setups, they can do so as well through machine maintenance. Keeping machines trouble free requires the involvement of shop-floor workers in continuous inspection and daily maintenance as well as engineers to solve chronic problems and to train the shop-floor operatives. As Suzaki (1987, p. 123) has put it,

> zero machine troubles can be achieved more effectively by involving operators in maintaining normal machine operating conditions, detecting abnormal machine conditions as early as possible, and developing countermeasures to regain normal machine conditions. This requires development of a close working relationship among operators, maintenance crews, and other support people as well as skill development and training to increase the abilities of those involved.

In American mass production, shop-floor workers have not only lacked the skills to maintain machines. They have also been denied the right to maintain machines by managers who feared that, far from reducing downtime by keeping machines trouble free, such shop-floor intervention would be used to slow the pace of work. Indeed, one role of first-line supervisors employed on American mass production lines has typically been to ensure that production workers do not interfere with machine operations on the assumption that such intervention will make the machines more trouble prone.

Cellular manufacturing, quick setups and machine maintenance all contribute to higher levels of machine utilization and lower unit costs. But ultimately unit costs are dependent on how quickly products can be transformed from purchased inputs into salable outputs. That is, unit costs depend on cycle time.

As Jeffrey Funk (1992, p. 197) described it on the basis of his experience working at Mitsubishi Electric Corporation for a year: 'The reductions in cycle time were achieved through numerous engineer and operator activities.' The engineers were primarily responsible for making system-wide improvements concerned with identifying and resolving production bottlenecks, and with developing 'product families' of different types of chips that undergo the same processes, thus reducing setup times and eliminating mistakes. The operators were primarily responsible for identifying possibilities for localized improvements on the wafer and assembly lines. Each operator was in a working group that met once or twice a month, through which they made numerous suggestions for improvements, a high proportion of which were acted upon by engineers. Operators responsible for wafer furnaces contributed, for example, to improvements in the delivery, queuing and loading systems, all of which reduced cycle time. At Mitsubishi Electric between 1985 and 1989, cycle time for semiconductor chips was reduced from 72 days to 33 days, even as the number of chip styles more than doubled to 700 and the number of package types assembled increased from 20 to 70.

A comparison of the Mitsubishi wafer department with a US factory using similar equipment found that the Japanese factory produced four times the number of wafers per direct worker, employed fewer support workers per direct worker, had a higher ratio of output to input in the wafer process, and had a cycle time that was one-fourth of that achieved by the US factory. 'These improvements,' according to Funk (1992, pp. 198–204),

> lead to shorter cycle time, higher yields, less wafer breakage, and higher production of wafers per direct worker. The multifunctional workers enable Mitsubishi to have fewer support staff. Since the direct workers perform many of the activities typically performed by support staff in a US factory, the direct workers can determine which activities are most important and how to improve the efficiency of these activities.

Utilization of materials

Perhaps the most famous Japanese management practice to emerge out of the 'high-growth era' was the just-in-time inventory system (JIT). By delivering components to be assembled as they are needed, the carrying costs and storage costs of work-in-progress can be dramatically reduced. But JIT only works if the parts that are delivered just in time are of consistently high quality. JIT only yields lower unit costs when component suppliers, be they in-house or external subcontractors, have the incentive and ability to deliver such high-quality parts. It was to ensure the timely delivery of such high-quality components, for example, that in 1949 and 1950 the first step taken by Taichi Ohno in developing JIT at Toyota was to reorganize the machine shop into manufacturing cells that required multi-skilled operatives (Wada, 1995, p. 22).

In the Japanese assembly process, JIT demands high levels of initiative and skill from production workers. Using the *kanban* system, it is up to assembly workers to send empty containers with the order cards – or *kanban* – to the upstream component supplier to generate a flow of parts. The assembly worker, therefore, exercises considerable minute-to-minute control over the flow of work – a delegation of authority that American factory managers deemed to be out of the question in the post-World War II decades on the assumption that shop-floor workers would use such control to slow the speed of the line. To prevent a purported shortage of components from 'creating' a bottleneck in the production process, American managers kept large buffers of in-process inventory along the line.

The Japanese assembly worker also has the right to stop the line when, because of part defects, machine breakdowns, or human incapacity, the flow of work cannot be maintained without sacrificing product quality. When a problem is discovered and a worker stops the line, a light goes on to indicate its location and others in the plant join the worker who stopped the line in finding a solution to the problem as quickly as possible. To participate in this process, therefore, shop-floor workers must develop the skills to identify problems that warrant a line stoppage, and they must contribute to fixing the problem. Without hierarchical integration, JIT and *kanban* cannot work (Urabe, 1988).

Product quality

The willingness of Japanese companies to develop the skills of shop-floor workers led to a very different mode of implementing quality control in Japan than in the United States. Statistical quality control (SQC), as already mentioned, originated in the United States. In American manufacturing, however, SQC remained solely a function of management, with quality-control specialists inspecting finished products after they came off the line. Defective products had to be scrapped or reworked, often at considerable expense. Defects that could not be detected because they were built into the product would ultimately reveal themselves to customers in the form of unreliable performance, again at considerable expense to the manufacturing company, especially when higher-quality competitors came on the market.

For American companies, from the 1970s the higher-quality competitors were typically the Japanese. In Japan, the integration of shop-floor workers into the process of organizational learning meant that product quality could be monitored while work was in progress in the production process, and thus that defects could be detected and corrected before they became built into the finished product. The result was less scrap, less rework, and more revenues from satisfied customers.

In the 1950s American managers could justify the exclusion of shop-floor workers from participation in quality control on the grounds that the SQC methods in use were too complicated for the blue-collar worker. Only more highly educated employees were deemed capable of applying these tools. Given the quality of education received by young Americans destined to be 'semi-skilled' factory operatives, the managers of US companies had a point. With mass education being controlled and funded by local school districts, most future blue-collar workers received schooling of a quality that was consistent with the minimal intellectual requirements of repetitive and monotonous factory jobs. This correspondence between schooling and prospective skill requirements in hierarchically segmented workplaces helps to explain why to this day the United States ranks among the lowest of the advanced economies in terms of the quality of mass education and among the highest in terms of the quality of higher education.

In Japan, even in the 1950s, blue-collar workers with manufacturing companies were high-school graduates. But as part of a national system of education of uniformly high standards, they received much the same quality education as those who would go on to university. Even then, the involvement of Japanese shop-floor workers in SQC was accomplished by making the methods more easily accessible to, and usable by, blue-collar workers. As Kaoru Ishikawa (1985, p. 18), the pioneer in the implementation of SQC in Japan, put it: 'We overeducated people by giving them sophisticated methods where, at that stage, simple methods would have sufficed.'

The reliance of Japanese companies on the skill and initiative of shop-floor workers for superior machine utilization and reductions in materials costs made these employees ideal monitors of product quality. Relying on this skill base, SQC became integral to the Japanese practice of building quality into the product rather than, as in the United States, using SQC to inspect completed products that had defects built in.

In the 1960s the involvement of shop-floor workers in improving machine utilization, materials costs and product quality became institutionalized in quality control (QC) circles. In addition to initiatives undertaken by individual companies to apply QC methods in particular factories, a series of radio broadcasts by JUSE in the late 1950s had diffused an awareness of the potential of quality control. Then, in 1960, JUSE put out a publication, *A Text on Quality Control for the Foreman,* that became widely used by first-line supervisors in the workplace (Ishikawa, 1985, p. 21). The success of this publication led to a monthly magazine, *Quality Control for the Foreman (FQC).* In the process of gathering information for the magazine, JUSE found that, in many factories, foremen and workers had formed themselves into small groups to discuss quality control and its application to specific problems. The editorial board of *FQC* (of which Ishikawa was the chairman), in issuing the following statement, effectively launched the QC circle movement:

1. Make the content [of *FQC*] easy for everyone to understand. Our task is to educate, train, and promote QC among supervisors and workers in the forefront of our work force. We want to help them enhance their ability to manage and to improve.
2. Set the price low to ensure that the journal will be within the reach of everyone. We want as many foremen and line workers as possible to read it and benefit from it.
3. At shops and other workplaces, groups are to be organized with foremen as their leaders and include other workers as their members. These groups are to be named QC circles. QC circles are to use this journal as the text in their study and must endeavor to solve problems that they have at their place of work. QC circles are to become the core of quality control activities in their respective shops and workplaces. (Ishikawa, 1985, p. 138)

QC circles could be registered with, and announced in, *FQC*. Beginning in 1963, a national QC circle organization was created, complete with central headquarters, nine regional chapters, conferences, seminars and overseas study teams. Twenty years later there were almost 175 000 QC circles registered, with nearly 1.5 million members (Ishikawa, 1985, pp. 138–9; Nonaka, 1995).

QC circles became extremely effective in generating continuous improvements in the quality and cost of Japanese manufactured products. In participating in the continuous improvement of these production systems, shop-floor workers did not solve problems in isolation from the rest of the organization but rather as part of a broader and deeper process of organizational learning that integrated the work of engineers and operatives. The foreman as team leader served as the conduit of information up and down the hierarchical structure.

The QC circle movement, led by JUSE, helped to diffuse throughout Japanese industry the organizational and technological advances made at the leading companies. For example, in the mid-1960s there were frequent breakdowns of a newly installed automatic metal-plating machine in the assembly division of Toyota's Motomachi Plant. The relevant QC circle systematically considered possible causes, and through testing came up with solutions. In reporting the work of this QC circle, *FQC* stated:

> The supervisor may understand the design of the machine and how to run it, but is probably unaware of its detailed tendencies or weaknesses. The people who know best about the condition of the machine are the workers, and quality circles provide an opportunity to get important information from them.
>
> (Quoted in Nonaka, 1995, p. 154)

In solving problems in machine utilization, QC circles found that the solutions invariably entailed improvements in product quality as well. As Izumi Nonaka (1995, p. 151) has put it in his account of the history of quality control at Toyota and Nissan:

> Toyota production methods, such as just-in-time, kanban, and jidoka (automation) are well known, but it should be stressed that, in relation to quality control, if 100 percent of the parts reaching a given process are not defect free, Toyota methods will not work smoothly. In other words, quality is the foundation of Toyota production methods. From about 1963, just-in-time and jidoka were adopted in all Toyota factories, and a close relationship between these methods and quality was immediately established.

The QC circle movement focused Japanese workers on the goal of achieving 'zero defects' – detecting and eliminating defects as the product was being built rather than permit defects to be built into the product. In recounting why an incipient zero defect (ZD) movement (initiated by the US Department of Defense for its contractors) failed in the United States in the mid-1960s, Ishikawa put the blame squarely on the failure of American companies to integrate shop-floor workers into the process, as was being done in Japan. ‘The ZD movement became a mere movement of will,’ Ishikawa (1985, pp. 151–2) observed, ‘a movement without tools … It decreed that good products would follow if operation standards were closely followed.’ In the Japanese quality control movement, however, it was recognized that ‘operation standards are never perfect.'

> What operations standards lack, experience covers. In our QC circles we insist that the circle examine all operation standards, observe how they work, and amend them. The circle follows the new standards, examines them again, and repeats the process of amendment, observance, etc. As this process is repeated there will be an improvement in technology itself.

Not so, however, in the United States, where management practice ‘has been strongly influenced by the so-called Taylor method.’ In the United States, according to Ishikawa (1985, pp. 151–2),

> engineers create work standards and specifications. Workers merely follow. The trouble with this approach is that the workers are regarded as machines. Their humanity is ignored. [Yet] all responsibilities for mistakes and defects were borne by the workers … No wonder the [ZD] movement went astray.

In the late 1960s and early 1970s, on the eve of the Japanese challenge to US manufacturing, many American industrial managers began to worry not so much about the quality of the products they were generating as about the quality of shop-floor work itself. The alienated worker was fingered as the source of lagging productivity (US Department of Health, Education, and Welfare, 1972; Walton 1979). During the first half of the 1960s, the annual average rate of increase of manufacturing productivity in the United States had been 5.1 percent while that of manufacturing wages had been 3.9 percent. But in the second half of the 1960s, when the annual rate of increase of manufacturing productivity averaged a mere 0.6 percent, manufacturing wages rose at a rate of 5.9 percent (Lazonick, 1990, pp. 280–84). Amidst an escalation of absenteeism and unauthorized work stoppages, the productivity problem sparked a search among US manufacturing companies for new structures of work organization that would secure the cooperation of shop-floor workers in realigning the relation between work and pay.

Within the automobile industry, the United AutoWorkers joined corporate management on a National Joint Committee to Improve the Quality of Worklife. The problem was to convince workers that programs of 'job enrichment' and 'job enlargement' were not merely new ways to speed up production and reduce employment. Unfortunately, during the 1970s, even many promising experiments at work reorganization that had already yielded significant productivity gains were cut short when middle managers and first-line supervisors realized that the ultimate success of the programs entailed a loss of their power in the traditional hierarchically segmented organization (Walton, 1975; Zimbalist, 1975; Marglin, 1979). Indeed, in general, the more pervasive response to the productivity problem in American manufacturing in the 1970s was an increase in shop-floor supervision rather than the transformation of work organization. From 1950 to 1970, the number of foremen per 100 workers in American manufacturing increased from 3.4 to 4.8; by 1980 this ratio had shot up to 8.0 (Lichtenstein, 1989, p. 166).

During the 1980s, in the face of intense and growing competition from the Japanese, many companies throughout the United States sought to introduce Japanese-style 'quality programs' into their workplaces. In their comprehensive survey of available case studies of these 'experiments in workplace innovation,' Eileen Appelbaum and Rose Batt (1994, p. 10) found that 'US companies have largely implemented innovations on a piecemeal basis and that most experiments do not add up to a coherent alternative to [traditional US] mass production.' They contended that

> quality circles and other parallel structures [of work reorganization] were a 'fad' in the early 1980s and have since been discredited in most US applications as either not sustainable or providing limited results … The overwhelming majority of cases show that firms have introduced modest changes in work organization, human resource practices, or industrial relations – parallel structures such as quality circles involving only a few employees, a training program, or a new compensation system. We consider these to be marginal changes because they do not change the work system or power structure in a fundamental way.
>
> (Appelbaum and Batt, 1994, p. 10; see also Kochan et al., 1984; Lawler et al., 1989; Cole, 1989)

The fundamental problem, I would argue, was lack of resolve by those who governed these corporations to effect the organizational integration of 'hourly' shop-floor workers and 'salaried' managerial employees. What is more, it appears that hierarchical segmentation in US industrial enterprises fostered functional segmentation. Distant from the realities of problem-solving in the actual production process, US technical specialists sought to solve problems by using the tools of their own particular disciplines, putting up barriers to communicating even with other specialists within the managerial organization, and throwing partially solved problems 'over the wall' into the domains of other functional specialists.[1] In Japan, by contrast, the hierarchical integration of technical specialists in a learning process with production workers created lines of communication and incentives to solve problems in concert with other specialists. Relative to their competitors in the United States, the result of functional integration for Japanese manufacturers has been not only superior product quality but also more rapid new product development.

The different ways in which quality control systems were implemented in Japan and the United States is a case in point. In Japan, QC was embedded in the whole structure of organizational learning. In Japan quality control is, as Nonaka (1995) has put it, 'the responsibility of all employees, including top and middle management as well as lower-level workers, from planning and design, to production, marketing, and sales … [in] contrast with the American reliance on specialist quality control inspectors.' Ishikawa (1985, p. 23) has emphasized the functional segmentation of American QC inspectors:

> In the United States and Western Europe, great emphasis is placed on professionalism and specialization. Matters relating to QC therefore become the exclusive preserve of QC specialists. When questions are raised concerning QC, people belonging to other divisions will not answer, they will simply refer the questions to those who handle QC.
>
> In Western countries, when a QC specialist enters a company, he is immediately put in the QC division. Eventually he becomes head of a subsection, a section, then of the QC division. This system is effective in nurturing a specialist, but from the point of view of the entire business organization, is more likely to produce a person of very limited vision.
>
> For better or for worse, in Japan little emphasis is placed on professionalism. When an engineer enters a company, he is rotated

among different divisions, such as design, manufacturing, and QC. At times, some engineers are even placed in the marketing division.

Factory automation

In the late 1970s, American manufacturers continued to attribute the mounting Japanese challenge to low wages and the persistent productivity problem at home to worker alienation. By the 1980s and 1990s, however, the innovative reality of the Japanese challenge became difficult to ignore, as the Japanese increased their shares of US markets across a range of key industries, even as Japanese wage rates rapidly rose and the yen steadily strengthened.

Even then, there appeared to be a way out for US manufacturers that did not require imitation of the Japanese by building broader and deeper skill bases. Since the 1950s American management had envisioned 'the Factory of the Future' – a completely automated production facility that would do away with the need to employ production workers altogether (Noble, 1984, ch. 4). Yet, notwithstanding massive investments by US corporations and the US government in factory automation, attempts by American companies to create the 'factory of the future' failed (Noble, 1984; Thomas, 1994).

In sharp contrast, building on their investments in broad and deep skill bases, and decades of continuous improvement of production processes, Japanese companies succeeded. At the end of 1992, the Japanese had installed about 349 500 robots compared to 47 000 in the United States and 39 400 in Germany (Tsuneta Yano Memorial Society 1993, p. 191). The Japanese also developed and utilized flexible manufacturing systems (FMS) – computer-controlled configurations of semi-independent work stations connected by automated material handling systems – in advance of, and on a scale that surpassed, other nations (Jaikumar, 1989). Japan's success in machine tools and factory automation reflected their leadership in the integration of mechanical and electronics technologies, or what since the mid-1970s the Japanese have called 'mechatronics' (Hunt, 1988; Kodama, 1995, p. 193).

For example, in his case study of the introduction of FMS at Hitachi Seiki, Ramchandran Jaikumar (1989, p. 126) found that the first two attempts, undertaken between 1972 and 1980, had failed because of insufficient coordination across functions. In 1980, therefore, the company set up the Engineering Administration Department that 'brought together a variety of different functions from machine design, software engineering, and tool design.' The new structure of organizational learning, which built on the lessons of the previous failures, led to success. The development teams on the two failed attempts had, according to Jaikumar (1989, p. 126),

> integrated the different components of their systems through machinery design rather than through general systems engineering concepts. They had viewed flexible manufacturing systems as technical problems to be solved with technical expertise. The difficulty of evaluating trade-offs whenever conflicts arose over design specifications or procedures convinced Hitachi Seiki that it was problems of coordination among people that was stymying systems development. The company realized that what was needed was to view FMS as a manufacturing problem to be solved with both manufacturing and technical expertise. Consequently the third phase of FMS development at Hitachi Seiki was a radical departure from the previous two.

In his comparisons of Japanese and US FMS in the first half of the 1980s, Jaikumar found that, even though the FMS installations in both countries contained similar machines doing similar kinds of work, the Japanese developed the systems in half the time, produced over nine times as many parts per system in average annual volumes that were about one-seventh of American practice, with much greater automation and utilization rates. 'Differences in results,' said Jaikumar (1989, p. 129), 'derive mainly from the extent of the installed base of machinery, the technical literacy of the work force, and the competence of management. In each of these areas, Japan is far ahead of the United States.'

More specifically, he described how the Japanese developed the reliability of FMS to achieve untended (automated) operations and system uptime levels of over 90 percent, in the process transforming not only shop-floor technology but also the job of a 'shop-floor operator.'

> The entire project team remains with the system long after installation, continually making changes. Learning occurs throughout and is translated into on-going process mastery and productivity enhancement … Operators on the shop floor, highly skilled engineers with multifunctional responsibilities, make continual programming changes and are responsible for writing new programs for both parts and systems as a whole. Like designers, they work best in small teams. Most important, Japanese managers see FMS technology for what it is – flexible – and create operating objectives and

> protocols that capitalize on this special capability. Not bound by outdated mass-production assumptions, they view the challenge of flexible manufacturing as automating a job shop, not simply making a transfer line flexible. The difference in results is enormous. (Jaikumar 1989, p. 130)

Central to factory automation have been teams of highly educated and highly trained engineers who had mastered their technical specialties but who were also able and willing to integrate across electronic, mechanical and chemical specialties. As stated earlier, that the Japanese could even consider entry into complex manufacturing industries such as automobiles and consumer electronics after World War II was due to the learning that their scientists and engineers had accumulated in the decades before as well as during the war. But the Japanese history of the hierarchical integration of traditional blue-collar workers into the development and utilization of manufacturing technology laid the basis for functional integration as technology became more and more complex.

The accumulated learning of Japan's scientists and engineers after the war was in and of itself no match for that which the Americans possessed. Yet, during the postwar decades Japanese scientists and engineers developed and utilized their collective capabilities in manufacturing as part of an organizational learning process that integrated the capabilities of shop-floor workers in making continuous improvements to the manufacturing process. In the 1980s and 1990s this history of hierarchical integration played a significant role in fostering the functional integration that has been key to Japan's success relative to the United States in factory automation.

The importance of taking organizational learning to the shop floor also applies in the semiconductor industry, the most complex and automated of manufacturing processes. As Daniel Okimoto and Yoshio Nishi (1994, p. 193) argue in their excellent comparative study of Japanese and US semiconductor manufacturing:

> Perhaps the most striking feature of Japanese R&D in the semiconductor industry is the extraordinary degree of communication and 'body contact' that takes place at the various juncture and intersection points in the R&D processes – from basic research to advanced development, from advanced development to new product design, from new product design to new process technology, from new

> process technology to factory-site manufacturing, from manufacturing to marketing, and from marketing to servicing. Owing to pragmatic organizational innovations, Japanese semiconductor manufacturers have excelled – where many American and European manufacturers have faltered – at the seemingly simple but extremely difficult task of making smooth 'hand-offs' at each juncture along the long-interconnected R&D pipeline.

The key links in this pipeline in Japanese semiconductor R&D are between divisional labs and factory engineering labs. Engineers from these labs, according to Okimoto and Nishi (1994, p. 195), 'continually meet and interact in seeking to iron out problems that inevitably arise in mass-manufacturing new products.' Okimoto and Nishi continue, stressing the importance of the integration of R&D with manufacturing:

> The largest concentration [of engineers] is usually found at the FELs [factory engineering laboratories], located at factory sites where the messy problems of mass production have to be worked out. The majority of Japanese engineers have at least some exposure to manufacturing engineering as part of their job rotation and career training. Not only is there no stigma attached to manufacturing assignments; the ladder of promotion leading up to higher reaches of executive management – and beyond (including amakudari, or post-career executive entry into new companies) – pass through jobs that involve hands-on manufacturing experience. It is almost a requirement for upward career and post-career mobility.
>
> In the United States, by contrast, manufacturing engineers carry the stigma of being second-class citizens. To the manufacturing engineers falls the 'grubby' work of production – for which they receive lower pay and lower prestige compared with the 'glamorous' design jobs. In how many US semiconductor companies can it be said that the majority of engineers are engaged in manufacturing? Few, if any. And, looking at the large number of merchant semiconductor houses in Silicon Valley, we see that only a minority even possess manufacturing facilities, much less factory engineering laboratories.
>
> (Okimoto and Nishi, 1994)

It would appear more generally that, by focusing the skills and efforts of engineers on continuous improvements in quality and cost in the production process, hierarchical integration provided a foundation for functional integration in Japanese manufacturing. If, in the first half of the 1980s, most Western analyses of the sources of Japanese competitive advantage focused on the integration of the shop-floor worker into the organizational learning process, over the last decade or so the emphasis has shifted to the role of 'cross-functional management,' 'company-wide quality control,' or 'concurrent engineering' in generating higher-quality, lower-cost products. Much of the discussion of functional integration has been focused on its role in 'new product development' in international comparative perspective (Clark and Fujimoto, 1991; Nonaka and Takeuchi, 1995). But, I would argue, the key to understanding the influence of functional integration on innovation and international competitive advantage is the integration of product and process development, and the skill-base strategy that such integration entails. Such an understanding of organizational integration requires an analysis of functional integration in relation to the legacy of hierarchical integration or segmentation.

A research agenda

If valid, the skill-base hypothesis can reconcile the facts that many US industrial enterprises still remain innovators in international competition even though income inequality has become worse in the United States. A systematic bias of US industrial corporations to compete for product markets by investing in narrow and concentrated skill bases could provide a significant explanation for the income inequality trends over the last two decades or so. Testing the skill-base hypothesis may help provide answers to a number of related questions concerning the ways in which, in particular industries and activities, US industrial corporations have responded to international competitive challenges.

- To what extent have US companies exited from particular industries, and particular activities within a particular industry, in which they have been challenged by enterprises that have invested in broader and deeper skill bases as an alternative to transforming their strategies and structures to make the requisite investments in organizational learning?
- To what extent have the attempts of US companies to respond to these competitive challenges been hampered by their failure to confront and transform sufficiently the strategic, functional and hierarchical segmentation that they have inherited from the past?

- What can we learn about the incentive and ability of US companies to make investments in broader and deeper skill bases by comparing strategy, organization, and performance of different companies in the same industry – for example, Ford, GM and Chrysler in automobiles – that have sought to respond to the same international competitive challenges?
- What has been the importance of foreign direct investment – for example, Japanese 'transplants' in the United States – as distinct from international trade in shaping the responses of US companies to international competitive challenges?
- What has been distinctive about the investment strategies and organizational structures of US companies that have become or remained leaders in international competition in the 1980s and 1990s? Did a historical legacy of investments in broader and deeper skill bases, and a relative absence of organizational segmentation, enable an older company like Motorola or 3M to continue to make such investments in the 1980s and 1990s, thus representing the exceptions that prove the rule in US industry? Have newer companies such as Intel and Microsoft become world leaders through the organizational integration of narrow and concentrated skill bases?

Such questions indicate that testing the skill-base hypothesis and its immediate implications requires in-depth research of particular companies that compete in particular industries in different national economies in different, and typically over prolonged, periods of time. The more limited objective of this paper has been to elaborate the analytical framework for testing the skill-base hypothesis by synthesizing available evidence on differences in organizational learning in industries in which the United States and Japan compete head to head.

What are those industries, and how has competitive advantage been shifting between the United States and Japan? Tables 3.2a–c show the structure of bilateral Japanese–US trade from 1979 to 1995. As useful as these data are as points of departure, they have important limitations for defining the comparative case studies needed to test the skill-base hypothesis. The importance of foreign direct investment, cross-border outsourcing and third-country exports means that trade data provide only a partial picture of shifts in head-to-head competitive advantage. Moreover, as we shall see for example in the case of 'aircraft engines and parts,' hidden within a narrowly defined industrial classification of traded goods may be important international divisions of labor that reflect investments in different types of skill bases.

Table 3.2a Japan–US bilateral merchandise trade, 1979, 1987 and 1995 (in millions of current US dollars)

	1979		1987		1995	
	Exports	*Imports*	*Exports*	*Imports*	*Exports*	*Imports*
Total	26 402.5	20 430.8	83 579.9	31 490.5	120 858.9	75 408.1
Foodstuffs	189.0	4 422.9	404.1	6 778.9	303.4	15 951.4
Raw materials	136.5	6 927.3	167.3	7 039.8	380.9	9 329.1
Light goods	2 200.6	1 660.7	6 465.5	3 037.6	7 979.4	8 745.8
Chemical goods	653.1	2 053.3	2 080.8	4 035.3	4 826.2	7 072.7
Metal goods	3 939.6	481.1	4 101.8	901.0	4 045.1	2 190.4
Machinery	19 008.3	4 310.2	69 493.9	9 075.4	100 182.5	30 515.6
Office machines	679.9	530.1	7 373.7	1 589.9	14 183.7	4 862.5
Electrical machinery	4 393.3	1 349.9	17 050.1	3 008.9	29 384.8	12 746.4
Transportation equip.	10 106.4	985.5	32 050.3	1 854.7	32 023.9	5 987.7
Precision instruments	1 515.9	357.9	4 325.0	620.1	6 545.7	1 844.5
Re-exports, unclassified	275.4	575.3	866.5	622.5	3 141.4	1 603.0

Source: Ministry of International Trade and Industry, *White Paper on International Trade*, Tokyo 1980, 1988, 1996.

Table 3.2b Japan–US trade growth, 1979–95 (1979 = 100)

	Japanese exports to United States			*United States exports to Japan*		
	1979	*1987*	*1995*	*1979*	*1987*	*1995*
TOTAL	100	317	458	100	154	369
Foodstuffs	100	214	161	100	153	361
Raw materials	100	123	279	100	102	135
Light goods	100	294	363	100	183	527
Chemical goods	100	319	739	100	197	344
Metal goods	100	104	103	100	187	455
Machinery	100	366	527	100	211	708
Office machines	100	1085	2086	100	300	917
Electrical machinery	100	388	669	100	223	944
Transportation equip.	100	317	317	100	188	608
Precision instruments	100	285	432	100	173	515
Re-exports, unclassified	100	315	1141	100	108	279

Source: Ministry of International Trade and Industry, *White Paper on International Trade*, Tokyo, 1980, 1988, 1996.

Table 3.2c Proportionate shares of Japan–US bilateral merchandise trade, 1979, 1987 and 1995 (percent of annual bilateral exports)

	Japanese exports to United States			*United States exports to Japan*		
	1979	*1987*	*1995*	*1979*	*1987*	*1995*
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Foodstuffs	0.7	0.5	0.3	21.6	21.5	21.2
Raw materials	0.5	0.2	0.3	33.9	22.4	12.4
Light goods	8.3	7.7	6.6	8.1	9.6	11.6
Chemical goods	2.5	2.5	4.0	10.1	12.8	9.4
Metal goods	14.9	4.9	3.3	2.4	2.9	2.9
Machinery	72.0	83.1	82.9	21.1	28.8	40.5
Office machines	2.6	8.8	11.7	2.6	5.0	6.4
Electrical machinery	16.6	20.4	24.3	6.6	9.6	16.9
Transportation equip.	38.3	38.3	26.5	4.8	5.9	7.9
Precision instruments	5.7	5.2	5.4	1.8	2.0	2.4
Re-exports, unclassified	1.1	1.0	2.6	2.8	2.0	2.1

Source: Ministry of International Trade and Industry, *White Paper on International Trade*, Tokyo, 1980, 1988, 1996.

In 1995 Japan exported $120.9 billion of goods to the United States (27.3 percent of all Japanese exports) and imported $75.4 billion from the United States (22.4 percent of all Japanese imports) for a merchandise trade surplus of $45.5 billion. The United States is by far Japan's foremost trade partner for both exports and imports. Japan's next largest trade partners in 1995 were for exports South Korea (7.1 percent of Japan's total) and for imports China (10.7 percent of the total) (*Nikkei Weekly,* 1997, p. 107).

Of Japan's exports to the United States in 1995, 82.9 percent fell under the broad category of 'machinery.' This category included, among the major classifications, office machines (11.7 percent of all goods exports), electrical machinery (24.3 percent), transportation equipment (26.5 percent, of which automobiles were 18.3 percent and automobile parts 6.5 percent), and precision instruments (5.4 percent) (see Table 3.2c). The remainder of Japanese exports to the United States consisted largely of chemical goods (4.0 percent), metal goods (3.3 percent) and light industrial products (6.6 percent).

What did the United States export to Japan? Machinery accounted for 40.5 percent of US exports, consisting mainly office machines (6.4 percent), electrical machinery (16.9 percent, of which semiconductors and integrated circuits were 7.1 percent), and transportation equipment (7.9 percent). The remainder of US manufactured exports to the United States consisted mainly of an assortment of light products (11.6 percent, including textiles, paper products, records and tapes, and sporting goods) and chemical goods (9.4 percent). But all manufactured goods only accounted for less than two-thirds of US exports to Japan. Over one-third of US exports to Japan in 1995 were either foodstuffs (21.2 percent) or raw materials (12.4 percent). For Japan, foodstuffs and raw materials exports were only 0.6 percent of its total exports to the United States.

Note that, in the 1970s, as the Japanese challenge mounted, the United States was even more reliant than it would be in 1995, in relative terms at least, on exports of foodstuffs and raw materials to Japan. In 1979, 55.5 percent of US exports to Japan took the form of these basic materials. In that year 65 percent of Japan's raw materials imports from the United States were soybeans (5.7 percent of total imports), wood (11.2 percent) and coal (5.0 percent). By 1995 Japan imported a somewhat larger quantity of soybeans (but the proportion of total imports fell to 1.5 percent), and absolutely smaller quantities of wood (4.2 percent) and coal (0.9 percent). Hence over the 16-year period, the relative importance of foodstuffs for US exports to Japan was maintained, while the relative, and in some cases absolute, importance of raw materials declined.

The case of US agriculture is a case in point of the need for in-depth industry-specific analyses of the sources of sustainable competitive advantage. Looking at the trade data, an economist might conclude that the importance of raw materials and foodstuffs in US exports to Japan is simply a matter of very different land–labor ratios in the two nations' factor endowments. But to draw such a conclusion would be to miss the critical importance of collective and cumulative learning on a national scale over the past century in making agriculture the one industrial sector in which the international competitive advantage of the United States is most sustainable. Such a conclusion would neglect a century-long history of organizational learning in agriculture, akin to the managerial revolution that occurred within major US industrial corporations. In the agricultural managerial revolution the US Department of Agriculture created a national system of research and development that diffused new technology to millions of farmers through the state-based activities of land-grant colleges, experiment stations and county agents. Indeed, the legacy of this massive investment in organizational learning is not only productive supremacy in agriculture but also the world's foremost structure of industrial research institutions embedded in the US system of higher education (Ferleger and Lazonick, 1993, 1994).

Note also that the relative importance of machinery exports from Japan increased substantially in the first eight-year period, while the relative importance of US machinery exports increased from 1979 to 1995, with the major gains being made in the late 1980s and early 1990s. The United States made these gains despite the continuing decline of its machine tool industry in the face of relentless Japanese competition. By 1991, compared with the US machine tool industry, the value of Japanese machine tool production was 356 percent and machine tool exports 443 percent (Tsuneta Yano Memorial Society, 1993, p. 199). In the 1990s, the Japanese also successfully challenged the German machine tool manufacturers, surpassing them for the first time in 1992 in the value of production, and in 1993 in the value of exports. Capturing larger and larger shares of export markets through 1996, Japanese companies now completely dominate the mid-range and high-range markets for CNC (computer numerically controlled) machine tools. The low-end markets have been left mainly to Taiwanese companies, and the high-end niches in non-CNC machine tools remain in the hands of the Swiss, Germans and, to a more limited extent, the Americans (Forrant, Chapter 4, this volume).

Between 1987 and 1995 the US gains in machinery were mainly in integrated circuits (up 4.6 percent) and automobiles (up 3.9 percent), these two categories accounting for almost 75 percent of the increase in US machinery exports as a proportion of total exports. Within the category of Japanese transportation equipment exports, in 1985 30.2 percent were automobiles (3 278 724 vehicles) and another 6.2 percent were auto parts; in 1995 these figures were 18.2 percent (2 066 255 vehicles) and 6.6 percent respectively. The decline in Japanese exports reflected the Japanese strategy of foreign direct investment in automobiles, either directly in the United States or in Southeast Asian countries such as Thailand and Indonesia that then exported automobiles or parts to the United States. In 1985 Japanese automobile companies produced 254 000 cars and 107 000 trucks in the United States; in 1995 1 942 000 cars and 414 000 trucks (Nikkei Weekly, 1996, p. 151). In 1987 the leading US industry within the transportation equipment category was aircraft, which represented 5.0 percent of all exports. In 1995 aircraft had declined to 2.6 percent of US exports to Japan, and had been surpassed by automobiles, which in were 4.2 percent of US exports (294 874 vehicles), up from only 0.3 percent (88 395 vehicles) in 1987.

It was mainly Japanese companies operating in the United States that were doing the exporting. Of just over 100 000 automobiles exported from the United States to Japan in 1994, 53 500 were from Honda USA and another 11 300 from Toyota USA. Only about 35 percent of the exports came from GM, Ford, and Chrysler (some of whose cars were produced through joint ventures with Japanese companies). The total number of cars exported to Japan by the three US automakers was less than the number exported by Volkswagen/Audi and only about 60 percent of the combined sales of BMW and Mercedes-Benz in Japan. Each of the US companies was also outsold in Japan by Rover, Opel (owned by GM), and Volvo (Nikkei Weekly, 1996, pp. 101, 103).

The United States and Japan almost balance trade within the classification 'aircraft engines and parts' (Almeida, Chapter 5, this volume). Increasingly parts dominate the trade in aircraft engines, especially from Japan to the United States. The ability to integrate innovation in advanced materials with precision engineering has been key to Japan's growing success. Building on pioneering investments in the development of polyacryonitric carbon fiber by Toray Industries in the 1970s, three Japanese synthetic fiber producers now dominate 60 percent of the world market (Nikkei Weekly, 1997, p. 210; Suzuki, 1994; Kodama, 1995, pp. 59–60). Finding a market at first as a light and durable material for sports equipment such as tennis rackets and golf clubs, in the 1980s Japanese-made carbon fiber became a primary composite material used in both aircraft and engines. For example, Ishikawajima-Harima Heavy Industries – one of the three major Japanese companies involved in jet engine manufacture – currently produces carbon fiber blades for jet engines made by General Electric (Glain, 1997). Japan's competitive advantage in producing such parts that combine advances in chemical and mechanical engineering would seem to derive from its investments in broad and deep skill bases.

Organizational integration also appears important in explaining trade in semiconductors. In 1995, Japanese exports of integrated circuits accounted for 6.2 percent of all Japanese exports to the United States (up from 1.4 percent in 1987), and hence represented one-quarter of 1995 electrical machinery exports. This bilateral trade in integrated circuits reflects US specialization in microprocessors and Japanese specialization in dynamic random access memories (DRAMs) – an international division of labor built on investments in different skill bases in the two nations. Describing the 'lagged parallel model' of new product development, pioneered at Toshiba and subsequently diffused to other Japanese enterprises as well as US-based Texas Instruments, Okimoto and Nishi (1994, pp. 197–8) have pointed out that

> the lagged parallel project model is effective for work on only certain types of technology. It works for DRAMS, SRAM [sic], and other commodity chips, which share highly predictable linear trajectories of technological advancement. The model is not particularly well suited for products based on nonlinear, highly volatile technological trajectories, where the parameters of research for the next and successive product generations cannot be understood ahead of time. Thus it is not accidental that Japanese companies have dominated in commodity chips but have lagged behind US companies in logic chips, microprocessors, and software for applications and operating systems. The latter may require a different, perhaps less structured, organizational approach.

As for computers, American success in PCs and packaged, standardized software does not mean that the Japanese have not been successful competitors. US government agencies, including the military, have been buying supercomputers from the Japanese. The success of a company like Toshiba in laptop computers reflects Japan's long-standing success at miniaturization, a technological advance that requires the integration of design and manufacturing. Japan also dominates international competition in liquid crystal displays (LCDs), a technology invented by RCA in 1967, but developed from the early 1970s most successfully by Sharp in a growing number of applications. By 1992, Sharp controlled 38 percent of the world's rapidly growing market for LCDs (Kodama, 1995, pp. 56–58; Johnstone, 1999, ch. 3).

In the United States, there is growing evidence that even in industries such as jet engines and medical equipment, the trend in the United States is out of manufacturing and even design, and into the low-fixed-cost and highly lucrative business of servicing high-technology equipment (Almeida, Chapter 4, this volume; Lazonick and O'Sullivan, 1998). A recent hostile takeover attempt of Giddings & Lewis, the largest machine tool maker in the United States, by another American company, Harnischfeger, had as it objective the shedding of the target's business of manufacturing machine tools for the automotive industry so that the company could focus on servicing installed machinery (Wall Street Journal, 1997). In the end, a 'white knight,' the German company, Thyssen, acquired Giddings, promising to maintain its manufacturing business. But the fact is that considerable money can be made by taking a reputable manufacturing company and turning it into a servicing company.

Precisely because the United States has been a leader in industries such as jet engines, medical equipment and machine tools, the nation has a huge accumulation of experienced technical specialists, many of whom no longer have as secure employment with equipment producers as they had in the past. Some of these people are finding continued employment servicing the equipment that the companies for which they worked used both to produce and service. In the past, they acquired these skills through organizational learning. But their utilization of these skills today confines them to narrow and concentrated functions and removes them even further from the processes of organizational learning that will drive innovation in the future.

In the absence of indigenous manufacturing capability and organizational learning in these industries, where will the next generation of American high-technology service specialists accumulate new state-of-the-art skills? The US economy has a vast accumulation of high-technology skills that derives from the organizational learning that took place in managerial structures over the past century, and off which it can live, and even innovate, for some time into the future. But, if instead of using this organizational learning to build broader and deeper skill basis, American businesses move toward relying on even narrower and more concentrated skill bases, the trends toward income inequality of the last two decades will continue. If I am right, addressing the problem of income inequality in the United States means paying serious attention to the comparative research agenda and the issues of corporate employment and corporate governance that the skill-base hypothesis implies.

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Notes

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1. During the late 1980s and early 1990s, the problem of functional segmentation in US–Japanese competition became a prime focus of comparative studies carried out in American business schools. See, for example, Clark and Fujimoto (1991); Funk (1992); Okimoto and Nishi (1994); Westney (1994).

4
Good Jobs and the Cutting Edge: The US Machine Tool Industry

*Robert Forrant**

Introduction

Good jobs started to disappear from the United States economy in the late 1970s. By good jobs I mean employment that can 'provide high standards of living in terms of earnings, employment stability, and benefits for sickness and old age' (Lazonick and O'Sullivan, 1996, p. 1). The loss of the majority of these jobs was the result of structural, not cyclical, problems in the manufacturing sector. The sharp decline of the US machine tool industry was caused by the managerial strategic failure of industry leaders and in turn led to the significant weakening of important capital goods industries in the country.

For much of the post-World War II period a symmetry existed as American preeminence in machine tool construction and the productivity advantages that accrued to manufacturers who purchased these machines enabled builders and capital goods producers to prosper and provide well-paying and stable job opportunities. However, the jobs of well-paid skilled machinists were lost during the 1970s and 1980s as the country passed from being a net exporter to being the world's largest importer of machine tools, and goods producers lost their first access to top-notch production machinery and the competitive advantages over foreign producers that this equipment once purveyed. The rusting of the machine tool industry thus contributed to the overall hollowing out of the country's manufacturing base and the drop in the real incomes of many working families over these years.

An important focus here is a review of the development of computer numerically controlled machine tools in the US and Japan. The US was far and away more advanced in the development of this technology in the early 1970s, yet by the early 1980s Japan was able to wrest global machine tool preeminence from the US as a result of its success in the development and application of the technology to a broad-based pool of customers worldwide. There is also a discussion of the failure of US industry leaders to pursue sustained investments, ironically enough, in the very technologies they were building, as well as in the development of their skill base. By comparison, it was the investment in state-of-the-art technology bolstered by the integration of shop-floor workers into the process of developing numerical control machine tool technology that provided the foundation for Japan's success in the machine tool industry and the larger capital goods sectors from the mid-1970s through the 1990s.

A brief history and current trends

History

By the middle of the nineteenth century numerous US shops employed skilled machinists and their apprentices in the manufacture of machine tools that were the catalyst for the country's manufacturing preeminence. In Springfield, Massachusetts the federal armory's nineteenth century innovations in the use of gages to insure consistency in production led to dramatic improvements in the manufacture of a host of products. The diffusion of armory best practices was fundamental to the establishment of mass production techniques. The nation's locomotive builders, builders of mill machinery and machine tool companies symbolized America's 'rising technically driven society.' Finished goods producers like the Baldwin Locomotive Works, Columbia Bicycle, Singer Sewing Machine, International Harvester and Ford Motor Company demanded continual machinery innovations from machine tool builders in order to boost their production. Goods producers incorporated successive machinery innovation waves on their factory floors and thus were able to produce more goods, more cheaply and with better quality than their competitors (Gibb, 1950; Broehl, 1959; Rosenberg, 1963; Rolt, 1965; Woodbury, 1972; Cincinnati Milacron, 1984; Hounshell, 1984; Best, 1990; Forrant, 1994; Brown, 1995; Best and Forrant, 1996).

Through World War II defense-related production buoyed machine tool demand. For example, in 1939 Jones and Lamson, Fellows Gear Shipper and Bryant Chucking Grinder, all located in Central Vermont, collectively sold 1486 machines, by 1943 their sales increased fivefold to 7525 machines. But at war's end orders quickly dissipated caused in part by the federal government's sale, at 20 cents on the dollar, of 200000 of the 500000 machine tools it had purchased and placed in defense plants. In 1949 the national output of machine tools was just 34500, down sharply from the 103000 units shipped in 1945, while the dollar value of these machines declined to $249 million from $424 million over the same period (Broehl, 1959; Wagoner, 1968, p. 319; Holland, 1989, pp. 20, 282).[1] In spite of these losses US builders remained dominant in world markets through the 1950s because there was little global competition for sales to US producers in the rapidly expanding automobile, aircraft, and other durable goods sectors. Several builders also continued to receive lucrative contracts from the military. But by the late 1960s this market hegemony was challenged by builders in Japan and Germany and, as we shall see, the industry's response to new competition was technically and organizationally bereft.

Current trends

Today there are approximately seven hundred machine tool firms in the US engaged in the production of equipment that cuts, forms, bends and shapes metal. Hundreds of these companies are small and family-owned; only 88 employ more than 100 people. The typical family-owned or closely held firm employs ten to 50 people, produces just a few machines a year and has annual sales of $7–$10 million. There is a related metalworking equipment sector that is an important adjunct to the machine builders.[2] Firms are contained within two US Department of Commerce Standard Industrial Classification codes: 3541 – metal cutting machine tools; and 3542 – metal forming machine tools. Metal cutting machines account for roughly two-thirds of the total of US-built machine tools and include grinding machines, millers, and lathes. Forming machines include presses to stamp metal into various shapes, metal shears and saws. The easiest way to distinguish between the two categories is to remember that cutting machines remove metal while forming machines alter the shape of metal. In his history of the Burgmaster Company, Max Holland describes machine tools as 'the "mother" or "master" machines' that make all other machines. He adds that 'Every manufactured product is made by a machine tool or by a machine that was made by a machine tool' (Holland, 1989, p. 2).

As a general rule small firms invest very little in research and development and produce a few machines each year making it difficult to gain any production advantages through the deployment of computer technologies. There is a handful of large firms – Cincinnati Milacron, Litton Industries, Ingersoll-Rand, Monarch Machine Tool and Giddings and Lewis – that accounts for close to 70 percent of total industry production and sales. Firms with increased market share have done so mainly as the result of mergers and takeovers, not as the result of customer growth, global market share gains, or the development of innovative products. Many mergers resulted in the acquisition of machine tool firms by large, diversified companies without experience in the business (Holland, 1989, p. 84). When sales were high the new owners invested their profits in other businesses, while during downturns they failed to make the necessary investments in training and technology that were required to keep the industry competitive; instead, the assets of the machine tool firms were sold off, thus further debilitating the industry.[3] US firms produced $3.6 billion worth of machine tools in 1982, thereafter production declined for most of the 1980s through the mid-1990s before it slowly increased. But it was not until 1994 that output exceeded the 1982 figure. The increase in US sales resulted from the growth in the purchase of machine tools by US manufacturers as they emerged from the early 1990s recession. But according to *Metalworking Insiders' Report,* growth could have been substantially higher had the industry not lost production capacity from closings, mergers and consolidations. US demand was actually satisfied by a surge in imports: in 1995 the US imported nearly six times more machine tools by dollar value than did Japan (DiFilippo, 1986, p. 7; Critical Technologies Institute, 1994, vol. 1, pp. 11–12; Tsuji et al., 1996, pp. 31, 35). In 1997, of the ten largest builders by sales volume (Table 4.1), seven were Japan-based; in a 1994 survey six were Japan-based. Of the next ten companies by sales volume five were Japanese, two were German, two were US and one was Swiss.

A significant feature of Japan's sales growth, one that demonstrates its global strength, is the fact that foreign demand led the recovery there, unlike in the US where exports fell. Japanese firms dominate in the global sale of computer numerical control machining centers, and Japan-based FANUC is the world's largest producer of computer control systems, the brains of state-of-the-art machine tools. Three other East Asian countries, Taiwan, China and Korea, rank sixth, seventh and eighth respectively in the global production of machine tools.

What about markets?

There are two principal ways for machine tool firms to increase sales: either there is an industrial expansion that requires customers to add

Table 4.1 Ten largest machine tool builders in 1997 by sales (in millions of US dollars)

Company	*Country*	*Sales*
Yamazaki Mazak	Japan	1 253.0
Amada	Japan	1 214.3
FANUC	Japan	1 007.4
Thyssen Maschinenbau	Germany	922.3
Okuma Machinery Works	Japan	873.5
Fuji Machine	Japan	815.4
UNOVA, INC	US	789.8
Trumpf Group	Germany	778.2
Mori Seki	Japan	740.7
Toyoda Machine Works	Japan	650.9

equipment to meet this new demand, or customers decide to replace their old and/or obsolete machinery with more effective technology. In the US, according to a 1983 study by Data Resources Inc. (DRI) for the National Machine Tool Builders Association, 'by conservative estimate, up to 20 percent of the aggregate domestic consumption of machine tools is related to defense needs, even in peacetime' (cited in NRC, 1983, p. 54). Machine builders also depended on the vicissitudes of demand from the automobile industry. In the 1970s the automobile industry consumed 28–30 percent of domestic machine tool orders. The automobile industry 'captured the attention of several machine tool builders in the mid-West. But like defense, these machines had little application for anything other than the automobile industry, and here too, purchases were cyclical' (Wagoner, 1968, pp. 92–3; Noble, 1986). As a consequence of their focus on defense and automobiles, machine tool firms derived only a minimal transfer of engineering and production knowledge from the development of machines for other sectors.

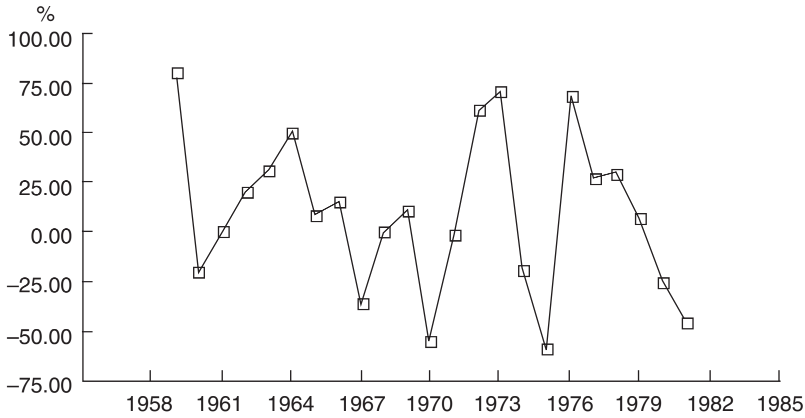
This dependence on defense and auto sales might not have been a significant problem had three things remained constant: first, the defense and automobile industries continued to grow; second, there was little or no international competition in the production of more general-purpose machine tools; and third, the pace of machine tool innovation remained slow. None of this held true by the mid-1960s. After out pacing the world in the 1950s and 1960s, machine tool builders went through a period of sharp decline as a consequence of heightened international competition and numerous management missteps, including a failure to invest sufficiently in product and process developments, an inability to manage erratic business cycles, a failure to capitalize on important technology developments like computer controls, an inability to establish effective collaborations among a host of quite small firms, a disregard for customer needs and a failure to invest in workforce development.

In summary, under the weight of heightened global competition, a lack of purchases by the US Big Three automobile assemblers, a cut in defense procurement, and the overall decline in several categories of domestic manufacturing, 600 of the 900 US machine tool builders with fewer than 20 employees permanently closed their doors between 1982 and 1987. Of the approximately 650 machine tool firms in the US today just 30 employ more than 250 people, and 467 employ fewer than 50 people. Machine tool total employment declined to 57 000 in 1995 from 88 000 in 1975, while the number of shop-floor production workers dropped to 35 700 from 57 400 over the same time period. For comparison purposes total employment in 1967 was close to 120 000. Large firms had the opportunity to take advantage of the manufacturing cost savings that can result from production scale. However, these firms failed to organize their manufacturing activities to gain such advantages. The lack of scale advantages, the inability of small firms to work together to accrue scale-like advantages, and an over-reliance on defense and automobile customers hampered the industry in the face of global competition.

The failure to manage industry order cyclicality

Almost immediately after World War II the US machine tool industry began to suffer from extreme new order cyclicality (DiFilippo, 1986, pp. 89–93; Corcoran, 1990, p. 230). According to the National Academy of Engineering ‘perhaps the most important trait associated with the machine tool industry is the extreme cyclicality of its income, profits and cash flow’ (NRC, 1983, p. 10). For example, in 1956 orders decreased 50 percent compared to 1955, and then increased by 75 percent two years later, while orders increased 90 percent between 1970 and 1972 and were followed by a drop to pre-1970 levels between 1973 and 1975. Figure 4.1 charts the roller-coaster change in new orders. Absent global competition, US firms endeavored to manage these fluctuations at the expense of their customers by maintaining inordinate backlogs of work; for some builders shipments lagged two to three years behind orders.

Figure 4.1 Percentage change in new orders in the US, 1958–82

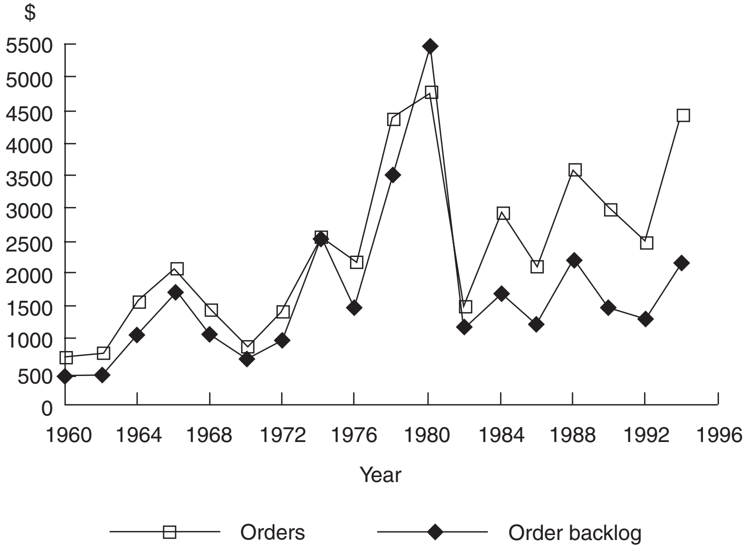


Sources: National Machine Tool Builders' 1984–1985 Year *Economic Handbook*. Data table in DiFilippo (1986) p. 90.

Max Holland found that when Burgmaster introduced a series of new numerically controlled (NC) machines in 1964 orders increased to $16 million from $8.4 million in one year, while shipments increased 18 percent. By January 1966 Burgmaster had a backlog for the new equipment of $30 million, yet it shipped roughly $900 000 worth of machines each month. As a consequence, unhappy customers waited up to two years to take delivery of the machines they desperately needed to boost their own output. The backlog strategy alienated customers and left builders vulnerable to competitors able to produce low-cost, high-quality equipment that could be delivered on time (March, 1988, pp. 12, 106–7). Figure 4.2 shows orders and order backlogs between 1960 and 1994.

What happened to Jones & Lamson (J&L), one of the first major US producers of computer controlled lathes, is instructive. J&L's order book for the lathes filled up in the late 1970s yet the company chose to build these in-demand machines on a one-at-a-time basis, making eager buyers wait over a year to take delivery. Able to produce similar lathes on a volume basis because of their more simplified design and shop-floor improvements, Japanese firms easily wrested orders from J&L's disgruntled customers (March, 1988, p. 13). Japanese builders also provided excellent service and training. Using industry surveys, the NRC determined that:

Figure 4.2 New orders and backlog of unfilled orders, 1960–94 (in billions of US dollars)



Source: US Bureau of Economic Analysis, *Business Statistics 1979* for 1960–78, hereafter US *Survey of Current Business Patterns*.

> The traditional practice of order backlog management, which served US machine tool builders well for several decades, was based on an implicit assumption that potential foreign competitors did not have the resources to take advantage of wide swings in the US machine tool market. Whether this assumption was ever valid, it certainly was not so by the late 1970s. By that time many foreign firms had the resources to offer fast delivery of quality machines to US customers who did not wish to wait for backlogs to be worked down by their domestic suppliers.
>
> (p. 26)

The surge in the importation of Japanese machinery mirrored the mid-1970s build-up of unfilled orders in the US. And as their market share increased, Japanese builders made the decision to invest in new equipment and shop-floor skills to increase their productivity and sustain their competitive advantage. To simplify the assembly process, and cut the cost of their machine tools, managers in Japan made critical production changes. Machines were redesigned to increase the number of common parts across the entire range of machines that a firm built. More common parts meant longer production runs of the parts and a reduction of time-consuming equipment changeovers. Thus, while US firms began to reduce costly machine setup times, Japanese firms were on the way to eliminating most setups. And since the Japanese machine tools were designed with fewer parts, assembly was simplified, reducing customer costs even further (Japan Society, 1994, 1996).[4]

The erratic business cycle also adversely affected US research and development expenditures. During downturns little was done to develop new products while in upturns builders filled every available hour working to fill back orders. Cincinnati Milacron was one exception to the general rule, and its slow, steady growth attests to a more successful strategy. Its top officers made a decision in the early 1970s to stay number one in technology. Between 1972 and 1982 they boosted research expenditures each year so that in 1983 the company invested 5.4 percent of sales this way. In September of 1979 James Gray, the president of the NMTBA, noted that:

> In Europe and Japan, research and development is a way of life for the machine tool industry. R & D funds come off the top. They are not a residual expense, to be invested if the money is available. As a result, our foreign competitors have generally narrowed the quality, productivity, and technology gap.
>
> (Gray, quoted in DiFilippo, 1986, p. 52)

Ill-conceived efforts to manage the business cycle occupied the time of US industry leaders for most of the 1960s and 1970s and contributed to the deterioration of the technical superiority of the US machine tool industry (Cincinnati Milacron, 1984; DiFilippo, 1986).

The innovation process in the US and Japan: the case of computer controls

Introduction: builder–customer linkages

In the first half of the twentieth century the output demands of various mass production industries spurred innovation in the machine-shop sector, and thus contributed to the success of those builders and manufacturers that worked in close, consultative relationships. For instance, the demands posed by early twentieth century automobile companies for machinery that could produce greater output resulted in the development of several new machines, including multiple-spindle drill presses to work cylinder blocks and heads, a machine to grind the cylinders themselves, a lathe to turn camshafts and a vertical turret lathe to turn flywheels (Broehl, 1959; Rosenberg, 1963; Carlsson and Taymaz, 1993). The symmetry between builders and customers was critical. Leading users had the ability to identify the technical problems to be solved and without such sophisticated users there is 'no basis for a strong domestic machine tool industry' (Carlsson and Jacobsson, 1991, p. 5). At the same time, a basic machine tool industry must be present for new product development and manufacturing process innovations to occur (Rosenberg, 1963; Hounshell, 1984).

The ratcheting upward of machine tool performance, followed by the dispersal of the new equipment on factory floors, was a cornerstone of US manufacturing success dating back to the Springfield Armory (Best and Forrant, 1996). This was a symbiotic relationship, for the continuous sales gains that manufacturers made required them to push machine tool builders harder to innovate and produce new and better technologies so that they could maintain their market advantage. According to Hounshell, as each production problem was solved by machine tool companies and goods producers new knowledge returned to the machine tool firms which then could be used to solve production problems in other industries. However, when a downward trajectory marks one of the partners in the design, build and utilization symbiosis, both partners eventually suffer the consequences. A weakened machine tool industry in country A impinges upon the ability of that country's goods producers to compete with those firms from country B that have first access to state-of-the-art machine tools from country B's machine tool companies. In turn, the manufacturers in country A, weakened by their international competitors, spend less on new machine tools, and thus do little to push their machine tool builders toward greater design improvements. The downward slide, once set in motion, is difficult to arrest.

After World War II Japan did not aim for high performance niches as it produced machine tools, instead strategic decisions were made to design and build reliable low-cost, standard products that many firms could use (March, 1988, p. 5). Once tool builders in Japan, with government support and the backing of a vigorous trade association, successfully directed their attention to the development of appropriate computer controls for these basic machine tools, global sales expanded, particularly to the US, where manufacturers eagerly purchased these machine tools. By the 1980s the US had become the leading global importer of such tools, with a trade deficit of $2.2 billion by 1995. Almost half of these imports came from Japan in the form of computer numerically controlled machining centers and lathes.[5]

As will be seen in this section, the US and Japan took quite different strategic paths as they developed computer controls for machine tools. It is not an exaggeration to state that the epicenter of Japan's late twentieth-century manufacturing advantage is its successful development of computer controls for a wide array of machine tools suitable across numerous industries. Over the same time period the flawed efforts of US tool builders, drawn into large-scale research projects funded by the Defense Department and prime defense contractors, greatly contributed to the weakened overall state of the US machine tool industry and by extension those critical capital goods producers who had relied on gaining access to first-class production equipment.

The US: a Pentagon-derivative strategy

In the post-World War II period the would-be partners in the manufacturing innovation process – machine tool builders, manufacturers, universities, the government – disregarded the symbiotic history of tool builders and end users discussed earlier in this chapter. To reiterate, progress in machine tool design from 1900 to 1950 was 'often stimulated by developments in other industries' and major changes 'resulted from a combination of applications engineering and skilled workmanship to solve practical metalworking problems' (Wagoner, 1968, p. 327). However, US manufacturers were not purchasing new machine tools, thus slowing this innovation demand-pull. In 1973, just 33 percent of machine tools in use in the US were less than ten years old, as compared to 60 percent in Japan. Five years later 40 percent of US machines were over 20 years old, while in Japan the figure was 18 percent. This hurt machine tool industry sales and it hindered overall manufacturing productivity. Even the average age of the machine tools utilized by builders themselves increased as less attention was paid to strategic investments on the shop floor and owners became preoccupied with cost accounting, profit ratios, mergers and buyouts (March, 1988, pp. 16–8; NRC, 1983, p. 2).

US industry leaders were well aware of developments in Japan. For example, the *American Machinist* noted that Japanese firms were 'moving into the international arena big time,' but the trade publication's editors pejoratively added that Japanese machines were simple, and only appealed to 'Southeast Asia and other industrially backward nations.' After all, numerical control (NC) technology had its genesis in research conducted at the Servo-mechanisms Laboratory at the Massachusetts Institute of Technology (MIT) in the early 1950s. While the trade publication pointed out that Japan's Ministry of International Trade and Industry was supporting the development of machine tools, and in particular a computer numerically controlled jig borer suitable for use in small machine shops, it failed to grasp the significance of its report. Thus myopic US builders, perhaps clinging to some nationalistic zeal, lost sight of Japan's feverish, innovative efforts to develop exportable, low-cost numerically controlled machine tools appropriate for the thousands of small shops in Japan and the US (*American Machinist*, 1 June 1959).

MIT's involvement came from a subcontract it received from machine tool builder John Parsons. Parsons needed assistance to develop controls for a complex machine tool he was building for the air force to perform consistent and automatic contour cutting on aircraft wings. Eventually MIT received a direct contract from the air force and squeezed Parsons out of the effort and by 1952 it demonstrated its control system on a Cincinnati Machine Tool vertical milling machine.[6] With air force funding, MIT, Cincinnati, Bendix, Kearney & Trecker, Giddings & Lewis and several aircraft builders all set out individually to build machines (Ashburn, 1990, p. 46–7). To confound the project further, five companies, Bendix Aviation, Cincinnati Milling, General Electric, Giddings & Lewis and Electronic Control Systems, set out separately to design distinct control systems for the machines (Noble, 1986; Ashburn, 1990, p. 47). Eventually the NC divisions of these companies sold their controllers on the market but with only limited success, partially because each firm's system remained proprietary. By 1970 ten machine tool builders had developed their own controls, incompatible with the controls and machine tools of competing firms (Collis, 1988b, p. 11).

The air force directed the attention of the machine tool industry to NC through its investment of an estimated $62 million in research and development and machine tool purchases. However, the air force role proved a mixed blessing. While the MIT-researched air force machines performed in laboratory conditions, when they were placed on actual shop floors and became exposed to vibrations, electrical interference, dirt, and operators who were never properly trained to handle the tape controls, the machines failed miserably. At the same time, because the firms building the prototypes were heavily subsidized, they paid scant attention to cost controls, thus the resultant machines were 'far more sophisticated than anything a civilian manufacturer might need, or be willing to pay for' (Holland, 1989, pp. 34–5). The machines were so complex and expensive that no aircraft builders – the hoped-for customer base – were willing to purchase them. The air force was forced to subsidize commercial development by purchasing and giving away 100 of the five-axis continuous-path profile milling machines. In summary, the development of a complex technology was made more complicated because, first, so many firms were involved in a thoroughly uncoordinated way, second, the all-important controls were developed without any established standards, and third, the machine tools and controls were built to engage in the exotic and difficult task of machining the skins of aircraft wings. According to Ashburn, the MIT program created the 'the initial impression that NC was something that could be used effectively only by aircraft firms working with a government subsidy' (Ashburn, 1990, p. 47–8).

Japan: A customer-focused strategy

Compare this history to what unfolded in Japan where the first substantial hint at what was happening came through a 1970 Osaka, Japan machine tool show. On display was a system of 28 different machine tools operated with controls built by FANUC.[7] By 1974 the entire production process at FANUC's Hino factory was under computer control. Computers tracked orders and parts testing and also controlled such complex activities as the assembly of NC parts and final assembly of NC systems. In the same year FANUC opened a service center in the US to boost exports (Ashburn, 1990, p. 52; Mealey, 1974, pp. 31–4). How was this possible when US firms struggled to develop an affordable controller?

The government of Japan, through the Ministry of International Trade and Industry (MITI), played a pivotal role as part of an overall strategy to rebuild the country's manufacturing base, as did the Japan Machine Tool Builders' Association (JMTBA). The JMTBA was formed in 1952 by 40 of the country's largest builders to act as their voice with the government and to facilitate the exchange of technical information among member firms (Holland, 1989, p. 111; Tsuji et al., 1996). In the 1950s the JMTBA and the government often clashed over policies related to the industry. For example, in the 1950s builders wanted their markets protected, while MITI wanted to boost the output of all Japanese manufacturers. Rather than apply high tariffs to keep foreign machine tools out of the country, MITI instituted financial incentives for its manufacturers to purchase domestically built equipment.[8]

Two national laws, the *Gaishi-ho* (Foreign Capital Law, 1950) and the *Kikaikogyo Rinji Sochio-ho* (Temporary Measures for the Development of the Machinery Industry Law, 1956) helped machine tool builders to gain access to foreign technology and much-needed capital. The Foreign Capital Law encouraged and regulated the introduction of foreign technology to help the industry 'catch back up' after the destruction caused by World War II. Licensing agreements with foreign machine tool companies were brokered by MITI, while direct foreign investment in Japanese machine tool firms was discouraged. Twenty-nine technology-licensing agreements were established with foreign builders between 1961 and 1964 as firms sought to learn about conventional machine tool developments in order to join the race for innovation in more advanced technologies. Japanese firms that benefited from the agreements include Mitsubishi Heavy Industries, Toshiba Machine Company and Toyoda Machine Works. The US firms involved include Burgmaster, Van Norman, Kearney & Trecker, Warner Swasey and Bryant. Between 1952 and 1981, when the law was repealed, 161 foreign technology-licensing agreements were made. Joint production ventures with US firms included: Koyo and Van Norman to build centerless grinders; Toshiba Machine and Kearney & Trecker to build transfer machines; Sansei and Bryant to build centerless grinders; and Murata and Warner Swasey to build a variety of machines. Countries with the most agreements were the US with 67, West Germany with 33, France with 32 and Switzerland with 18 (Chokki, 1986, pp. 131–2, 134; Tsuji et al., 1996, p. 22).

For a time these licensing agreements provided an opportunity for US firms to gain entry to the Japanese market. Burgmaster signed one such agreement with Chukyo Denki, a Nagoya-based machine tool firm in 1962. In the past Burgmaster fought with Chukyo in patent court, arguing that Chukyo was copying some of its machine designs. The licensing agreement provided the Japanese company with the rights to build and sell Burgmaster-designed machines in Japan and other Asian countries. In return Burgmaster received a one-time payment for the engineering designs and annual royalties on sales. Over time these agreements cut into US sales in Japan as exports fell 50 percent in 1963 and an additional 50 percent in 1965. But in the midst of large-order backlogs caused by the demands of the Vietnam War, American builders paid scant attention to this drop-off, while as ominous, and as unnoticed, Japan's machine tool exports to the US skyrocketed to \$26.2 million in 1967, up from \$2.4 million in 1964. Chokki downplays the importance of the licensing law, arguing that the resultant production and sales capacity was minimal. But it may be the case that when the law was enacted, sales were of secondary importance when compared to the gains in technical knowledge that could result.

Under the Temporary Measures for the Development of the Machinery Industry Law, 21 industries were selected by the Ministry of International Trade and Industry (MITI) for modernization assistance. MITI extended long-term, low-cost government loans through the Japan Development Bank for firms in the targeted industries to invest in new equipment. The law encouraged machine tools firms to specialize, and it helped machine tool builders to standardize their parts across a number of machines to reduce their production costs. As a result, firms specialized in markets in which they could 'seize a significant share and achieve economies of scale in production' (CTI, 1994, vol. 2, p. 3).

MITI and the JMTBA established a government approval process for product development that helped regulate research expenditures among firms and attempted to guarantee that firms that did invest in product development had a protected domestic market (Tsuji et al., 1996, p. 9).[9] An important adjunct to the government role was the ability of machine tool builders to work together and share knowledge. While MITI played a role in the rapid turn around of the industry, the firms themselves embarked on their own aggressive modernization campaigns, using MITI programs as their launching pad (Friedman, 1988). According to Yoshimi Ito, of the Tokyo Institute of Technology, industry research and development efforts were supported by a well-configured human network 'organized on the basis of Alma Mater and also of the close society called Machine Tool Engineer's Family.' As Ito describes it, the Japanese machine tool society is small, and has 'an implicit system to transfer the grass-root like knowledge, information, and technology from the senior to the junior engineers as like the Inheritance from Father to Son.' It was the ability to pass on organizational learning within and across firms that was one of the basic prerequisites for the success of Japanese machine tool firms in the world market (Ito, 1996).[10]

Analysis

US builders made a strategic decision to focus their research and development attention on solving Pentagon-related problems lured by the promise of large payoffs and lucrative cost-plus contracts. Clearly, the Pentagon influenced what was designed through its technical specifications. In one case the government ordered 11 four-spindle, five-axis machines to be built at a cost of $1 million each while there was already available a four-axis machine for $150 000 that could do the required work. The government's insistence on such customized machines raised design and build costs without affecting performance and deterred firms from designing machines relevant to their non-defense customer base. According to the NRC custom, design requests diverted scarce engineering and management time to the construction of machine tools that 'will not be useful to other machine tool customers' (NRC, 1983, p. 67). In sharp contrast, simplification, standardization, miniaturization and systematization drove companies like FANUC and Mori Seki and allowed their customers in the automobile, semiconductor fabrication, and consumer electronics sectors to participate in the development of useful new equipment.

The resultant expanded market share allowed Japan's machine tool firms to make continual investments in automated equipment and assembly systems to increase their own productivity and build lower-cost machines. Access to world-class machine tools gave production advantages to Japanese automobile and consumer electronics producers, who were able to deploy the equipment in advance of their international competitors, in much the same way as US producers had achieved production advantages earlier in the century. According to the director of a 1986 General Motors study on machine tools,'If you buy the very best from Japan, it has already been in Toyota Motors for two years, and if you buy from West Germany, it has already been with BMW for a year-and-a-half' (March, 1988, p. 3). There were reciprocal advantages for builders involved in *keiretsu*. For example, Toyoda Machine Works began to manufacture large numbers of machine tools for Toyota Motors which owned 25 percent of Toyoda Machine Works stock, while Toshiba Machine built machines for Toshiba Corporation, owner of 50 percent of Toshiba Machine stock. Machine tool builders also gained access to financing from banks in their *keiretsu* (Chokki, 1986, p. 138; Sarathy, 1989).

The rapid growth in demand for NC machine tools meant that builders capable of producing such equipment in a timely manner received a significant sales boost. (For the size of the US domestic market in the early 1980s see Table 4.2.) In 1979 computer-controlled machine tools comprised just 9 percent of unit output in Japan and 2 percent in the US. By 1991 these output figures were 42 percent and

Table 4.2 Numerically controlled metal-cutting machines produced and consumed in the US

	Domestic production	*Export*	*Import*	*Consumption*
1980	8 889	959	4 524	12 454
1982	5 116	659	5 549	10 006
1984	5 124	479	7 655	12 300
1986	4 633	606	12 146	16 173

Source: Ashburn (1990), p. 53.

7 percent respectively (Friedman, 1988, p. 124; March, 1988; CTI, 1994, vol. 2, p. 13). With small and medium-sized CNC lathes and machining centers representing about 30 percent of the worldwide demand for machine tools in the early 1980s, Japan's first-mover domestic status in the industry helped firms there eventually to dominate the global export market. During the same years the loss of major portions of its own sizable domestic market seriously damaged the financial position of US firms. In 1984 NC turning machines and machining centers comprised 25 percent of the value of machine tools built in the US and 42 percent of the value of imported machine tools. Using Manufacturing Census data and reports from the NMTBA, Ashburn determined that by the mid-1980s all types of NC were accounting for almost half the US consumption of machine tools. Yet by 1991 the total dollar value of production of this type of machine was lower than it was in 1982, even as the dollar value of the US market for the technology was $2.2 billion in 1991, up from $1.25 billion in 1983 (Ashburn, 1990, p. 5; CTI, 1994, vol. 1, p. 15; vol. 2, pp. 5, 104).

Conclusion

Two distinct strategic approaches emerge from this comparison of machine tool builders in the US and Japan. First, Japanese machine tool firms worked together, with the encouragement and financial support of the government, to invest in NC technologies. FANUC focused on the development of controls and software, while the machine tool builders worked on the design of the machines to be operated with the new controls. Second, because the fusion of the traditional machine tool with new technologies was complex, a strategic decision was made by Japanese firms initially to perfect the technology on a series of basic milling, drilling and cutting operations. When these tasks were mastered, and organizational learning increased, more complex operations were added. By comparison, US builders constructed complex, highly engineered and very specialized machines for their defense and automotive customers and they did so without any serious attempt to develop an industry standard for the computer controls. Even if we were to assume that the US strategy could work, the question remains as to where demand would come from for the massive and expensive machine tools that were produced. The design-and-build path employed by Japanese firms carried with it extensive market volume possibilities among the thousands of small and medium-sized companies in Japan, the US and elsewhere around the world. Here, builders were assisted by MITI's strategy to develop a simple, standard set of controls for basic lathe, milling and grinding machines. MITI's offer of low-interest loans to machine tool and other metalworking firms to purchase the new equipment helped to establish a domestic market for builders (Subramanian and Subramanian, 1991).

By the early 1980s US firms were neither building the most technologically advanced equipment, nor were they purchasing advanced equipment or employing sound production practices to build their machines. The US industry had failed to capitalize on new technologies and was even a slow mover to utilize advanced technologies after they became the global standard. Thus, builders did not increase real output per worker from the 1950s through the mid-1990s (CTI, 1994, vol. 1, p. 21). Based upon interviews with 43 US builders, the NRC concluded that managers were more concerned with the financial health of their companies than with the overall impact of technology on the industry (NRC, 1983, p. 41; Ashburn, 1990). US firms were thus at a particular disadvantage when it came to competing on the basis of price and delivery with Japanese firms that built and deployed the more advanced technology.

The failure in the US to pay attention to the globalization of the machine tool industry was perilous since the traditional manufacturing customer base was eroding.[11] Between 1980 and 1990 US domestic purchase of machine tools declined by 37 percent, even as worldwide demand grew. For example, the machine tool purchases of Pacific Rim manufacturers grew by 104 percent, while European firms increased their purchases by 55 percent. By 1990 the German and Japanese machine tool markets were more than double the size of the US market. With the home market contracting and global rivals competing for it, US firms were caught in an ever-tightening vise (CTI, 1994, vol. 1, pp. 19–20).[12]

US managers adopted a lower-skill strategy, unlike their counterparts in Germany and Japan, and this discouraged the most able young people from entering metalworking (CTI, 1994, vol. 1). One after another, firms ended their apprenticeship programs, in part as a response to the cyclical nature of the business. If managers were going to survive the vagaries of the industry through massive layoffs and recalls, why invest in the workforce? Skill, and by implication historical knowledge of the manufacturing process, became expendable. And if a skilled machinist was needed, it was cheaper simply to offer more money to one from a neighboring firm than invest in an in-house apprenticeship program.[13] This approach can be compared to the shop-floor strategy found among Japanese machine tool firms, predicated upon lifetime employment, respect for worker tacit knowledge, and the ability to create a synthesis of knowledge from various sources to resolve technical problems (Lazonick, 1990, esp. ch. 9; Moritz, 1996).

The purchase of firms by conglomerates exacerbated the erosion of shop-floor skills as strategic decisions were now being made by corporate directors with scant knowledge of the industry. Investments in innovation gave way to short-term profit-seeking. Max Holland's history of Burgmaster reveals the arrogance of the outside owners from Houdaille, who went about dismantling Burgmaster's shop-floor structure in their quest for a fast return on their investment. The company's longtime skilled machinists and engineers were not consulted and numerous failed shop-floor reorganizations were the result. Houdaille's acquisition changed the plant from a structure based on knowledge and ability to one built on allegiance to the corporate way of doing things (Holland, 1989, p. 90). The shop floor was all too typical of shop floors in machine shops and heavy industry across America in the post-war period. 'Management and labor were less like partners in an enterprise, and more like adversaries. Management presumed that machinists disliked their work, and would avoid it if at all possible. To the extent that they could be made to work, the blue-collar work force had to be controlled or coerced' (Holland, 1989, p. 92).

Japanese firms employed a superior strategy on the shop floor and placed a great deal of emphasis on the utilization of worker skills. As the Rand study concluded: 'These chief US rivals use their own factories as test beds for the latest tools, relying on workers to come up with new incremental improvements in products or the process of making them. This includes not only engineers, but production workers as well' (CTI, 1994, vol. 1, p. 49). In the 1983 NRC study the head of manufacturing engineering at an aerospace firm provided this quite succinct analysis of the industry: 'The Japanese are more likely to give you a product that will run the first time,' he stated. 'US manufacturers usually give you a longer lead time, and the reliability of their machines is not the greatest' (NRC, 1983, p. 76). The MIT Commission and the Rand report identify several industry weaknesses, including: the small size of firms and their inability to gain any scale production advantages; over-reliance on too narrow a customer base; the cyclicality of primary customers like the automobile and aerospace industries; and lagging product innovation and internal technology and skill investments.[14]

In 1978 the National Machine Tool Builders' Association determined that the book value of the equipment in use among its 16 largest members, that is the machines these builders utilized in their own manufacturing processes, had dropped markedly between 1970 and 1977 when compared to the 1965–70 period. This 'failure to invest in itself' was tantamount to the industry being engaged in an 'unconscious and involuntary' process of self-liquidation (cited in DiFilippo, 1986, p. 47).[15] Three years later the NMTBA issued a report highly critical of the industry after members completed a fact-finding trip to Japan. There was no magic bullet that explained Japan's rise to industry prominence; instead there was a sustained commitment to the continuous improvement of the production process. According to the NMTBA (p. 5):

> Nowhere in the thirteen factories toured by our study group did we see any unique manufacturing technology. In general Japanese machine tool builders use the same types of machinery to build their products as in America. However, the equipment and technology are very intelligently applied and many builders are investing heavily in the latest technology to improve productivity further.

Research expenditures were pitifully low throughout the 1960s and 1970s; estimates for the 1970s place such spending at roughly 1.6 percent of sales. This increased somewhat by the early 1980s, but the merger and conglomerate wave hurt the process as new-industry giants Houdaille, Textron and Litton failed to invest sufficiently in the development of their CNC product lines. One independent builder interviewed for the MIT study noted that conglomerates had no serious commitment to the industry and 'thought that they could make money by selling the same old designs and building them on depreciated equipment.' Employing this approach they became easy targets for global competitors (March, 1988, p. 15).

The NMTBA's 1981 study tour report concluded that Japanese builders were successful because of the 'willingness of management to invest heavily in its future, market its products aggressively throughout the world, work doggedly toward long-term goals, and pay an unusual amount of attention to the training and motivation of its workforce.' There existed a long-term commitment of both managers and workers to the improvement of the industry. 'Every Japanese machine tool builder's goal is market share and output volume, as opposed to profit. They will boldly sacrifice profits for several years to build the groundwork for later success.' This approach grew out of a firm's 'greater reliance on bank loans than on the sale of securities to meet its capital requirements. Thus stockholders lack power to pressure for yearly profits.' There were also substantial investments in training and the organization of the shop floor to encourage participation from machinists (NMTBA, 1981, pp. 12–13):

> Keeping their workplaces and machines in good order is a responsibility assigned to the operators themselves, along with maintaining output, helping fellow workers and assuring they every part produced meets or exceeds quality standards. … each worker is trained to correct the minor problems that often arise in the course of the day, to conduct regular preventive maintenance to monitor and adjust equipment, and to search continually for ways to eliminate potential disruptions and improve efficiency.

The US industry failed to perform even adequately in these areas, thus firms were incapable of sustaining well-paying jobs in the face of a concerted challenge for market share from firms located elsewhere in the world that did.

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Notes

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1. Just before the end of the Korean War the US Office of Defense Mobilization put forward a plan to stabilize the machine tool industry to avoid the terrible slump that followed World War II. It was recommended that the government purchase $500 million worth of machine tools a year, but this did not take place. Instead, federal procurement fell steadily after the Korean War to $22 million in 1961, down from $100 million in 1954 and 1955 (Holland, 1989, p. 285).
2. Metalworking equipment firms design and build specialized dies, molds, tooling and fixtures for machine tool builders and other manufacturers, usually on a contract basis. Important customers include the defense, aerospace, automotive, appliance, agricultural, medical and electronics industries.
3. For example, Bendix acquired the Warner and Swasey Company in 1983 and almost immediately transferred most of Warner and Swasey's production to the Japanese machine tool company Murata, thus hollowing out this once venerable US company (National Research Council, 1983, p. 44).
4. The report of the 1981 US builders' tour noted that 'machine assembly was accomplished by teams' and that while assembly methods are not substantially different in the two countries, 'their machines have been designed for easy assembly' (NMTBA, 1981, p. 22).
5. In 1995 Japan, Germany, Switzerland, Italy, Taiwan and Spain had a positive trade balance in machine tools, while Korea, China and the US ran trade deficits. The US deficit was the largest in the world at over $2 billion,

while Japan's surplus was the largest in the world at slightly over $5.5 billion. US imports of machine tools were $167.1 million in 1973, $318.3 million in 1976, and slightly over $1 billion in 1979. As a percentage of total purchase of machine tools, imports climbed from 9.7 percent to 22.2 percent during these same years (NMTBA, *Economic Handbook*, 1987).

6. MIT's engineers sought to develop a universal system capable of commanding a machine tool to cut any mathematically definable contour. This required the development of what MIT engineers called continuous path NC. A far more simple system known as point-to-point was already used by Burgmaster to instruct machine tools to perform simple drilling and milling procedures, but Burgmaster was not part of the MIT team (Holland, 1989, p. 284; Noble, 1986).
7. FANUC started as a division of electronics giant Fujitsu and competed with several US firms, including General Electric, Bendix, Sperry UMAC and Actron, in the development of machine tool controls. It was a 1972 spin-off from Fujitsu. In the early 1970s Bendix still owned all the basic NC patents and firms licensed the technology from Bendix at a cost of $500 000–$1 000 000 per license (Critical Technologies Institute, 1994, vol. 2, p. 108).
8. Tsuji makes the point that Japan's technology acquisition strategy is in marked contrast to the one deployed by many other East Asian countries in the 1980s. Japan licensed technology while other nations employed a strategy based on direct foreign investment in their countries (Tsujiet al., 1996, p. 5).
9. For detailed accounts of the government's role in machine tool development see Friedman (1988) and Vogel (1985). Friedman and Vogel differ in their analysis of the impact of these laws. Firms often resisted government pressure to move out of product markets and also entered markets set aside for other firms. But the government did help to bring coherence to the industry and boosted industry efforts to develop NC technology.
10. By the end of the 1950s the Japanese machine tool industry had been reconstituted. In 1960 annual production was $150 million, up from $10 million just five years earlier. MITI's original plan was for the industry to spend about $167 million on new capital investments; by 1960 the figure was $492 million.
11. The experience of one metalworking firm sums up the industry's disregard for its customers. 'I was in a shop up in the country in New York. This guy had two machines in a barn and he had an American built machine. He had a lot of trouble with it. Had trouble getting the service man to come up in the country. He bought a Japanese machine and said – they would fly a man from San Francisco over night. He would rent a car in Albany in New York and he would drive up and he did have the guy here the next day. He said: when he bought his second machine, he didn't even invite an American to bid on it' (Laske, 1996, p. 166).
12. In the MIT study a Cincinnati Milacron executive acknowledged that 'We ignored the Japanese in machine tools, and now it's late; our attitude has changed, and we're trying not to let the same thing happen in injection molding machines for plastics.' To do so Cincinnati Milacron has made significant changes in the ways in which it builds its machines by establishing cross-functional design teams and reducing parts by 30 percent (March, 1988, p. 14).

13. By comparison, the industry-based German apprenticeship system produces four times as many skilled machinists (on a percentage of the population basis) as the US. US builders also employ fewer engineers than Japan (Critical Technologies Institute, 1994, vol. 1, p. 44).
14. These are not new issues. In the 1920s the American Society of Mechanical Engineers (ASME) expressed a concern that there was too little coordinated research in the field of machine-shop practices. They noted that a solution to this industry weakness was the establishment of a 'central institute or laboratory to be supported by contributions from the various trade associations and individuals in the industry' (Wagoner, pp. 29–30). During World War II government procurement agencies encouraged the standardization and simplification of machine tool production as a way to boost output. Firms were urged to eliminate unnecessary sizes and types of machines and standardize across the industry (ibid., 31).
15. According to DiFilippo, capital investments by tool builders dropped sharply in about 1970 as the Vietnam War order boom started to dissipate. By the end of the decade capital expenditures were lower, in inflation-adjusted dollars, than they had been in 1965 (National Research Council, 1983, p. 47).

5

Good Jobs Flying Away: The US Jet Engine industry

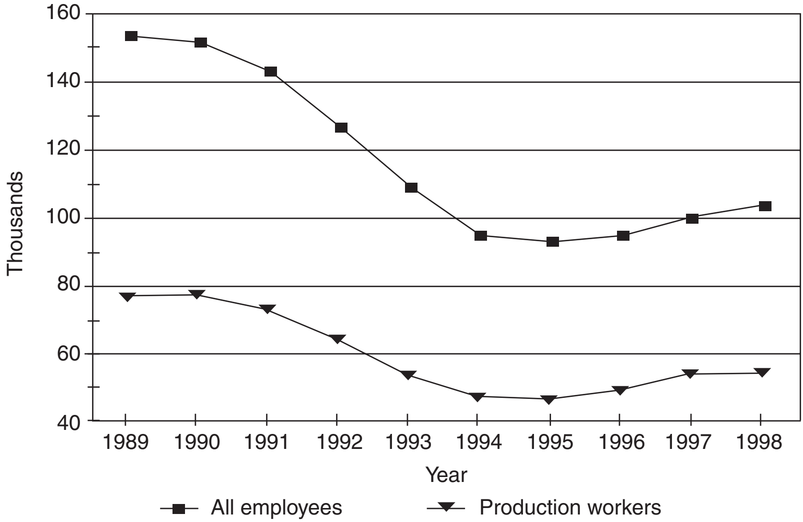
*Beth Almeida**

Introduction

In a manner not unlike the other industries highlighted in this book, aerospace, the 'crown jewel' of post-war US manufacturing, is experiencing a structural decline, seeing 'good jobs' slipping away at an alarming rate. During the 1990s the US aerospace industry has undergone a far-reaching process of consolidation, shedding thousands of highly-skilled, well-paid blue-collar precision production jobs in addition to white-collar design and engineering jobs that only a few years ago seemed secure.[1] In five short years, between 1989 and 1994, aerospace equipment manufacturers cut close to half a million jobs, representing a decline of 37 percent from their 1989 employment level of 1 331 000 (Barber and Scott, 1995, p. 12). Much of the job loss in the industry at that time could be attributed to the slowing of military orders as the cold war drew to a close. A steep drop in commercial demand, due to worldwide recession, rising fuel prices, and the onset of the Gulf War followed, further contributing to the downsizing of the aerospace workforce. But it is important to note that declining employment in aerospace manufacture during the 1990s occurred alongside a narrowing of the trade surplus, an increase in the foreign content of commercial aircraft and jet engines, and greater opportunities for companies abroad to participate in aerospace equipment production, product development and even basic research activities. Such developments are all indications of a structural shift in the industry, one whereby production has become increasingly globalized over the last two decades.

These developments have been particularly significant in the area of aircraft engine manufacturing. As shown in Figure 5.1, the industry saw employment peak in 1987 at 158 200 US employees. By 1995,

Figure 5.1 Employment in US aircraft engine manufacturing



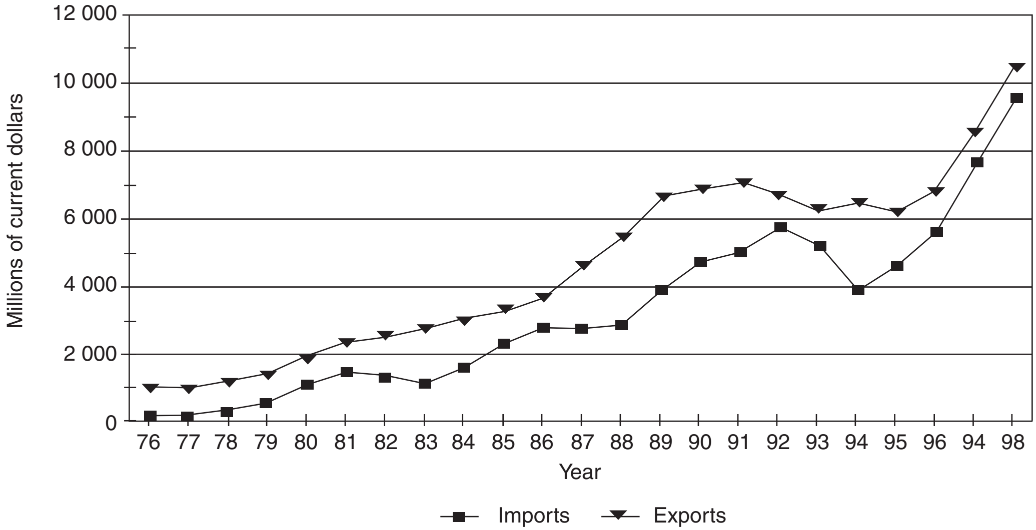
Source: US Department of Labor, Bureau of Labor Statistics (1999).

employment in the industry had plummeted by about 40 percent to 93 000. The number of jobs in the industry saw a slight rebound mid-decade, reaching 103 400 by 1998, but layoffs began anew in 1999 and employment appears again to be headed on a downward course (US Department of Labor, Bureau of Labor Statistics, 1999). The failure of past employment levels to be restored cannot be attributed to a slack market for aerospace goods. Sales of complete aircraft reached a record level of almost $63 billion in 1998. Even the end of the cold war could not relegate aerospace goods to the status of the proverbial 'buggy whip.' As income levels rise globally, so does the market for air travel, increasing the demand for aircraft. Over the past two and a half decades, annual growth in world passenger traffic has averaged a robust 6 percent per year while freight traffic has increased about 7.5 percent per year over the same period.[2] The problem facing US aerospace workers is not that aircraft and jet engines are no longer manufactured. Rather, the problem is that less and less of the work is being done within the United States. The sluggish employment picture in the jet engine sector in particular reflects an intensification of international competition in the supplier tier of the industry. The US trade balance in jet engines and engine parts, one of the most strategic of all high-tech industries, has been shrinking throughout the 1990s to the point where the US barely maintained a trade surplus in the industry in 1998. Exports that year measured $10.5 billion and imports were $9.6 billion. (See Figure 5.2.) This erosion of the aircraft engine trade balance might be surprising to those who are familiar with the industry, since the two largest firms in the industry, General Electric Aircraft Engines and Pratt & Whitney, which together command more than two-thirds of the world market, are US-based (AIAA, 1999, p. 128).[3] The deteriorating US trade position in jet engines and engine parts speaks to a growing reliance of market leaders General Electric and Pratt & Whitney on foreign sources of supply for the tens of thousands of precision-fabricated components which make up a jet engine.

The downsizing of the aerospace industry should serve as a warning to those who would maintain that the US will always win out in the high-tech manufacturing race. The idea that only poor-quality jobs in 'low-tech' industries are being lost to competitor nations is refuted by the experience of aerospace workers who lost their jobs during the 1990s. Jobs in this industry are ones which no nation can afford to lose. Workers in jet engine manufacturing, for example, earned an average of $18.93 per hour in 1998, a wage that was 40 percent greater than the average for manufacturing overall (US Department of Labor, Bureau of Labor Statistics, 1999). But the globalization of aerospace equipment manufacture is occurring differently than it occurred in other industries, say, in consumer electronics or apparel manufacture. It is less about setting up shop in a low-wage locations via foreign direct investment and more about the forging of a new global division of labor by reshaping supply relations. By outsourcing production and establishing a web of 'strategic partnerships' with firms in other countries, US aerospace equipment manufacturers have found a way to maintain profitability while disengaging from actual production, and even some design and research activities. Under the banner of focusing on their 'core competencies' of design, marketing and servicing of aircraft engines, the leading US producers of jet engines are increasingly getting out of the business of actually building this equipment. And the consequences of this strategy have been devastating to the US production workforce.

The disappearance of shared prosperity in the aerospace industry appears to be linked to a movement of enterprises toward prioritizing the channeling of financial returns to stockholders in the name of 'creating shareholder value' and away from making investments in the development and maintenance of a domestic production skill base.

Figure 5.2 US trade in aircraft engines and engine parts



Source: Aerospace Industries Association of America, based on data from the US Department of Commerce, International Trade Administration.

That those investments are being made elsewhere has positive consequences for workers abroad and negative ones for workers in the US, at least in the short term. But the 'downsize-and-distribute' decisions made by the major players in the aerospace industry during the 1990s could have long-term consequences that may eventually be truly damaging to the competitive advantage of US producers themselves. In order to understand what those consequences might be, it is important to establish how the US aerospace industry went from being the world's leader in the design, development and manufacture of some of the most sophisticated equipment in transportation to its current, diminished state. Before addressing that question, however, an overview of the industry is in order.

Industry overview

The aircraft engine and aircraft engine parts industry is made up of firms engaged in the design, development and manufacture of engines for various types of aircraft. Aircraft engines can be of two types, turbine or piston engines. The latter makes up a negligible fraction of engines produced, measured by value.[4] For the purposes of this report, we will focus on large turbofan engines produced for large civil transports or military aircraft.[5] According to the 1997 Economic Census, the US aircraft engines and engine parts industry (classified by the North American Industry Classification System as NAICS 336412 or Standard Industrial Classification 3724) recorded shipments of $22.7 billion. The industry employed 82 892 people in 1997, and had a total payroll of $4.2 billion. (See Table 5.1.) Although it is much smaller than the 'airframe' portion of the aerospace industry, engine manufacturing is deemed of great strategic importance, from both a military and an

Table 5.1 US aerospace industry shipments 1998 (in $ millions)

Industry	*Military sales*	*Non-military sales*	*Total sales*
Aircraft and aircraft parts	20 395	42 470	62 865
Engines and engine parts	2 789	10 035	12 824
Missile systems and parts	4 043	n.a.	4 043
Space vehicle systems and parts	4 360	9 648	14 008
Engines for missiles/space vehicles	496	2 155	2 651
Other aerospace	12 835	11 456	24 291
Total aerospace sales	44 918	75 764	120 682

Source: US Department of Commerce, Bureau of the Census (1998).

industrial perspective in the sense that advances in propulsion have, historically, been the 'pacing technologies' that led the way for improvements in aircraft performance. Moreover, the production technologies involved in building aircraft engines are among the most advanced in any manufacturing industry. Specialty materials that can withstand extremes in operating conditions must be fabricated to the tightest of tolerances.[6]

While the number of firms in the aircraft engine manufacturing industry is quite large, the bulk of industry employment is concentrated in large establishments. Of the 370 establishments recorded by the most recent Economic Census, 234, or 63 percent of these establishments were small, employing fewer than 100 employees. Although large in number, these establishments accounted for only 8 percent of industry employment. Most of these establishments represent smaller parts and components manufacturers. These many, small firms supply the three, large, integrated firms that design, manufacture and sell complete jet engines for large commercial and military transport aircraft worldwide; Pratt & Whitney, owned by United Technologies Corporation (UTC), General Electric Aircraft Engines, both US based, and the British firm Rolls-Royce plc. A second tier of firms which includes enterprises in Europe and the Pacific Rim produces engines for smaller passenger jets and military aircraft.

The competitive landscape in engine manufacture

What at first glance appears to be a cozy, global oligopoly is in reality an intensely competitive industry. Engine manufacturers compete vigorously for initial orders, their customers being either airframe manufacturers (for example, Boeing or Airbus), commercial airlines, or governments and their armed forces. Demand for engines is highly cyclical, depending on the financial health of commercial airlines as well as on government expenditures, especially on defense. Manufacturers in the industry attempt to compete across a range of products, offering a 'family' of engines that span from 16 000 lb of thrust to more than 80 000 lb to fit aircraft carrying from as few as 100 to as many as 500 passengers. Partly in response to the shrinkage of military orders, engine manufacturers have, in recent years, moved aggressively into the 'overhaul and maintenance' sector of the industry, servicing the equipment that they build for their customers long after the original sale is made. This is a promising growth area for manufacturers since margins on servicing activities can be up to twice as large as profits earned on equipment sales. And while a new engine is sold just once, it may remain in service for 25 years or more. To do so, it must be continuously maintained and periodically repaired.

General Electric currently leads the market worldwide and had 1998 sales of $10 billion and operating profits of $1.7 billion, figures which translate into a very impressive operating margin of 17 percent. (Approximately half of GE's 1998 sales came from servicing operations.) Runner-up Pratt registered operating profits of $1.0 billion on $7.9 billion in revenue, or a 13 percent operating margin in 1998. Together, these two firms dominate the market for large, commercial turbofan engines. To illustrate, Table 5.2 shows the backlog of engine orders for all Boeing and Airbus aircraft on order as of mid-1997. Based on these data, GE appears to control 61 percent of the large commercial jet engine market, Pratt holds a 20 percent share, while Rolls comes in a distant third with 15 percent of orders. However, it is important to keep in mind that these three firms do not build aircraft engines on their own. For example, 50 percent of the value of each CFM56 engine is produced by GE's partner, SNECMA, in the joint venture CFM International. Firms in the industry rely to a very great degree on a far-flung network of sophisticated supplier firms, which, taken together, may be producing upwards of 75 percent of the value of any given jet engine.

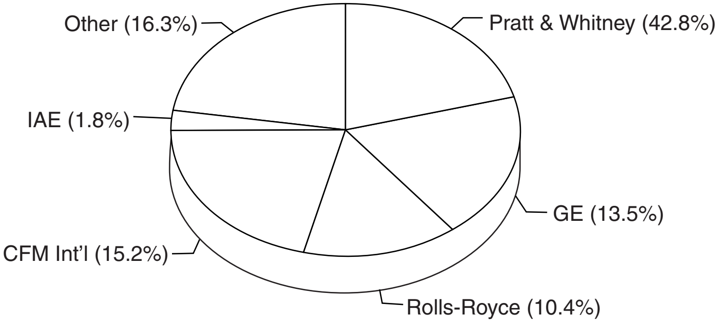
GE's ascendancy to the lead position has been a relatively recent development. Historically, the company trailed Pratt and, to a lesser

Table 5.2 Large engines for major civil aircraft – order backlog as of August 1997

Engine	*Manufactured by*	*Order backlog (units)*	*Share of total (%)*
CFM56	GE	2 220	48.0
PW 4000	Pratt	574	12.4
CF6	GE	464	10.0
V2500	Pratt/Rolls-Royce	456	9.9
RB.211	Rolls-Royce	262	5.7
Trent	Rolls-Royce	202	4.4
GE90	GE	138	3.0
PW2000	P&W	104	2.2
Undecided	–	206	4.4
TOTAL		**4 626**	**100.0**
GE total		2 822	61.0
Pratt total		906	20.6
Rolls total		692	15.0

Source: *Flight International* (1997).

Figure 5.3 Installed engine base (% of civil turbojet engine market by manufacturer)



Source: Aerospace Industries Association of America based on data from Aviation Data Service.

degree, Rolls in the sales game. In 1997, 43 percent of all engines installed on civil aircraft worldwide were Pratt & Whitney engines, while GE's share of the installed engine base amounted to just half that. (See Figure 5.3.) This is significant since, in the engine business, the product can last 20 to 30 years. Pratt's historic dominance of the market, which extended through the mid-1980s, means that it is still earning revenues as a result of orders that were filled as long ago as the early 1970s thanks to spare parts sales. The unusually long product cycle in the engine business (and indeed in the aircraft industry at large) means two things: dominance in market share takes a long time to build and once built, it is not easily lost. How was it that US producers were able to build such dominance in jet engine manufacture? The advantages of producing for a large domestic market regulated by direct and indirect government intervention had no small roles to play.

History of the jet engine industry in the US

Employing more workers than any other manufacturing industry save autos, the aerospace industry was the 'crown jewel' of American manufacturing during the postwar era. The industry enjoyed a technological advantage that no other nation was able to match, thanks to the effects of decades of cold war military expenditures and a stable, regulated commercial market. Nowhere was the concept of military-to-commercial 'spin-off' greater than in the aerospace industry, where hefty defense contracts from the US Department of Defense (DOD) as well as from foreign allies helped to finance research and development activities for aircraft designs that made their way onto civilian transport aircraft.

The textbook case for spin-off is today's market leader, GE Aircraft Engines, which owes its very existence to the military market. The company got its start in jet engine manufacture when it was selected by the US Air Force in September 1941 to manufacture a version of the British Whittle engine for America's first jet aircraft, the Bell XP-59. Though GE had been involved in gas turbine research dating back to 1903 under the direction of engineers Sanford Moss in Lynn, Massachusetts and Glenn Warren in Schenectady, New York, GE did not commit the resources necessary to develop a fully-operational jet engine during the 1930s while engineers in Europe forged ahead in designing the world's first jet engines (Constant, 1980, p. 221). While this early research was crucial in positioning GE for undertaking wartime projects, it was not until the 1960s that GE finally was able to break into the commercial market. Again, though, military contracts served as the foundation for GE's success. GE's first big commercial success was the CF-6 high-bypass engine, which was based on the design of the TF-39 engine developed for the Air Force's giant C-5 transport aircraft. The Department of Defense picked up $495 million in development costs for that project. Likewise, today's best-selling CFM56 engine (built by GE and its French partner, SNECMA, for the Boeing 737) is designed around the core of the F101, an engine also developed for the Air Force by GE (March, 1989, p. 76). For its part, Pratt & Whitney, a builder of aircraft engines dating back to the 1920s, had a much longer engagement with military customers, though the linkage between military and commercial ventures was qualitatively the same it was for GE.[7]

But it was not just research and product development that benefited from government investments in the development of technical capabilities. The production workforce whose hands built these aircraft was itself a kind of 'spin-off' from military activities. The World War II, Korean War and Vietnam mobilizations supported the training of thousands of skilled toolmakers, machinists and precision assemblers without whose skills advanced designs would have remained mere dreams on engineers' drawing boards (Bluestone et al.,1981, pp. 129–31). Government support for the development of a precision metalworking skill base was significant, since it helped solve the training dilemma faced by manufacturers in the industry. A proper apprenticeship program by which a new machinist learns to master general metalworking techniques is an expensive proposition. Moreover, for a private company there is always the risk that investments made in general training could be lost to a competitor should the worker decide to leave the firm and go to work elsewhere. Government support of apprenticeships during wartime served as a solution to this dilemma, providing a 'public good' that benefited firms and workers alike (Bluestone et al., 1981, pp. 129–33).

At the same time that the US Department of Defense and the National Aeronautics and Space Administration were supporting aerospace research, development and production activities, the regulation of commercial airlines under the Civil Aeronautics Board (CAB) also had the effect of fostering technology improvements in aircraft and engine design and manufacture. CAB regulation of routes and fares meant that airlines were, for the most part, not competing on the basis of price, but rather on the basis of service. This had the effect of creating a 'technology pull' from airlines and allowed airframe and engine manufacturers to pass on costs of new product development to these customers, who could then pass increased costs along to consumers in the form of CAB-approved fare increases.[8] The stable margins created for manufacturers as a result of these direct and indirect forms of government support played a crucial role in financing development activities in this risk-laden industry where a product, once built, may last for 25 years or more and where the costs of developing a new product run into the billions of dollars. The technological and market advantages of US manufacturers combined to place the industry at the pinnacle of global aerospace: in 1971, 2076 of the 2136 jet aircraft in service on US airlines were produced by American manufacturers (Thornton, 1995, p. 29). This landscape began to shift, however, during the mid-1970s.

The shifting landscape of engine manufacture

Just as the end of World War II and the Korean War had slowed orders during the 1940s and 1950s, the 1970s brought a post-Vietnam military downsizing. In the 1940s and 1950s, the novelty of jet propulsion technology and the great uncertainty over US–Soviet relations dictated that the country maintain wartime spending levels on aerospace even after the conflict had drawn to a close (Biddle, 1991, p. 296). But by the 1970s, different political imperatives, the maturing of jet aircraft technology and a reorientation toward long-range missile defenses all contributed to a steep drop-off in government spending on aerospace. Real federal expenditures on aerospace declined by half between 1968 and 1974, and this caused employment among engine manufacturers to plummet from its historic peak of 195 400 employees in 1967 to only

99 300 by 1976 (AIAA, 1999, pp. 21, 24 and US Department of Commerce, 1977, p. 37B-5).

But an even more dramatic shift in the competitive landscape of jet engine manufacture came in 1978 with the end of airline regulation in the US, marking an end to CAB-approved fares and the end of an era of equipment cost 'pass-through.' In the new environment of post-deregulation competition airlines now found themselves competing firmly on the basis of price and pushed manufacturers for more price competition in aircraft purchasing. Most significant for GE and Pratt & Whitney was the disappearance of 'single source' engine deals. Whereas in the past the purchase of a particular aircraft meant the purchase of one designated engine, airlines pushed manufacturers for a choice of engines. While the disappearance of single sourcing was not a result of deregulation per se (it in fact had begun to fade with the advent of the turbofan in the mid-1960s), single sourcing became even more of a rarity post-deregulation, and contributed even more to a climate of increased uncertainty for manufacturers.

In response, US firms, unwilling or unable independently to make the kinds of investments in organizational integration the new environment required, reacted in two ways to the new environment. First, both GE and Pratt & Whitney made significant investments in automation as a means of avoiding reliance on both their own organized workforces and on their suppliers. Second, these firms began a pattern of aggressively courting international partners to collaborate in production activities and to share the financial risks of product development in the new, more uncertain environment.

Parallel production, automation and the reshaping of supply relations

The first reaction of firms in the industry to the changed landscape of the 1970s was a geographic dispersion of production. Traditionally, the engine and engine parts industry in the US had been concentrated in Southern New England and in the Midwest, centered around Pratt & Whitney's headquarters in Hartford, Connecticut and around GE Aircraft Engines alternating headquarters in Lynn, Massachusetts and Evendale, Ohio. Starting in the late 1950s, however, GE had begun to pursue a 'parallel production' strategy in its engine division, with the establishment of a plant in Ludlow, Vermont. Later in the mid-1970s, GE greatly expanded its practice of building multiple production facilities capable of handling the same work. First came the establishment of another Vermont plant in the town of Rutland. Then in subsequent years, the company added plants in Madisonville, Kentucky, Durham and Wilmington, North Carolina, and Albuquerque, New Mexico. Meanwhile Pratt & Whitney pursued a similar course, establishing plants in Canada, West Virginia, Maine, Florida and Georgia to supplement its home production base in Connecticut. This strategy of parallel production was, according to Bluestone et al. (1981), a way for GE and Pratt to ensure that work stoppages due to strikes or other labor actions would not jeopardize the on-time delivery of products.

Disputes like the 1965 strike by the International Union of Electrical Workers (IUE) against GE at the Lynn, Massachusetts 'River Works' plant were indicative of the rocky nature of labor–management relations in the industry. As documented by David Noble in his landmark work, Forces of Production (1986), the central issue of that strike was not the 'bread-and-butter' wage question. Rather the dispute centered around GE's effort to introduce numerically controlled machine tools into the plant. Skilled machinists in Lynn struck to resist the way in which GE was attempting to introduce the new technology, viewing GE's strategy as an attempt to substitute reliance on worker skills with automation. In this way, parallel production served as a means to reassert workplace control, blunting the impact of workers' ultimate weapon, the strike. In their major study of the engine industry, Bluestone et al. explain that parallel production served the dual purposes of 'provid[ing] production capacity during company/union labor disputes, and severely weaken[ing] the union's ability to strike in the first place' (Bluestone et al., 1981, pp. 82–3).

But the nature of the technology embodied in the capital investments made in new parallel facilities tells us even more about labor relations at the lead players in the industry during this time. Much of the new capacity brought on line at parallel plants was designed from the outset to be skill-displacing in nature. Struggles like the one in Lynn over control of production technology decisions were themselves an important motivating factor in the parallel production strategy, and not merely because these struggles disrupted production. To the extent that an organized workforce meant that the direction of technological change could be contested in an organized fashion, escaping the constraints of a collective bargaining framework facilitated the implementation of a skill-displacing strategy. Thus, shop floors in the aircraft engine industry saw traditional machine tools supplanted by numerically controlled machine tools, which in turn gave way to computer numerically controlled machinery with each successive generation of parallel plants. By the 1980s, computer-integrated manufacturing techniques made a fully automated 'factory of the future' seem within reach, replete with robots that would never strike and that would never challenge technology investment decisions. Indeed, as the national mood changed over time, firms in the industry made fewer and fewer efforts to conceal the central role that union avoidance played in the establishment of parallel facilities that featured a heavy reliance on skill-displacing automation. For example, when Pratt & Whitney opened their 'factory of the future' plant in Georgia, the Hartford Courant (1987) reported, 'Pratt and Whitney announced from the outset that it planned to run a non-union plant in Columbus.' The newspaper also reported that, thanks to the high degree of automation (Swiss-built robots would perform several forging operations), the plant would require only half the number of workers that a non-automated plant performing similar tasks would need.

At the same time that the Columbus, Georgia plant reveals information about the state of labor relations in the industry at the time of the 1980s, it also tells us something of supply relations. This new plant was part of a vertical integration strategy on the part of Pratt & Whitney to bring 'in-house' the production of certain components that had been previously purchased from outside. The economic logic behind this 'in-sourcing' was that automation would improve quality and lower costs. But the company had a second motivation as well: reducing its reliance on suppliers who might be incapacitated by labor actions or who might fail to deliver on the quality of components they were manufacturing. Achieving a measure of control over supplier firms became a priority for the company when a 1979 strike at two important suppliers caused Pratt to be late in the delivery of F-100 engines to the Air Force. Production difficulties like these were layered on top of design flaws in the engine, both of which contributed to performance problems with the F-100 once it entered service. Defects in the engine resulted in turbine wear that could result in engine failure while in flight, a problem that was particularly acute since the fighter jet it powered was a single-engine aircraft! The F-100 was an unmitigated disaster for Pratt. The Air Force had so little faith in the company's ability to solve the problems with the engine that it took the unprecedented step of bringing on General Electric as a second engine supplier mid-way through the program. (Business Week, 9 June 1980, p. 34). Pratt managers knew that they needed to make drastic changes to re-establish the company's reputation as they entered the 1980s. The path they chose was to attempt to eliminate any reliance on any party that could create a vulnerability for the company, be they Pratt's own workforce or outside supplier firms. The ideal of the factory of the future was an attractive one for Pratt, and indeed for companies across industrial America, for it meant that they would not have to make investments in people or organizations that they felt they could not control. Automation was seen as the magic formula that would eliminate the managerial challenge of creating a system of incentives for employees and suppliers to act in such a way that investments made by the company in these groups might pay off. The ideal of the factory of the future meant that investments of this type could be avoided altogether. But, as will be discussed later, the disconnect between this ideal and reality turned out to be much larger than the companies had anticipated.

International partnering

While US firms were pursuing a downsizing of the industry and utilizing adaptive strategies such as parallel production and 'factory of the future' automation to drive down direct labor costs, during this same period, several European countries and Japan had recognized the strategic importance of aerospace, not merely in the traditional military sense, but also to industry overall in generating high-end product and process technologies. The good jobs associated with a world-class aerospace industry were an additional incentive in devoting resources to aerospace activities. Allies of the US wanted their share of the highly skilled, well-paid and relatively secure employment that American aerospace workers enjoyed partly as a result of military and commercial sales outside of the US. In Europe, this pursuit of a world-class domestic aerospace industry took the form of the successful Airbus Industrie consortium which had its beginnings in the early 1960s, joining firms from across Europe. The first Airbus, the commercial wide-body, twin-aisle A300, entered service in 1974, powered by the fuel-efficient high-bypass turbofan CF-6 (designed and developed by GE, but assembled by the French firm SNECMA). High fuel prices added to the design advantages of the A300 and, after a slow start, sparked demand for the Airbus. The success of the A300 marked a major shift in the direction of the commercial aerospace industry; the Europeans finally were able to regain the tremendous ground they had lost to US aircraft producers. Meanwhile in Japan, MITI had been playing important roles in targeting resources to develop a domestic aerospace industry and in aiding the process of technology diffusion across firms in the industry.

Throughout the 1970s and into the 1980s, Europe and Japan continued to nurture their respective aerospace industries and used NATO military procurements to leverage opportunities for access to US aerospace technologies and to produce US aircraft and engines under license. When US firms came knocking, looking for suppliers who would share the technological and financial risks of developing and building new engine designs, European and Japanese producers, eager for learning opportunities, were happy to oblige.

The nature of international partnering

Because of the great cost associated with developing new jet engines and the reluctance of the 'big three' firms in the industry to bear the uncertainty inherent in the industry individually, GE, Pratt & Whitney, and their British rival, Rolls-Royce, began to rely on collaboration with other firms to share the costs and risks of developing new commercial jet engines in the 1970s and this reliance has only grown over time. Collaboration in the jet engine industry has paired firms across both Atlantic and Pacific in partnerships taking a number of forms. There have been risk-sharing agreements where 'junior' partners have committed to financing some share of the project in exchange for a defined work share as a subcontractor, sometimes, though not always, participating in the development process. At a more involved level, there are also joint ventures where partners have formed entirely new corporations, with each partner holding an equity stake in the enterprise, dividing up responsibility for the whole range of activities from development to manufacture to marketing and after-sales service. The catch-all term that is used to describe the broad array of these arrangements is 'risk- and revenue-sharing partnerhips' or RRSPs. Table 5.3 provides a break-down of the participants of the major commercial RRSPs by engine program.

The most enduring of these partnerships involves GE and the French firm SNECMA (Société Nationale d'Étude et de Construction de Moteurs d'Aviation). The GE–SNECMA alliance dates back to 1969 when SNECMA played a key subcontracting role in producing GE's CF6 engines for the first generation of Airbus, the A300 (Hayward, 1986, p. 128). In its current form, this partnership takes the form of a joint venture called CFM International, in which each partner holds a 50 percent share. CFM International manufactures the highly successful CFM-56 for mid-size jets such as the Boeing 737 and Airbus A320 and the wide-body A340. The success of CFM International is reflected in the fact that its engines account for 15.2 percent of installed engines on civil transports – impressive market share when compared with

Table 5.3 Collaborative programs in commercial engine manufacture shares (%)

	CF-6	*GE90*	*PW 4000*	*JT8D-200*	*Trent*	*PW 2000*	*RB21-535*	*CFM56*	*V2500*
SNECMA	0–27	25.25			3.5*			50	
MTU	0–10		13	12.5		21.2		5**	11
FiatAvio	0–5	7	2			4			small share
Alfa Romeo	small share								
Fiat Avio									
Volvo	0–5			9		4			
BMW–Rolls Royce					5				
Techspace Aero			3						
Eldim			1						
Norsk Jet			3					small share	
IHI		8.66			5		5		share – JAEC
MHI			10	2.5					share – JAEC
KHI			1		4		4		share – JAEC
Samsung			1						large share
Singapore Aerospace			3						

*SNECMA's participation in the Trent program is not direct, but rather via its ownership of subsidiary, Hispano-Suiza, which holds a 3.5% stake in the Trent.
**MTU's participation in the CFM56 program is limited to the CFM56-5.
Source: Gunston (1998).

Rolls's 10.4 percent share and even GE's solo 13.5 percent share (AIAA, 1999, p. 86). GE has continued and expanded its partnership with SNECMA most recently in developing the GE90, the giant 80 000 lb thrust engine built to power Boeing's new 777 super twinjet which entered service in 1995. Facing a $1.5 billion price tag to develop the GE90, GE and SNECMA invited the Japanese firm Ishikawajima-Harima Heavy Industries (IHI) and the Italian firm Fiat Aviazione Societa per Azioni to collaborate in development (Smart and Schiller, 1995, p. 80).

Pratt is also involved in a number of collaborative partnerships as well as maintaining membership in a joint venture called International

Aero Engines (IAE), which manufactures the 25 000 to 30 000 lb thrust V2500 engine and its derivatives which power narrow-bodied aircraft like Airbus models A319, A320 and A321. Firms that make up IAE include Pratt, Rolls, Fiat, Daimler–Chrysler subsidiary Motoren-und-Turbinen-Union Munchen (MTU) and a consortium known as Japanese Aero Engine Corporation (JAEC). JAEC is, in turn, made up of Japanese 'Heavies,' Kawasaki Heavy Industries (KHI), Mitsubishi Heavy Industries (MHI) and Ishikawajima-Harima Heavy Industries. While IAE is made up of many firms, its structure is essentially a fusion of two groups centered around Rolls-Royce, which partners with JAEC, and Pratt & Whitney, which partners with MTU and Fiat (Mowery, 1991, p. 88).

A sort of cross-firm, cross-national 'division of labor' has developed on these cooperative projects. The lead firm on a project (Pratt, GE or Rolls) designs and manufactures the 'heart' of the engine, the high-pressure turbine and compressor. Fiat has come to specialize in gear boxes, while IHI has an expertise in long shafts which connect the low-pressure turbine and fan. MTU, MHI and IHI tend to manufacture disks and blades for low-pressure turbines and low-pressure compressors (National Research Council, 1994, pp. 131–139).

With the exception of the GE–SNECMA partnership, collaborative arrangements are generally project-specific, with firms that are fierce competitors in one product line cooperating in the development of other products. For example, Pratt's PW2037 is a direct competitor to Rolls's RB211–535 for the Boeing 757 (thrust range of 38 000 lb), yet through IAE these two firms collaborated in the development of the V2500 engine for the Airbus A320 (thrust range of 25 000 lb). Further illustrating the project-specific nature of cooperation was Fiat and IHI's recent collaboration with GE and SNECMA on development of the GE90 for the new Boeing 777, an engine which competes with the 84 000 lb thrust PW4084 built by Pratt, MHI and KHI. Although Fiat and IHI partner with Pratt, MHI and KHI through IAE, membership in IAE does not preclude cooperation with GE on other projects for these firms. Nor does Rolls's membership in IAE prevent it from launching its own engine for the 777, the RB211 Trent, independently.

As discussed above, participation in collaborative projects for the 'big three,' GE, Pratt and Rolls, are a way to offer a complete 'family' of engines in the face of what these firms view as exceedingly high costs of development, costs which they are unwilling or unable to bear on their own. For the smaller manufacturers, decisions to participate in risk-sharing partnerships or co-development may be made strictly on the prospects for sales, but usually involve a consideration of opportunities for learning. As will be discussed in more detail below, while partnering for the big three generally has had to do with accessing markets, sharing financial risks and lowering costs, for the smaller manufacturers, partnering has been a way to break into what might otherwise remain a global oligopoly, sacrificing short-term losses for access to specialized product and process technologies which, in the long term, created significant opportunities for organizational learning both within the aerospace industry and across other sectors. Japanese firms are a case in point. For KHI, MHI and IHI, all members of JAEC, participating in a number of collaborations across a range of products has become a conscious strategy. Richard Samuels, who has studied the Japanese aerospace industry extensively, notes, 'no new airframe in the twentieth century will be equipped with an engine that is not manufactured at least in part in Japan' (Samuels, 1994, p. 257). The emergence of Japanese and European firms as key players in an industry that as recently as 25 years ago was dominated by US manufacturers speaks to the determination of these firms, but also to the determination of the governments of their respective countries, which played important roles in steering resources to aerospace, mitigating potentially destructive competitive tendencies and fostering a stable, domestic market, helping to nurture aerospace growth. Interestingly, these were exactly the same roles that the US government played in fostering aerospace competitive advantage in the postwar era.

Certainly, the ability of international partners to collaborate with US engine manufacturers was a necessary precondition to the globalization of production in the industry. Had European and Japanese firms been lacking in skills and/or physical capacity, US firms would have had to come up with some other way of dealing with the uncertainty inherent in jet engine production. But clearly, this was not the case. In Europe and in Japan development of an internationally competitive domestic aerospace industry has been a goal pursued for many decades. The manner in which this goal was targeted and the degree to which it was achieved varies, of course, according to the country in question. Two examples of successful targeting of aero-engine manufacture can be found in France and Japan, examples to which we now turn.

Jet engine manufacturing in France

The development of France as a player in the world turbine engine market had its beginnings in military activities, activities that were closely tied with the US military. Samuels credits Châteaurault, Europe's largest F-86 and B-29 maintenance facility, with providing the French with opportunities to build skills and learning by servicing US military jets (Samuels, 1994, p. 203). But the French, far from being the new kids on the block, had a strong presence in aviation back to its earliest days. The industry, devastated like the rest of the country after the war, received help from the US in rebuilding its lost productive capacity. But it was the French government that played the strongest role in technology development. Many of the major French aerospace firms were state-owned during much of the postwar era. However, producing for a small domestic market in the context of a global market increasingly dominated by formidable competitors across the Atlantic, the French came to decide during the 1950s that their best competitive strategy would involve European cooperation (Thornton, 1995, pp. 45–56).

Prior French–German cooperation on such military projects as the Breguet 1150 Atlantic anti-submarine warfare patrol aircraft and the Transall C-160 troop transport laid the ground for the most comprehensive and successful European cooperative aerospace venture, the Airbus. The unwavering commitment of the French to European collaboration on the Airbus project in the face of vacillation on the part of Rolls-Royce was probably the single greatest factor that led to SNECMA's current success in the international aero-engine market. Rolls had lobbied hard as the Airbus project took shape to supply their RB207 engine for the first Airbus, the A300. The company's technical strengths as well as the track record of successful British–French cooperation on the Concorde supersonic transport aircraft positioned Rolls well in the competition to build engines for the Airbus. But the company subsequently was forced to withdraw from the program only a few years later, in 1968, under financial strains associated with the development of the RB211 engine for the Lockheed 1011 wide-body jet. Rolls had made a strategic error in over-committing to both the RB207 and RB211 projects simultaneously, resulting in both projects being plagued by performance problems and cost overruns (see Harker, 1979, ch. 20). The withdrawal of the only European manufacturer capable of designing, manufacturing and servicing a large turbofan for the ambitious Airbus program left cooperation with a US manufacturer as the only other alternative for the consortium. The Airbus partners decided on GE's CF-6 engine for the plane. SNECMA was assigned a leading subcontracting role amounting to about 25 percent of the value of the engine, and with the German firm MTU taking a 10 percent share (Hayward, 1986, p. 130).

The relationship between GE and SNECMA developed from a subcontractor to co-development partner, with the two firms joining as equal partners in the development of the CFM56 shortly thereafter.

SNECMA came to GE with a proposal to join in the development of a mid-sized engine that would power smaller, narrow-bodied airliners. GE was reportedly 'not entirely convinced' that an engine of the type SNECMA was proposing would be a viable product. However, it did find the idea of getting a state-owned firm to carry half the costs of developing such an engine an attractive one (Hayward, 1986, p. 131). In fact, at the time of the agreement in 1971, GE had very little to lose by cooperating with SNECMA and very much to gain. Not only could GE access inexpensive capital and strengthen its relationship with an important subcontractor, the CFM-56 designed around the military F101 engine would embody some of the most advanced technology available in a commercial power plant, representing a leap forward in engine performance and design. Moreover, the CFM-56 would enjoy a distinct advantage over US-built engines among European customers (especially Airbus customers) who would prioritize high levels of European content in engine decisions. For its part, SNECMA stood to gain from access to cutting-edge jet technology and from the opportunity to expand its commercial manufacturing activities. However, a scare came in 1972 for the principals in this story, when the US government threw cold water on GE's plans to transfer the F101's 'hot-core' technology abroad (Garvin, 1998, ch. 12).[9] After some political wrangling, which eventually reached the level of the White House, an agreement was negotiated between the US government, GE and SNECMA, limiting both the extent of technology transfer and SNECMA's role in systems integration. Within a year the project was up and running once again and the rest, as they say, is history. Thanks to a factor which no one could have forseen at the time of the project's initiation, the deregulation of the airline industry, the CFM-56 has been a tremendous success by either technical or commercial measures. After deregulation, airlines moved away from buying large planes that would carry many passengers for long distances and toward smaller, shorter-haul aircraft. This change in preferences mirrored the airlines' restructuring of routes into a 'hub and spoke' pattern in response to deregulation. The Boeing's 737 narrow-bodied aircraft outfitted with the fuel-efficient CFM-56 was perfectly suited to meet airlines' changing needs in the deregulated environment. As of 1997, 5476 CFM-56s were in service worldwide. The CFM-56 dominates the mid-size engine market: it is installed on more than two-thirds of Airbus A320s, on every Airbus A340, and on virtually all new Boeing 737s (AIAA, 1999, p. 86). This last fact is one that Boeing company sales staff enjoy pointing out to muddy the waters for European airlines which might base equipment purchases on local content considerations. They note that the Boeing 737, equipped with CFM-56 engines, has a greater positive employment effect on the French economy than does the competing Airbus model, the A319.

Still, it is not as though SNECMA has not faced challenges as well. The company recently suffered significant losses associated with its risk-sharing partnership with GE in the GE-90 program for Boeing's 777. Cut-throat price competition for engines for the 777 led to deep discounts, which in turn forced job cuts (Sparaco, 1996, p. 50). By late 1994, employment at SNECMA was down to about 11 500. GE's discount pricing strategies also had the effect of straining relations between the two companies. However, in the face of these difficulties, SNECMA tried to blunt the impact of cost-cutting, proposing a shortened work week and initiating efforts to reduce engine development costs by reducing lead times. Also, as a state-owned company, SNECMA has been able to rely on capital injections from the French government and other sources of low-cost, long-term financing to carry on new development projects, such as the CFM-XX, a 40 000–43 000 lb thrust engine for growth versions of the Airbus A340 (Sparaco, 1995, p. 29).

Whether this state of affairs will change in the coming years in light of SNECMA's pending privatization and the more widespread restructuring of the European aerospace industry will be an interesting question to keep an eye on. The success of the GE–SNECMA partnership illustrates the priority the French have placed on nurturing a globally competitive engine industry. Will SNECMA enjoy the same measure of success as a publicly held company as it has as a state-owned venture? Will it be able in the future to rely on capital that is as 'patient' as that which has been provided by the French government in the past? Most observers believe it is unlikely that SNECMA will independently undertake the design, development and manufacture of a major new engine program on its own, since to do so would require massive investments, not only in tooling and design and testing capabilities, but also in a worldwide network for marketing and product support. Still, for now it may be enough that the French have established themselves as critical links in the supply chain, maintaining a stock of good jobs in Europe when so many other industries see these good jobs slipping away.

Jet engine manufacturing in Japan[10]

The key players in engine manufacture in Japan are the Japanese 'Heavies,' Ishikawajima-Harima Heavy Industries (IHI), Mitsubishi Heavy Industries (MHI) and Kawasaki Heavy Industries (KHI). These former and current shipbuilders were able to parlay their technical capabilities in turbine manufacture into competitive advantage in aircraft and engine building. Japan's history in aircraft production is a long one, but was interrupted in the key postwar years 1945 to 1952. US military forces dismantled the industry, banning all activities related to aircraft, from manufacturing to repair to research activities. However, according to Samuels's comprehensive account of the history of Japanese aerospace, the key firms never really exited the industry. Ishikawajima-Harima, for example, was actively engaged in gas turbine research during the years of the ban, their shipbuilding activities providing a convenient complementarity. These research activities positioned IHI to become the leader among Japanese firms in turbine engine manufacture, a lead which has held to the present day (Samuels, 1994, pp. 198–200). Still, the postwar ban meant seven lost years in manufacturing at a critical juncture, just as jet technology was fundamentally changing military and, soon, commercial transports. In an effort to regain lost ground, Japan played an active role in repairing and servicing US fleets engaged in the Korean, then Vietnam Wars, hoping to become 'Asia's Châteaurault' (Samuels, 1994, p. 203).

As Japanese skills and capacity grew over time, so did opportunities for co-production, especially on military projects. Throughout the 1950s and 1960s, Japanese companies produced a variety of fighters, trainers and military transports under license from the US companies that had developed these products for the US Department of Defense. Generally, firms were first sent 'knock-down kits' to assemble; then, as learning progressed, domestic content gradually increased. Japanese firms benefited greatly from the substantial technology transfers associated with co-production as they gained access to not just product design specifications, but process specifications as well (Samuels, 1994, p. 209). Japanese firms received assistance with tooling and training and, in some cases, outright subsidies from the US DOD as part of licensed production programs. Over the course of the past three decades, the process of 'indigenization' of aircraft and engine production in Japan progressed impressively. For example, the J-79 engine designed by GE for the Lockheed F-104 Starfighter was originally imported from the US when Japanese firms began producing these aircraft under license in1960. By the end of the F-104 program in 1966, domestic content of the J-79 engine had risen to 59.9 percent (Samuels, 1994, p. 217). A more recent example of this same process can be found in Japanese licensed production of the Pratt & Whitney F100 engine, manufactured for Japan's F-15 fighter jets. By 1990, it had

Japanese content of 75 percent by dollar value, ten years after the first knock-down kits were delivered in 1980. However, in licensed production programs, Japanese firms were systematically excluded from certain activities, such as design and development, and they were shielded from sensitive components such as the high-pressure turbine and combustion system. Access to these activities and components would be crucial to Japanese firms becoming players in the world engine market. Thus, at the same time that the industry was following a strategy of 'autonomy through independence,' many in Japan argued in favor of indigenous jet development programs to give aircraft manufacturers practice in activities from which they were precluded in licensed production projects. Indigenous projects, both military and civil, were attempted and in some cases carried out, but these projects generally did not encompass engine development.

By the mid-1980s, the capacity and skills of Japanese producers had reached a level such as to be a real competitive threat to US firms in supplying certain aircraft and engine components. A report from the General Accounting Office states that as a result of the F-15 program some Japanese firms had become so proficient that they were able to out-compete the original US supplier that had licensed the technology in the first place (Samuels, 1994, p. 231). Resistance to transferring technology to Japan came to a head politically with the 'FS-X War' of the late 1980s. Japan felt ready to 'graduate' from co-producer of US military jets to developing its own next generation FS-X, or Fighter Support Experimental. But under intense political pressure, the Japan Defense Agency decided to develop only a modified version of the existing General Dynamics' F-16 for its combat aircraft needs. The plane would be powered by the GE F110 engine. A series of negotiations followed that decision regarding the co-development process, circumscribing the extent of technology transfer from the US to Japan, but also including provisions for the 'flow-back' of Japanese technologies to the US when Japanese firms made improvements to know-how originally transferred by American companies (National Research Council, 1994, p. 124). However, these technology transfer and flow-back issues are probably not as significant for the engine as they are for the rest of the FS-X aircraft. The F110 engine designated for the FS-X is not fundamentally different from the engine used on the previous generation F-16 fighter, so the development process is more or less a straightforward one (National Research Council, 1994, p. 135). At the same time, however, the FS-X program is significant in that it represents the first time that Japan has received assistance from American firms in the design and development of an advanced fighter aircraft. Samuels notes that this kind of co-development is significant in that it involves the transfer of 'not only manufacturing processes or "know-how" but full design processes, or "know-why," as well' (Samuels, 1994, p. 241).

This movement from supplier to co-producer to development partner has not been limited to military projects. In commercial projects, Japanese firms which started as suppliers began to participate with the large engine makers during the late 1970s as risk-sharing partners in projects such as the PW4000 (with MHI's stake at 10 percent and KHI's stake at 1 percent) and the JT8D-200 (MHI had a 2.8 percent stake). In these projects, while the Japanese firms played no development role, they committed as equity partners in projects, taking responsibility for tooling and plant investment in exchange for defined work shares on a sole-source basis. US firms pursued risk-sharing partnerships to spread the burden of up-front production costs as well as to secure relationships with firms that they viewed as reliable suppliers. Japanese firms participated in risk-sharing arrangements with the anticipation that such arrangements were just the next rung up the ladder towards eventual partnering in design and development.

Indeed, this type of partnering has progressed. Through the International Aero Engines (IAE) consortium, for example, the Japanese firms MHI, KHI and IHI developed and manufacture the fan and low-pressure compressor for the V2500 engine, giving these firms valuable learning opportunities in areas where they had previously been inexperienced. The organization of MHI, KHI and IHI in a consortium of their own, JAEC, within IAE, facilitates work-share distribution and technology diffusion among all three firms. A more recent example of Japanese–US firm co-development is the GE90 engine for the newest Boeing aircraft, the 777. On this project, IHI is responsible for designing and developing turbine disks for the low-pressure turbine, turbine blades for those disks and the shafting that connects the low-pressure turbine to the front fan (National Research Council, 1994, p. 131). GE was reportedly 'pleased' with IHI's performance, benefitting from IHI's fast prototyping of turbine blades (ibid., p. 49).

Japanese progress in aerospace manufacture has attracted much attention in academic and policy circles, perhaps curiously since the current competitive position of Japanese firms is quite lacking in certain key areas. The National Research Council reports, 'Across the board the Japanese companies are weak in software and lack sophistication in the analytical tools necessary to do world-class design. [These disadvantages are compounded by] relatively high unit manufacturing costs and overhead' (National Research Council, 1994, p. 143). However, observers are usually quick to point out Japanese 'ambitions' to overcome these weaknesses. The same National Research Council report notes that Japanese firms are 'asking more often for access to analytical tools [e.g. software and systems integration methodology] in their international alliances' (ibid.). Moreover, Japanese firms, like firms in other countries, have become specialized in the manufacture of particular components. For example, MHI is a specialty producer of turbine and compressor disks and turbine blades, while IHI specializes in the production of long shafts, manufacturing all such shafts for Pratt and Rolls and for GE's newest engine, the GE90 (ibid., p. 138). The Asian *Wall Street Journal* has remarked that IHI's ability to 'quietly become a force that the world's aerospace giants must reckon with' is attributable to the strengths of particular capabilities (especially in composite materials) it has developed. Such capabilities have made the systems integrators dependent on IHI and prompt comments like those from a Boeing official who recently remarked 'IHI could very well surpass General Electric and Rolls-Royce in next-generation technology.'

Whether the potential competitive 'threat' posed by Japanese firms is any more significant than potential competition from European producers, the loss of market share by US firms to Japanese producers in a range of other high-tech industries looms large in the discussion. In the words of the National Research Council's Committee on Japan, 'the committee believes that leadership in global competition will increasingly go to firms *emphasizing high-quality, low-cost manufacturing. This is precisely the area that the Japanese have made their top priority'* (National Research Council, 1994, p. 9, emphasis in original). The 'industrial targeting' strategy that has served Japanese manufacturing so well in areas ranging from automobiles to motorcycles to electronics has been steadily pursued by MITI in the aerospace industry over the course of the last two decades. If Japanese aerospace firms are able to replicate the successes of their counterparts in other 'targeted' industries, US suppliers, and perhaps even US integrators, will have reason for concern over their competitive positions.

One telling indication that Japanese manufacturers are indeed committed to maintaining a presence in the industry for the long haul is MITI's sponsorship of the Japanese Supersonic/Hypersonic Propulsion Technology Program (JSPTP or HYPR). The eventual goal of the project is the development of a scale prototype turbo-ramjet engine that could power a Concorde-successor next-generation supersonic transport (National Research Council, 1994, p. 140). The project is Japan's first national R&D effort to include international partners; foreign partners Pratt, GE, Rolls and SNECMA together share 25 percent of funding while the Japanese partners, IHI, Kawasaki and MHI receive 75 percent. The Japanese partners 'take the lead in technology development and design' while GE and Pratt serve as 'coaches,' reviewing design work and offering critique. That MITI is willing essentially to pay GE and Pratt for this service indicates that Japanese firms, though clearly still behind US producers in key areas, are not content to remain so.[11]

Sustainable prosperity in the US aircraft engine industry in the 1990s

Given the success of firms in countries like Japan and France in building domestic aerospace capabilities, what are the implications for employment in the industry in the US? Recent developments suggest they are not positive. Following an unprecedented peacetime boom in demand that peaked in the late 1980s, by the dawn of the new decade, the industry suffered the loss of Pentagon business as the cold war drew to a close. On the tails of that crisis, the 1990–91 Gulf War and a worldwide recession slowed global air traffic and damped demand for commercial jets. US airframe manufacturers Boeing and McDonnell-Douglas found themselves facing unprecedented competition from Airbus (to the point where Boeing acquired its US rival), while foreign capacity in engine manufacture continued to expand. In this buyer's market, jet engine manufacturers were forced to make substantial concessions to obtain orders and squeezed their workforces in an attempt to obtain cost savings and increase 'flexibility.'

The sales concessions offered in the industry were surprisingly steep. For example, 1995 and 1996 saw all three engine makers (GE, Pratt and Rolls) selling engines for Boeing's new 777 at discounts of up to 75 percent, charging prices that covered only half the cost of development and production (Smart et al., 1996, p. 124). Discounts of this magnitude would suggest that profits took a big hit, yet all three engine manufacturers have enjoyed increasing profits every year since 1994. This situation can be explained by the importance of spare parts and follow-on sales in the jet engine industry. Spare parts and maintenance may amount to two to three times the original cost of the engine over an engine's lifetime, creating a significant revenue stream for the manufacturer long after the initial sale (March, 1989, p. 27). According to one trade publication, pricing strategy in the engines market during the early 1990s amounted to 'win a sale no matter what and make it up in captive spares volume' (Vincent, 1992, p. 55). However, there is a worry that the over-reliance of manufacturers on future spares revenue to make up for losses incurred through discounting could pose problems down the road. In the past, sales of spare parts were the way to finance new development projects. With firms relying on spares revenue to recoup losses incurred at the time of the initial sale, resources for new product development will be sparse and may contribute to an increased reliance of GE and Pratt & Whitney on firms abroad to share the financing of bringing new products to market, accelerating the trend of international collaboration in engine production and development. Over the longer haul, it is conceivable that this dynamic could become self-reinforcing, evolving into a downward spiral for US producers. That is, as greater shares of production are taken on by international partners, it can be expected that more of the higher-margin spares business or even servicing activities will be undertaken by international partners as well, meaning even fewer resources flowing to US producers for future product development, creating an even greater need to collaborate with international partners in development with each successive generation of products. It may be the case that this dynamic has already been set in motion. The past two decades have seen the reliance on international partner–suppliers growing among GE and Pratt & Whitney in almost all phases of the business, from production to financing new product development, even product development itself. Currently in the industry there is not a single large commercial turbofan engine in production that was not developed without the financial and technical cooperation of firms overseas.

On top of the pressures of import competition, workers in the industry felt the brunt of management's attempts to work through production challenges. When the industry downturn of the early 1990s hit, GE and Pratt found out the hard way about the disconnect between the ideal and the reality of a heavy reliance on skill-displacing automation. They learned that only with a high level of throughput could their expensive investments in skill-displacing machinery justify them economically; small batch production was incompatible with the way in which GE and Pratt had structured their factories of the future. Each company found that it had to abandon its now-obsolete investments and each turned toward a 'lean' production paradigm that relied on structuring work to flow through cells of lower-tech machines staffed by multi-skilled workers. Womack and Jones, in their book, *Lean Thinking* (1996), highlight efforts at Pratt & Whitney to lower costs and improve production along 'lean' principles. They describe Pratt's success at reducing inventories, driving down lead times and lowering costs by reorganizing production into cells, collapsing job classifications, and introducing multi-skilling, job rotation and other forms of work reorganization. Unfortunately, Womack and Jones's study focuses on the activities of top managers, championing their 'steamroller' resolve to turn Pratt around, no matter how many people needed to be fired and how much work had to be outsourced. (As it turned out, employment at Pratt dropped from 51 000 in 1991 to 29 000 by 1994; several functions such as sheet metal forming, disk fabrication and gear and gearbox manufacture were all contracted out.)

Unfortunately, existing studies of workplace change in the jet engine industry have focused less on issues of organizational integration. How much involvement is there by front-line production workers in the reorganization on the shop floor? What has happened with apprenticeships at Pratt and GE? Are there other training initiatives being undertaken? Are there new capital expenditures? Of what nature? These questions by and large have not been addressed by existing studies of the industry, though they are crucial to assessing not only the likely long-term commitment of Pratt and GE to US-based production, but indeed the competitive position of these industry leaders in this increasingly competitive industry. Industry-wide figures on capital expenditures give us reason to believe that what lies behind trade publication reports cheering innovative work reorganization may in fact be a different story altogether.[12] It is an open question as to whether US firms have undergone a strategic reorientation toward investing in organizational learning or whether firms are just calling old-fashioned adaptive strategies by new names. Although on the surface it seems that Pratt and GE might be making strides towards a high-performance workplace that could potentially have positive effects for their competitive position and, in turn, for their US workers, a more careful look is worthwhile.

One example that might lead us to believe that attempts at work reorganization among US manufacturers may just be 'industrial window dressing' can be found at GE Aircraft Engines. Whereas, in the past, parallel production was established to minimize the effects of work-stoppage, it has recently played an important role in forcing changes in work organization. When GE abandoned its highly automated, 'factory-of-the-future' concept in favor of *kaizen*-style management practices, management attempted to collapse several job classifications and broaden tasks workers would be expected to carry out at its Evendale plant (Kandebo, 1994, p. 56). Coming as they did in the midst of a wrenching downsizing, these proposals were rejected outright by the union representing Evendale's workers, who viewed the changes as an assault on what few protections they still had at their disposal to protect job security. In response, GE management shifted work out of Evendale and into its other facilities in Massachusetts, Kansas and Canada and announced plans to re-open a mothballed plant near Durham, North Carolina. 'In all, 40 percent of all part numbers made at Evendale were shifted to other sites,' wrote one trade magazine (Kandebo, 1994, p. 56). At the same time, GE cut 3900 jobs in Evendale in a single year (Kandebo, 1993, p. 79). In the context of a cyclical downturn, these cuts were devastating. Employment at Evendale in 1988 was close to 20 000; by 1994 only 8000 workers remained (Kandebo, 1994, p. 56).

GE subsequently turned to its workforce in Lynn, Massachusetts, making the same 'multi-processing' demand which would have given management a free hand in assigning multiple operations simultaneously to any worker in the plant. Like their Ohio counterparts, workers in Massachusetts rejected this demand out of hand and the saga of Evendale was replayed in Lynn. Work was shifted out of Lynn and held out to the devastated Evendale plant as the 'reward' they would receive if they would now accept GE's work reorganization demands. It worked; Evendale employees voted in early 1994 to accept the company's demands. It was then Lynn's turn in the 'hot seat.'[13] The union there has continued to resist proposals that would give management any unrestricted rights to reassign workers, preferring to negotiate changes on a case-by-case basis. This strategy has been working reasonably well for the union, but problems remain. The multi-skilling agreements contain no provisions for training, and apprenticeship are long gone from GE. It is the union that has taken the lead locally in developing training programs that would maintain the region's skill base in the face of the aging Lynn workforce (author's interview with Jeff Crosby, President, IUE, Local 201, which represents workers at GE Aircraft Engines, Lynn). It is observations like these that suggest that there may be a darker side to the shift to the 'high-performance workplace' in the jet engine industry. They also suggest that GE, in spite of its long history of various 'programs,' the 'pilot program,' the quality control movement, the 'Work-Out,' and now 'Six Sigma,' has remained reluctant to make the kind of long-term investments that organizational integration requires.

GE chief Jack Welch, discussing his current strategy to drive down costs and improve quality, recently remarked,

> You can't behave in a rational manner. You've got to be out there on the lunatic fringe. You have to tell your people that quality is critical to survival, you have to demand everybody gets trained, you have to cheerlead, you have to have incentive bonuses, you have to say, 'We must do this.'
>
> (Quoted in Carley, 1997, p. A1)

But Welch's program appears to stop far short of the requirements for real organizational learning. For example, the training he refers to applies only to 'Quality Black Belts,' managers whose job is to 'spend full time roaming GE plants and setting up quality-improvement projects,' and not to front-line workers (Carley, 1997, p. A8). Likewise, incentive bonuses are reserved for management. The threat of job loss due to shifts of work seems to be the prime incentive held out for production workers. Indeed the threat of job loss at GE is a credible one: employment in GE's aircraft engine group fell dramatically from about 40 000 in 1988 to only about 22 000 by the end of 1994 (Kandebo, 1994, p. 56). Moreover, GE's job cuts were not restricted to production workers. The engineering ranks, whose number peaked in 1991 at 10 000 was slashed to 4000 by mid-decade (Smart and Schiller, 1995, p. 78). These cuts, however, had some unintended effects. While GE's 'downsize and distribute' was quite successful at generating financial returns for shareholders, the company's experience with its newest engine, the GE90, suggests that those returns may have come at the expense of the kind of innovative investments that are the very source of these returns themselves.

In the early part of the decade, GE's engine division was committed to a very large (and very expensive) development program and facing a slowdown in sales. As a result, the division saw its operating margin fall to 12 percent. That the division could in the midst of an industry downturn still achieve an operating margin that would be the envy of many firms even in good times is remarkable. But perhaps even more remarkable was the zero tolerance policy enforced by corporate higher-ups who demanded that all of GE's businesses meet a minimum threshold of 15 percent. The head of the engine business at the time of the industry's recession was Brian Rowe, an engineer by training who was reluctant to make drastic cuts to the employment ranks to restore profits, rightly fearful of the impact such cuts might have on the development process of the GE90. But when Rowe failed to act fast enough to boost margins, top management promptly came in and made the cuts themselves. Rowe himself was one of the casualties, though he perhaps could take some consolation in the subsequent news reports of design flaws and production difficulties which plagued the GE90 program. The engine was a great embarrassment for the company. Though it was scheduled to enter service in 1995, the Federal Aviation Administration withheld certification of the engine until the agency was satisfied that its many problems had been corrected (O'Boyle, 1998, pp. 225–226).

A look ahead

There are those who might argue that the downsizing of aircraft engine manufacturing industry was necessary to create a leaner, meaner industry, that the pain of rationalization was necessary to create the conditions for future productivity gains in an industry which for too long was overly dependent on Pentagon 'pork' for its survival. But the experience of the GE90 is just one example that calls into question whether the downsizing strategy pursued by the industry in the 1990s was the best way for such a transformation to be achieved. But there is another, more general, question to be answered as we attempt to make a judgement as to the prospects for a sustainable, shared prosperity to be restored in the industry. That is, who suffered the pain and who got the gain? The fact that workers in the US aerospace industry (both blue- and white-collar) bore the brunt of the industry's downsizing is indisputable. The trend of massive job losses early in the decade only slightly reversed after demand recovered. To illustrate, sales in constant dollars for the industry in 1998 had recovered just about to 1987 levels, off about 12 percent from their 1990 peak. But employment in the industry remains stuck at a level one-third below 1990 employment levels. On the wage front, the news is also bad: real wages in the aircraft engine industry have been stagnant over the course of the decade (US Department of Labor, Bureau of Labor Statistics, 1999). But it is important to point out that even during the darkest days of the industry's downturn, profit margins escaped the turbulent environment with just bruises. This was especially true for GE's engine division. Even in the leanest years of the industry's recession, the division never reported a loss and, indeed, never saw its operating margins dip below 12 percent (Smart and Schiller, 1995, p. 78). Today both General Electric and Pratt & Whitney's parent company, United Technologies, are recording profit levels that would be the envy of any enterprise.

And while there is some evidence that 'high-road,' productivity-enhancing strategies are being pursued in the industry, how to interpret these developments depends on the context in which they are viewed. It is true that by implementing more efficient manufacturing practices, inventory levels in many plants have been driven down, work in process has been reduced, and that these improvements have the effect of freeing up cash flow. At the same time, international partnering may have positive contributions to make by enhancing efficiencies through economies of scope. But the 'million-dollar question' for workers in the industry is what happens to the cash flow that is generated. Is it being reinvested in the growth of firms, either in the form of new capital expenditures or acquisitions that might rebuild employment opportunities now that the industry has recovered? Or are returns mainly being distributed to shareholders in the form of dividends and stock repurchases? Unfortunately for the prospects of workers in the industry, it appears that what investment activities are being undertaken are not happening domestically and, in any event, the scale of reinvestment appears almost insignificant when compared with the distribution of financial returns to owners.

General Electric and Pratt & Whitney have been able to generate their impressive rates of return as a result of having restructured themselves under the 'core competence' logic, focusing on design, marketing and servicing activities and retaining only those production activities viewed as essential for maintaining a competitive advantage in these other three activities. In an interesting twist, whereas servicing activities were once viewed as by-products of the manufacturing activities, now manufacturing is only retained to the extent that it supports the core servicing role.[14] By taking on 'supplier-partners,' GE and Pratt & Whitney have simultaneously gained long-term partners with a stake in the success or failure of the product and have freed up substantial financial resources that can be directed toward other purposes. But the benefits of this strategy have failed to accrue to the domestic production workforce because although disinvestment in production capacity is being substituted by, investments in more lucrative after-market servicing operations, these facilities need to be much more widespread geographically. Spreading servicing facilities across the globe translates into less time and less expense to airlines whose aircraft in need of repair or overhaul may be anywhere in the world.

But perhaps even more damaging to the prospects of shared prosperity has been the priority placed by both GE and United Technologies on creating 'value' for shareholders. It was in the name of 'creating shareholder value' that the drastic downsizing of the industry was carried out in the early 1990s. And while employment levels have stabilized since that time, the pressure managers in these firms face to continue to deliver this value continues and perhaps even grows. In this vein, both companies have embarked on a course of aggressive share repurchasing and have made setting high dividends a primary corporate objective. In 1998, General Electric spent $3.6 billion on stock repurchases and paid out $3.9 billion in dividends. These payments were based on a cash flow from operations of $10 billion. At the smaller United Technologies, 1998 cash flow reached $2.5 billion. The company spent $650 million of that buying back its own shares and paid out $316 million in dividends. The proportion of returns being distributed to stockholders is staggering and mirrors a more general trend among US enterprises in the 1990s. The idea that the structures which govern resource allocation in US corporations create short-termist pressures is not a new one. And it is one that appears to apply to the jet engine industry. When Brian Rowe was still the head of GE Aircraft Engines, he remarked 'If we spend $1 billion over four years [to develop an engine], we'll probably break even in 17 years.' Trade magazine *Air Transport World* summed up the position of managers in the industry, stating, 'That is on a product whose life may be 20 years. That's a long time when GE Chairman Jack Welch is your boss' (Vincent, 1992, p. 56).

The problem is that in a high-tech industry like jet engine manufacture, the links between maintaining manufacturing capacity and building competitive advantage in design, marketing and servicing activities may be much closer than anyone in the industry currently believes. If it turns out to be true that 'thinking' in this industry requires an engagement with 'doing,' then US producers could be in for a rough surprise, although that could take years if not decades to occur. Shareholders may be content to enjoy the feast while it lasts, but given the ambitions of firms across the world to become leading players in the aerospace market, the preference of US enterprises to 'downsize and distribute' rather than to invest in a domestic skill base should give pause to anyone concerned about the US economy's prospects as a high-wage, high-skill, high-tech economy.

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Notes

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1. Mergers of already-large enterprises during the 1990s created mega-firms like Lockheed-Martin (the product of the merger of Lockheed, Martin Marietta and the aerospace/missile divisions of General Dynamics, Local, Ford, LTV, and IBM), and enlarged existing ones such as Raytheon (which bought out Hughes Missile Systems) and Boeing (which acquired competitor McDonnell-Douglas in 1997).
2. Author's calculation based on data from International Civil Aviation Organization as reported in Aerospace Facts and Figures, 1999, p. 75. Passenger traffic is measured in passenger-miles performed, freight as ton-miles performed.
3. It should be noted that these trade figures are somewhat misleading due to the fact that the value of engines installed on aircraft which are then, in

turn, exported is not counted as 'engine exports,' but rather is counted in with the value of *aircraft exports*. Adjusting these trade data to reflect this fact would yield a measure of the trade balance greater than that reported here. But in the absence of such an adjustment, examining the ratio of US imports of engines and engine parts to the value of the US industry's annual shipments of engines and engine parts will serve the same purpose of demonstrating the growth of import penetration in the aircraft engine industry. In the 1970s, this ratio was in the neighborhood of 3 percent. By the mid-1980s, this ratio had grown to about 15 percent. Since that time, it has doubled to about 30 percent today.

4. In 1997, aircraft powered by piston engines represented shipments of only \$214 million, or less than 0.1 percent of total aircraft shipments (Aerospace Industries Association, 1999, p. 39).
5. Other markets for turbine engines are general aviation (e.g. business jets) and helicopters. Together these segments accounted for about 15 percent of civil aircraft shipments in 1997, with general aviation shipments of \$4.7 billion and civil helicopter shipments of \$231 million. By comparison, shipments of large civil transports totaled \$26.9 billion that same year. On the military side, the 1997 flyaway value of military helicopter acceptances amounted to \$800 million compared to \$10.8 billion for all other aircraft (e.g. bombers, fighters, transports) (Aerospace Industries Association, 1999, pp. 32, 40).
6. *Jane's Aero-Engines* (1998) is an excellent technical source of information on aircraft engine manufacture.
7. Singer (1998) provides a history of the early days of Pratt & Whitney's foray into building aircraft engines as well as a concise account of the role that military and the US government more generally played in fostering the growth of the aviation industry.
8. For more on the role of Civil Aeronautics Board (CAB) regulation in fostering 'technology-push' in commercial aircraft and engine manufacture, see March (1989).
9. The 'hot core' of an engine comprises the high-pressure turbine and compressor. It is the 'heart of any jet engine, and is the most difficult element in an engine's design' (Hayward, 1986, p. 132).
10. This section borrows from Samuels' thorough historical account of the Japanese aircraft industry, *'Rich Nation, Strong Army': National Security and the Technological Transformation of Japan* (Samuels, 1994).
11. GE and Pratt are collaborating on their own on research on high-speed civil transport (HCST), funded by NASA. According to the NRC, this project 'involves a much higher funding level than Japanese government support of HYPR. The US engine makers are not transferring technology from this work to the Japanese' (NRC, 1994, p. 141).
12. Net capital expenditures in the industry have been trending downward. In 1992, US aircraft engine manufacturers made net capital expenditures of \$66.2 million. By 1997, the industry was spending only \$55.6 million.
13. This whipsawing is made that much easier for GE due to the fact that its aircraft engine workforce is represented by three different unions: the International Union of Electrical Workers (IUE), the United Auto Workers (UAW), and the International Association of Machinists (IAM).

14. GE's expenditures on acquisitions and investments in the overhaul and maintenance business have dwarfed those of its rivals, amounting to $9.5 billion since 1995. Under the auspices of GE Engine Services, after-market activities as well as aircraft leasing activities contribute $45 billion a year in revenues to General Electric (Interavia Business and Technology, 1998).

6
What Prognosis for Good Jobs? The US Medical Diagnostic Imaging Equipment Industry

Chris Tilly with Michael Handel

Introduction[1]

The US diagnostic imaging equipment industry stands astride several of the most noteworthy trends in the current US economy. Diagnostic imaging equipment, which includes such machines as X-ray machines, CT (computed tomography) scanners, and MR (magnetic resonance) scanners, forms visual images of areas within the body for diagnostic purposes. Thus, although the diagnostic imaging equipment industry is a manufacturing industry, its fate is closely tied to the service sector – and specifically to health care. Diagnostic imaging has shared in the meteoric rise of health care spending over the last several decades. Now it shares the effects of managed care and other concerted efforts at health care cost containment.

Diagnostic imaging equipment is also a high-technology industry. The design of such equipment is extremely engineering-intensive, combining mechanical and electrical engineering with the specialized engineering involved in regulating various forms of radiation. New technological generations of CT or MR scanners succeed each other every few years, not unlike personal computers. New products, those introduced in the previous two years, typically account for 30 percent or more of industry sales (Standard & Poor's, 1999). The combination of safety concerns with enormous complexity renders these instruments among the most technologically sophisticated products manufactured in the world today. Unlike computers, however, diagnostic imaging machines are typically produced in small batches. The entire US output of CT scanners in a given year can be counted in hundreds, and the price tag for a single high-end CT or MR machine typically exceeds $1 million.

Thus, while diagnostic imaging equipment is not by any means a typical industry, it offers an example of a rapidly changing, high-technology sector – the kind of industry in which, according to many observers, US manufacturers ought to excel. And indeed, for most of the hundred-year history of this industry, US producers have led the field, generating engineering jobs aplenty and production jobs paying well above the average wage economy-wide. But in the last two decades, there have been dramatic transformations that have changed the face of the industry and pose new challenges for US companies. In the process, while world diagnostic imaging equipment leader General Electric has successfully maintained and even slightly increased its market share, second-tier US producers have lost ground to Japanese and European manufacturers.

The process of economic change in the industry can be summarized in four propositions.

1. *Thirty-five years of rapid growth in US demand may be coming to an end, making the international market increasingly important.*
   Since the early 1960s, demand for diagnostic imaging equipment has expanded vigorously. In addition, and helping to fuel the demand, there has been an exuberant run of innovation. As of the early 1960s, the diagnostic imaging industry consisted of X-ray machinery alone. As of the late 1990s, there are substantial markets in addition for four other major forms of diagnostic imaging equipment (CT, MR, ultrasound, nuclear medical instruments), as well as a number of smaller markets (for example, positron emission tomography [PET], picture archiving and communication systems [PACS]). However, the rise of managed care in the world's largest market for diagnostic imaging, the United States, along with fiscal pressures in Western Europe and Japan, appears to be causing growth in these mature markets to level off. Rapid demand growth in the future is likely to occur in developing countries.

2. *US producers have undertaken outsourcing and downsizing.*
   Companies have downsized in response to dips in the market for particular products, as well as the long-term flattening of health care demand. US companies' outsourcing of components has shifted many production and some engineering to smaller companies. The net impact of outsourcing on high-quality jobs is unclear, since it reduces good jobs in the company, but is likely to improve jobs in the suppliers.

3. *Japanese producers have made significant inroads into the global and US diagnostic imaging equipment markets.*
   For the first 70 years of the diagnostic imaging industry, US and European producers held sway, particularly in their home markets. But over the last 30 years, Japanese producers have entered and steadily expanded their market share. In addition to producing equipment under their own brand names, Japanese manufacturers – acting as suppliers, joint venture partners, or subsidiaries – have supplied components and complete machines to be sold by US and European companies.

4 *There is some evidence that US companies have carried out less organizational integration of suppliers, engineers, and production workers than Japanese producers.*
   By organizational integration, we mean the integration of productive actors into learning and decision-making activities. The existing case study literature has not paid enough attention to workforce issues adequately to assess the state of organizational integration in US companies, let alone to demonstrate the connection between organizational integration on the one hand, and job quality and competitiveness on the other. However, the limited evidence we have been able to find suggests that, as in other industries, US producers have achieved less organizational integration of certain groups than have their Japanese counterparts.

To trace this recent history, this paper draws on the case study literature on diagnostic imaging, on publicly available industry data, and on the business press. It also incorporates findings from interviews and site visits by the primary author and others at five diagnostic imaging companies, two in the United States and three in Japan. At the companies' request, their identities must currently remain confidential. Some of the company-based research has been supported by the Sloan Foundation through a project entitled 'Corporate Restructuring, Skill Formation, and Earnings Inequality.'[2]

The paper unfolds in four sections that mirror the four propositions. Each section summarizes both quantitative trends and case study evidence. The evidence available from published sources, coupled with preliminary interview findings, reveals quite a few interesting patterns, but also leaves a great deal unanswered. Consequently, we follow these four sections with a brief conclusion making the case for additional case study research and sketching directions for such future research.

Growth of the diagnostic imaging industry

An introduction to diagnostic imaging

The diagnostic imaging equipment industry produces machines that visualize structures and processes inside the human body for the purposes of medical diagnosis. Currently, diagnostic imaging embraces six main types of equipment, often called 'modalities':[3]

Conventional X-ray equipment

Conventional X-ray equipment, the oldest modality, dates back to 1896. Conventional X-ray machines pass X-rays through the patient's body to a piece of film. Because X-rays are selectively deflected by areas of greater density (particularly bone), the resulting image shows structures within the patient's body. X-rays are often used in conjunction with contrast media, chemicals injected or ingested within the patient to highlight particular anatomical features.

Nuclear medical instruments

Unlike other diagnostic imaging modalities, nuclear medicine uses the patient's *body* as the radiation source. Radionuclides (radioactive substances that emit gamma rays) are ingested by or injected into the patient, and then a detector is used to form a visual image of these radioactive materials within the body. This method depends on radiopharmaceuticals that are absorbed selectively by particular organs, or absorbed at different rates by healthy and diseased tissue. The first viable nuclear medical imaging machine went on sale in 1959. Nuclear medicine is relatively non-invasive and particularly useful for examining physiological functions (since sequential images can track the uptake of marker chemicals by an organ), but offers lower resolution than other modalities.

Nuclear medicine has given rise to two specialized spin-offs. Single photon emission computed tomography (SPECT) detects photons emitted by the radionuclides, and saw product launches in the mid-1970s. Positron emission tomography (PET), in turn, specifically detects photons created by positrons (positively charged electrons) generated by decay of the radionuclides. Commercial PET systems first appeared in the late 1970s. Despite the hopes of their innovators, neither SPECT nor PET has yet become a large market.

Ultrasonic imaging equipment

Ultrasound equipment passes high-frequency sound waves, rather than X-rays, through the body to form an image by the same methods as sonar. The first commercial ultrasonic imager appeared in 1963, but the breakthrough in ultrasound technology occurred in 1974, when a small company, Rohe Scientific, developed the first practical stored video 'gray scale,' permitting far greater resolution than previous black-and-white systems. Ultrasound imaging does not use ionizing radiation or invasive contrast media, and therefore is the method of choice for visualizing the fetus in utero. Ultrasound is also less expensive than other modalities, but ultrasound images are more difficult to interpret than those formed by other methods (Friar, 1986).

Computed tomography (CT) scanners

CT scanners, first sold in 1972, once more use X-rays. A CT scanner beams X-rays at detectors at a series of specified positions and angles, in order to create images of a series of thin slices of the body. This series of slices allows physicians to visualize structures inside the body in three dimensions. CT scanning can distinguish among 2000 levels of density, whereas standard radiography can only distinguish among 20. However, CT scans are considerably more expensive.

Magnetic resonance imaging (MR, or MRI) equipment

Magnetic resonance exploits the fact that atomic nuclei of various elements align themselves in distinctive ways when subject to a strong magnetic field. An MR scanner applies such a field, then transmits radio waves, resulting in the release of energy that can be used to map structure and/or function. The first MR imaging machines were marketed in 1980. MR scanning provides very sharp images without ionizing radiation, but remains quite expensive. The potential of using MR scanners to analyze chemical changes (that is, physiological function) as well as anatomical structure, touted by MR producers since the modality's inception, has not yet been fully realized, though a small market for functional MR equipment exists.

Digital radiography equipment

Digital radiography uses the same principle as conventional X-rays, creating two-dimensional images of the body. However, digital X-ray equipment, first marketed commercially in 1981, captures images on a detector rather than a piece of film, so that the information in the images can be manipulated by computer systems. One standard application is ‘digital subtraction’: an area of the body is X-rayed with and without a contrast medium, and the resulting images are digitally subtracted to focus sharply on where the contrast medium has been taken up by the body. Digital radiography offers greater resolution than conventional radiography (and allows use of smaller amounts of invasive contrast media), but at lower cost than CT scanning.

In addition to these six main modalities, the diagnostic imaging industry sells equipment designed to manage images created by a variety of modalities:

Picture archiving and communication systems (PACS)

PACS are computer systems that electronically record and archive images generated by any of the previous six modalities. PACS, often called ‘image management systems,’ were first commercialized in the 1980s. PACS are not yet widespread, since despite the appeal of ‘one-stop shopping’ they still are technically inferior to film in some regards (including some dimensions of image quality). But industry analysts expect the market for PACS to expand to rival the markets for MR and CT scanners in the United States (Medical and Healthcare Marketplace Guide, 1995).

A snapshot of the industry

The diagnostic imaging industry has been global – and dominated by giant companies – since its inception. Within months of Wilhelm Roentgen’s 1895 discovery of X-rays, both General Electric in the United States and Siemens in Germany were marketing X-ray machines for diagnostic purposes. Since that time, the roster of industry giants has expanded to include Philips (Netherlands), Picker (US-based, but acquired by Britain’s General Electric Corporation in 1981), Toshiba (Japan), and Hitachi (Japan). Other companies have come and gone. Small companies have most often been the casualties, but a number of giant corporations in medical supplies, pharmaceuticals and electronics have made forays into diagnostic imaging, only to retreat later. Examples include Johnson and Johnson, Litton, Pfizer, Raytheon, Searle, SmithKline, Squibb and Union Carbide.

Table 6.1 shows the current top ten producers of diagnostic imaging equipment and their shares of the global market, compared with the top ten in 1974. GE, Siemens, Toshiba, Philips, Picker and Hewlett-

Table 6.1 Worldwide sales of the ten leading diagnostic imaging companies and total industry sales, 1996 and 1974 (millions of current dollars)

1996 top 10 company	*1996 sales (US$)*	*1996 market share (%)*	*1974 top 10 company*	*1974 sales (US$)*	*1974 market share (%)*
General Electric	2 100	28.0	General Electric	90	22.5
Siemens	1 900	25.3	Picker	80	20.0
Hitachi	850	11.3	Litton Medical	55	13.8
Toshiba	660	8.8	Philips	50	12.5
Picker	500	6.7	CGR Medical	40	10.0
Philips	400	5.3	Siemens	40	10.0
Hewlett-Packard	320	4.3	EMI Ltd	15	3.8
Acuson	290	3.9	Toshiba	7	1.8
ATL	280	3.7	Hewlett-Packard	5	1.3
Elscint	200	2.7	Xonics	5	1.3
All companies	7 500	100.0	All companies	400	100.0

Source: *Medical and Healthcare Marketplace Guide* (1975, 1997/98).

Packard, the current top six, were all heavy hitters in 1974 as well. CGR (French) and EMI (British), two top-ten companies from 1974, have been absorbed into GE. Today, the six largest companies produce equipment across the six major imaging modalities. The four smaller companies in the top ten specialize in particular modalities: US-based Acuson, ATL and Hewlett-Packard excel in ultrasound equipment, and Israel's Elscint specializes in nuclear medicine instruments. US-owned companies still dominate the industry, but there is a substantial showing from other countries, including Siemens (Germany), Philips (Netherlands), Toshiba (Japan), Hitachi (Japan), Picker (US-based, but owned by the General Electric Company of Britain) and Elscint (Israel).

The epochal innovations in the industry – in particular, those resulting in the invention and commercialization of new modalities – have typically been developed by academic researchers and small startup companies. But the industry giants have proven successful fast followers, using their well-established marketing, distribution and service networks and their extensive in-house engineering capacity to enter and in many cases dominate new markets. In addition to designing their own products, the giants have often strengthened their hold on emerging markets (and gained specialized design capabilities) by acquiring smaller companies (Mitchell, 1988, Applebaum et al., 2000). General

Electric Medical Systems, for instance, absorbed EMI's CT scanner business in 1980, Nicolet XRD in 1984, CGR in 1986, Ultrasonix's ultrasound lines in 1988, and the PET line of Sweden's Scanditronix in 1990 and Japan's Tanaka X-ray Manufacturing Company in 1994 (in addition to setting up a variety of joint ventures in Asia) (Lazonick and O'Sullivan, 1998; *Medical and Healthcare Marketplace Guide,* 1989, 1991). While GEMS has been a particularly avid collector, Siemens acquired Searle's nuclear medicine business in 1981, Oxford Magnet (for MRI equipment) in 1985, and ultrasound company Quantum Med Systems in 1990. Toshiba bought the MRI division of Diasonics in 1989, and Applied Superconetics, Inc., a magnet business, in 1990 (*Medical and Healthcare Marketplace Guide,* 1996).

Unfortunately, tracking the diagnostic imaging industry in standard industrial data sources is no simple matter. Until 1987, the Standard Industrial Classification (SIC) system placed diagnostic imaging equipment in SIC category 3693, 'X-ray and electromedical equipment.' In addition to diagnostic imaging equipment, this group included machines ranging from electroencephalographs to pacemakers to bronchoscopes. By 1987, diagnostic imaging products amounted to just under half of the value of shipments in this category (US Census Bureau 1990, Table 6a-2). In 1987, SIC 3693 was split into SIC 3844, 'X-ray apparatus and tubes and related irradiation apparatus,' and 3845, 'Electromedical and electrotherapeutic apparatus.' Unfortunately for the purposes of analyzing diagnostic imaging, ultrasound and MR scanners, which do not employ ionizing radiation, were grouped in the latter category. In 1987, these two product groups accounted for about one-quarter of the value of shipments in SIC 3845, and one-third of total diagnostic imaging product shipments. As of 1994, ultrasound and MR equipment , still about one-quarter of SIC 3845, had risen to almost half of diagnostic imaging shipments (computed from US International Trade Administration, 1995, Table 1508, and US Census Bureau 1995, Table 2). In 1994, diagnostic imaging equipment as a whole accounted for just under one-half of total sales in 3844 and 3845 combined.[4] In 1997, the Census Bureau switched from SIC codes to the North American Industrial Classification System (NAICS). The X-ray category, now numbered 334517, was unchanged. But electromedical equipment was combined with electrotherapeutic apparatus in a larger category numbered 334510. Fortunately, key data in 1997 Economic Census are broken out separately for the electromedical category.

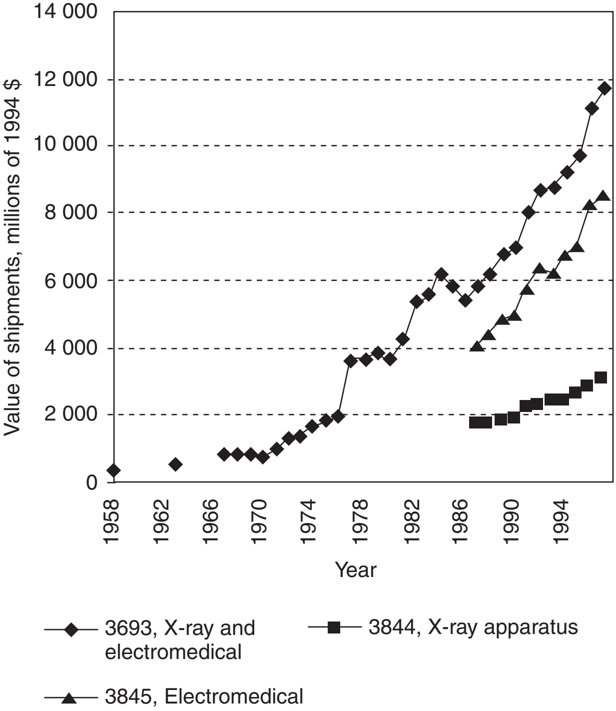
Since publicly available Census Bureau data are mostly organized by SIC (and now NAICS), the bottom line is that we can only examine government data about diagnostic imaging in combination with other electromedical equipment. Private sector industry analysts have generated far more detailed estimates, but their work resides in the fugitive literature of consultants' reports. Such reports are in general expensive and/or difficult to access, poorly documented, and often inconsistent. The imperfect solution adopted in this paper is to report results by SIC, supplemented by estimates from industry analysts in the limited instances that these were readily available.

Diagnostic imaging equipment is a relatively small industry. In 1994, US diagnostic imaging equipment manufacturers shipped close to $5 billion worth of equipment.[5] Compare this with the other two industries we have studied closely: the machine tool industry shipped a roughly equal amount that year; aircraft engines and engine parts shipped $17 billion. But unlike these other industries, diagnostic imaging has seen near-miraculous growth. In real terms, output has grown almost 15-fold since 1970, and nearly 32-fold since 1958. Over this period, the industry has posted average annual compound growth rates of about 9 percent (in real terms), roughly triple that of the US economy as a whole.[6] However, the industry now faces new challenges to continued growth.

Limits to growth?

Figures 6.1 and 6.2 trace the US diagnostic imaging industry's meteoric ascent. Figure 6.1 shows diagnostic imaging combined with electromedical instruments, whereas Figure 6.2 offers estimates of diagnostic imaging alone. In its 32-fold expansion since 1958, diagnostic imaging has both benefited from and contributed to the upward arc of health care spending in general, which grew nearly fourfold in real terms between 1960 and 1996 (US Department of Commerce, 1995, Table 150 and 1998, Table 164, deflated by total medical care CPI). Key to the continued growth in sales was the third-party reimbursement system in place in the United States until the 1980s. Between 1940 and 1982, third-party payers (insurance companies and government agencies) increased their share of health care expenditures from 15 percent to 75 percent – and 90 percent of hospital expenditures in particular (Foote, 1986; 1992). During this time, insurers paid for medical services on nearly a cost-plus basis, giving doctors and hospitals little incentive to contain costs. Though Medicare did not cover most capital costs,

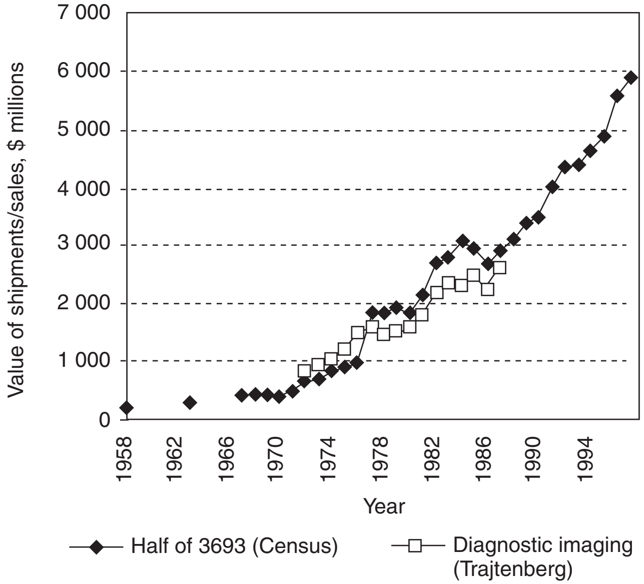
Figure 6.1 Value of shipments for US diagnostic imaging and electromedical industries 1958–97 (in millions of 1997 dollars)



Sources: US Office of Technology Assessment (1984) Table 1; US Census Bureau (1984), Table 1a; (1990), Table 1a-2; (1996) Table1; (1998) Table 1. Values adjusted for inflation using Producer Price Index for machinery and equipment.
Note: After 1986, SIC 3693 is continued by the sum of SICs 3844 and 3845.

there was some pass-through and hospitals could often negotiate sufficiently high reimbursement rates for procedures to recover capital costs. Private insurers tended to follow Medicare in deciding what to cover. Cost-plus reimbursement in health care poses interesting parallels with industries in which the Defense Department has been a major customer, such as machine tools (see Chapter 4 by Forrant in this volume) and jet aircraft (Almeida, Chapter 5 in this volume). As with defense contractors in these other industries, there was for a long time little pressure for cost containment, which may have left manufacturers ill prepared for more recent waves of cost-cutting and competitive pressure.

Figure 6.2 Sales of US diagnostic imaging industry, approximated from two data sources, 1958–97



Sources: Sources for SIC 3693 are as in Figure 6.1. Other series from Trajtenberg (1990) Table 2.1. Values adjusted for inflation using Producer Price Index for machinery and equipment.

Up to the early 1980s, radiologists and other medical specialists controlled equipment purchases as a professional prerogative, and hospital administrators played little role. Since availability of advanced technology is an important factor in a hospital's general prestige and ability to attract top-flight doctors, particularly radiologists, there was little incentive to restrain purchasing (Mitchell, 1995; Foote, 1992; Steinberg and Cohen, 1984; Tomsho, 1996).

As Figures 6.1 and 6.2 show, the rise in diagnostic imaging equipment sales has not been unbroken. Rather, periods of rapid growth have alternated with periods of stagnation or even short-term decline. Slowdowns resulted from some combination of restraints on health care spending and lags in equipment innovation. Up to the last few years, the industry saw three main periods of stagnant sales.

First, in the 1960s, the US market for X-ray equipment temporarily reached saturation. However, the creation of Medicare and Medicaid as part of President Lyndon Johnson's War on Poverty provided a new infusion of cash into health care. The development of CT scanners further revitalized the market in the 1970s.

Second, after nearly doubling in a single year between 1976 and 1977, sales leveled off again in the late 1970s. Producers had overestimated the CT market and overproduced, bringing down prices. Equally important, the US Health Care Financing Administration (HCFA), which handles Medicare reimbursement, imposed a requirement that hospitals seeking to acquire costly equipment must file a Certificate of Need (CON) and obtain approval. Medical diagnostic imaging equipment sales, especially CT, declined briefly. However, while hospitals had to file CON forms, outpatient facilities did not, spurring the growth of outpatient CT imaging facilities affiliated with hospitals or hospital-based radiologists. Since the procedures were still covered by insurance but the facilities did not fall under governmental capital control regulations, the intent of the regulations was effectively undermined. In addition, the appearance of MR machines gave the industry an added boost. Sales began to soar again.

Third, diagnostic imaging equipment sales drooped in 1985–86. The decrease in sales was limited to conventional X-ray equipment, CT scanners and digital X-ray machines. Once again, a combination of reimbursement jitters and market saturation set in. Digital X-ray equipment did not live up to its technical billing, and its sales were flat for the second half of the 1980s. CT scanners, selling for roughly $1 million per machine, were reaching the limits of demand – especially since MR imagers could offer crisper resolution at a similar price. And in 1983 HCFA implemented a prospective payment system for patient treatment. Prospective payment established fixed reimbursement tied to each patient's diagnosis, replacing cost-plus reimbursement. HCFA is the nation's single largest health care customer, and its regulations are typically adopted by Medicaid and by private insurers as well, so the potential reverberations were enormous. Private insurers, pressed by corporate clients stung by the rising costs of providing health insurance to their employees, followed suit. By 1984 Secretary of Health and Human Services Margaret Heckler claimed that the Reagan administration had 'broken the back of the health care inflation monster' (Stein, 1986; Reinhardt, 1986).

Heckler's boast was premature. Hospitals and doctors' offices soon found ways to at least partially evade the system, and health care industry concerns about cost controls abated somewhat. Diagnostic imaging sales also recovered. MRI purchasing shifted to the now well-established outpatient radiology facilities, and capital costs were accorded lighter treatment under the new system than other hospital costs (Mitchell, 1995; Foote, 1992; Trajtenberg 1990). MR and conventional X-ray sales enjoyed renewed growth, but ultrasound and nuclear medical equipment, fueled by technical innovations, led the growth spurt.

The continuing difficulty in restraining costs reflected the political and ethical pressures to follow up promising research avenues and to extend available services to the widest possible numbers. The public has an ideal that no one should be denied medical care and that no expense should be spared in delivering the finest care (Foote, 1992). Even though the ideal has always been violated regularly in practice, politicians are loath to contradict the ideal too obviously, so it is not surprising that previous cost control plans seem to have been rather porous. Given that CT and MRI represented such dramatic breakthroughs, it is not surprising that the law failed to curb physician and public demand (Foote, 1992; Trajtenberg, 1990).

Figure 6.1 shows a pause in industry growth at the beginning of the 1990s, but then robust expansion through the rest of the decade. However, this rosy picture obscures important warning signs. According to many industry experts, the US market for diagnostic imaging equipment has become relatively flat (see, for example, Standard and Poor's, 1999). This trend is offset in Figure 6.1 by strong export performance by US producers – two-thirds of increased sales between 1992 and 1996 result from growing exports (calculated by authors from US International Trade Administration, 1999) – and by sales growth in non-imaging instruments that are part of this industrial classification.

The recent flattening of US sales reflects sales losses in almost every modality, according to Biomedical Business International (Standard & Poor's, 1995). Industry analysts have pointed to overcapacity in a number of modalities, particularly MRI (*Health Industry Today*, 10/94; Naj, 1994; Standard & Poor's, 1995, 1997, 1999). Actual or anticipated reimbursement changes have clearly had an impact as well. An obvious explanation for sputtering of diagnostic imaging equipment sales during 1993–94 is the frisson due to President Clinton's health care proposal – which was, of course, never enacted. But other changes that attracted far less public attention were at least as important. In 1991, Medicare began to extend prospective payment to hospitals' equipment. Whereas earlier Medicare paid hospitals for actual costs minus a 15 percent discount, the new system, phased in over a number of years, pays flat fees based on diagnosis (Standard & Poor's, 1992). Moreover, in 1993 new legislation proposed by Congressman Pete

Stark of California partially plugged the diagnostic imaging center loophole, by placing limits on physicians' ability to refer patients to imaging centers in which they hold an equity stake (Brean Murray, Foster, 1996).

In short, the historical and recent fortunes of the US diagnostic imaging industry have ridden primarily on two factors: the pacing of technological innovations, and the nature of health care financing. Figures 6.3a-6.3d trace US and world sales of diagnostic imaging equipment, broken down by modality. Unlike Figures 6.1 and 6.2, these graphs depict sales by all producers, not just US-based ones. Figures 6.3a and 6.3b show US sales by all producers in constant dollars, and sales in each modality as percentage of the total. Figures 6.3c and 6.3d show the same two series for world sales (for which we were not able to obtain as many years of data). The impact of successive waves of innovation is clear. CT and ultrasound scanners first made a major splash in

Figure 6.3a US sales of five diagnostic imaging modalities, 1972–94 (in millions of 1997 dollars)

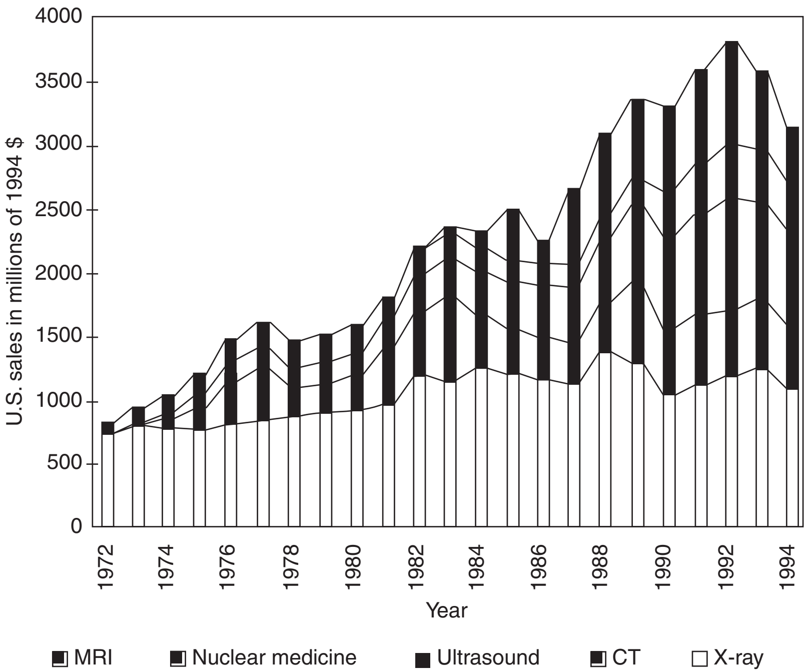
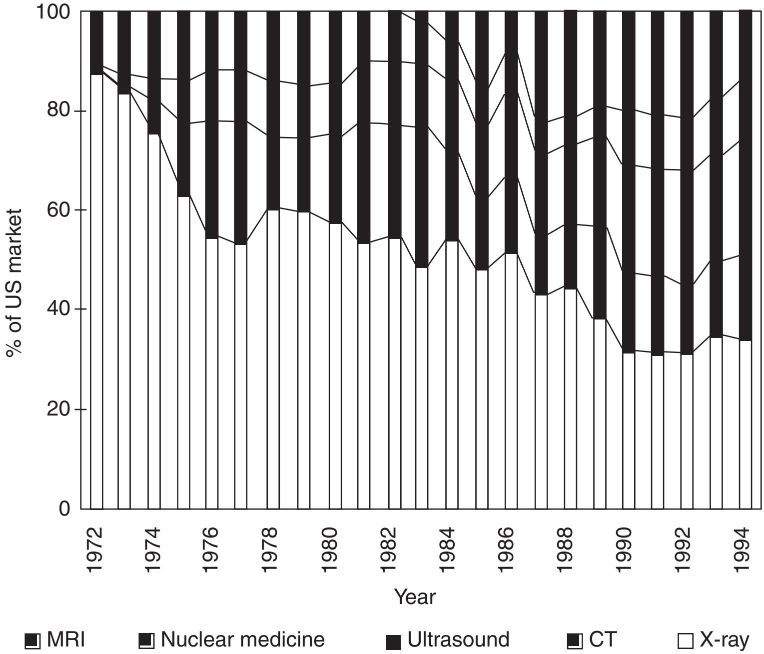


Figure 6.3b Five diagnostic imaging modalities as a percentage of the US market, 1972–94

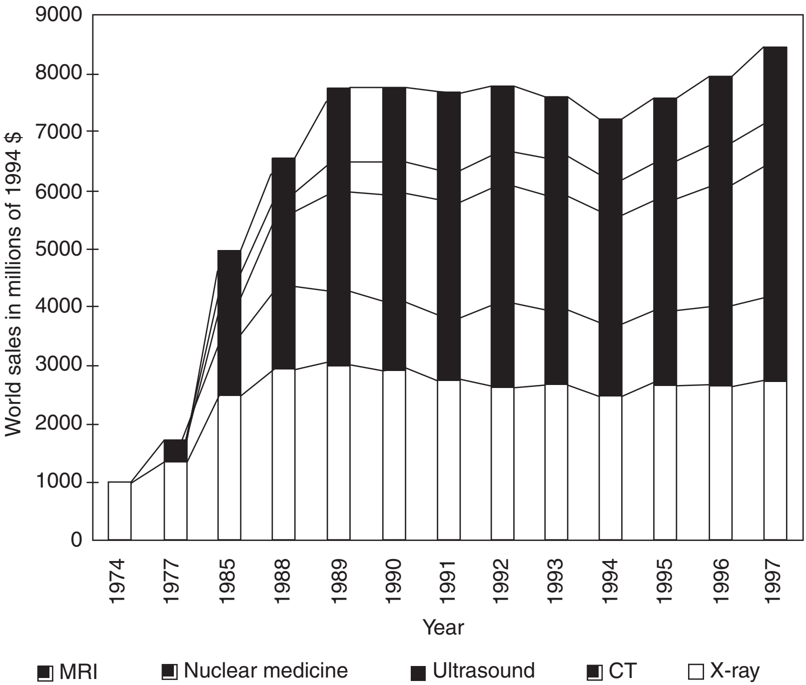


Note: X-ray and CT sales imputed, 1988–89.
Sources: 1972–87 from Trajtenberg (1990), 1988–89 from National Electrical Manufacturers Assoc, reported in Standard & Poor's (1992) 1990–94 from Frost & Sullivan, reported in Standard & Poor's (1995).

1974, and MRI appeared in 1983. From 90 percent of the US market in 1972, X-ray equipment declined to just above 30 percent in the 1990s. The US market and the broader world market have followed very similar patterns in the composition of equipment sales. Also, both US and world sales dipped after a 1992 peak. Growth of world sales resumed in 1995. Though we do not have data beyond 1994 for the US market, recent industry analyses suggest that US sales have not rebounded in the same way.

Given the historical pattern driven by technology and third-party reimbursement, should we view the slowdown in the US market since 1992 as another temporary halt, or a long-term plateau? Assuredly, it would be unwise to predict an end to innovation in diagnostic imaging.

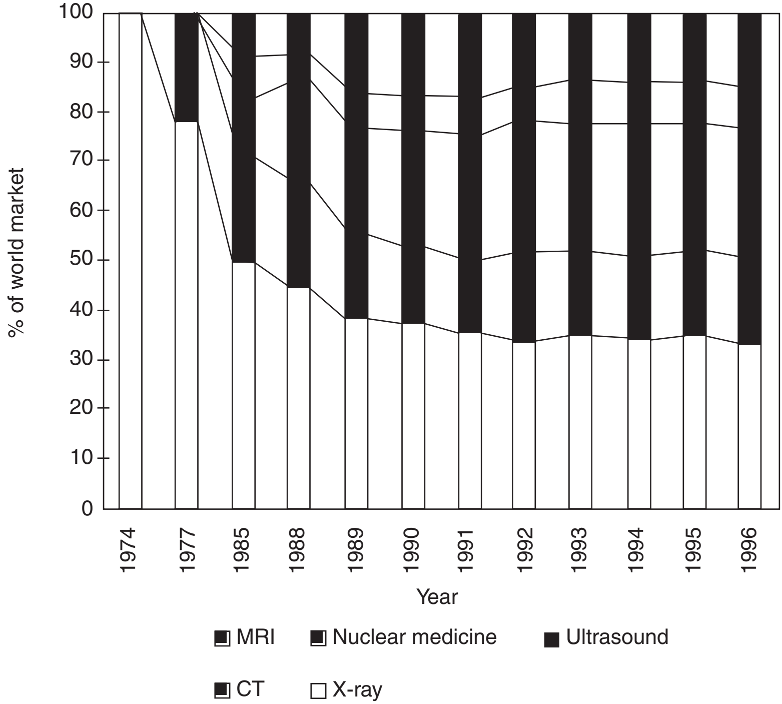
Figure 6.3c World sales of five diagnostic imaging modalities, selected years, 1974–97 (in millions of 1997 dollars)



But most innovation in the field has had a moderately long incubation period. For example, ten years passed from the construction of the first nuclear medicine machine to the creation of a marketable product; the CT scanner took five years from invention to commercialization (Mitchell, 1988). Despite some analysts' excitement over emerging advances in MRI (Standard & Poor's, 1997), in our view the only innovation currently visible on the horizon that seems likely to have an impact similar in scale to the appearance of a new modality is the PACS.

As for reimbursement, the federal government continues to clamp down bit by bit on health care costs, including equipment costs. But even if government's success in containing health care costs remains limited, the spread of health maintenance organizations (HMOs) and managed care in the private sector has begun significantly to squeeze reimbursement rates. Between 1986 and 1996, HMOs spread from

Figure 6.3d Five diagnostic imaging modalities as a percentage of the world market, selected years, 1974–97



Note: CT combined with X-ray in 1974. X-ray interpolate, 1985 and 1988. 1997 estimated.
Source: Medical and Healthcare Marketplace Guide (various years).

10 percent to 30 percent of the insured population (Pham, 1997) and they have become much more aggressive in limiting payments to providers. HMOs and other managed care providers often link hospitals or other health care facilities into large buying consortia, which can effectively bargain for lower prices with vendors.

The effects of this latest wave of cost containment are profound and appear likely to deepen further in coming years. For diagnostic imaging equipment in particular, the implications are grave. In addition to the direct impact of managed care, purchaser uncertainty has escalated. One response by health care providers has been to turn to the market for second-hand and reconditioned equipment (DRI/McGraw-Hill, 1998). Large hospital chains are now buying refurbished systems, which previously were only marketed to rural and Third World buyers. GE markets its own used equipment; other companies such as Picker are offering to overhaul machines from other companies, as well as their own. Used MRIs can cost \$0.85–\$1.1 million, rather than \$1.5–\$2 million, used CT scanners can cost \$245–470 000, rather than \$700–850 000 (Scott, 1995; Tomsho, 1996). 'This was a market where you bought something new, you bought the bells and whistles and you replaced it every five years,' commented Robert McGee, president of Serviscope Corp., an equipment services company in Wallingford, Connecticut. 'Now it's more like the airline industry. With proper maintenance and proper upgrades, equipment does not need to be replaced every five years unless there is some clinical reason' (Scott, 1995). Refurbishers even formed a trade association, the International Association of Medical Equipment Remarketeers, in 1994 (DRI/McGraw-Hill, 1998). In addition to shopping for used equipment, smaller hospitals are starting to contract with mobile MRI and CT units that make regular visits (*Health Industry Today,* 10/94; Standard and Poor's, 1999). And hospitals are also simply deferring replacement of diagnostic imaging equipment (Lehman Brothers, 1996; Standard & Poor's, 1997).

With breakneck rates of equipment acquisition through most of the 1980s followed by stringent cost pressures in the 1990s, the current US market appears to be saturated. Though our time series for US demand extends only to 1994 (Figures 6.3a–b), a Picker executive reported that the market for diagnostic imaging products declined 25 percent in the following two years (1994–96) (*IW*, 5/6/96). General Electric Medical Systems, the industry leader, announced a restructuring plan in 1993 in response to the downturn (Health Industry Today, 7/93). Hewlett-Packard's medical equipment division followed suit with an initial restructuring a few years later (Hewlett-Packard Web site, 1996) and in 1999 H-P's parent company spun off its measurement divisions (including the medical equipment division) altogether (Hamilton and Thurm, 1999).

But in addition to innovation and reimbursement, a third factor is proving increasingly important: international markets. While US imaging equipment sales – which currently account for about 40 percent of sales worldwide – may be leveling off, world sales are poised to take off. Already, between 1989 and 1995, exports have climbed from 32 percent to 40 percent of X-ray and electromedical shipments by US producers (US International Trade Administration, 1999). Consultants Frost and Sullivan projected a near-doubling of the world market between 1993 and 2000 (Standard & Poor's, 1994). Most of this growth will not take place in Western Europe or Japan, since, as in the United States, the markets of these countries are relatively saturated (and the national health systems of Western Europe have placed strict controls on new equipment purchases) (Standard & Poor's, 1999). Instead, rapid demand growth is likely in Asia, Latin America and Eastern Europe. For instance, between 1991 and 1993, US exports to China of diagnostic ultrasound equipment more than doubled; exports of MRI machines increased a staggering 14-fold (Chan, 1994a; see also Lipson and Pemble, 1996; DRI/McGraw-Hill, 1998). Though these export bursts were exceptional, overall medical device exports to China grew at double-digit rates through much of the 1990s, three or more times as great as growth rates in more mature markets (DRI/McGraw-Hill, 1998). And for overall growth in sales of US-made medical equipment, China was actually at the low end among Asian countries (Chan, 1994b). In the former Soviet Union, US exports of medical equipment and supplies grew at a blistering 54 percent per year between 1992 and 1996 (DRI/McGraw-Hill, 1998). Trends favorable to growing medical device sales in such emerging markets include economic growth, an aging population and deregulation of health care. Exports to emerging markets slowed in the late 1990s due to financial troubles, particularly in large markets such as China, Brazil and Russia (Standard & Poor's, 1999), but in the long run these countries are nonetheless likely to provide the main sources of growth. The key question, then, is to what extent US producers are well positioned to maintain and expand their world market share. We will return to this question below.

Outsourcing and downsizing by US diagnostic imaging equipment producers

As cost reduction pressures gradually mounted from the late 1970s onward, diagnostic imaging equipment manufacturers responded with a variety of strategies. As of the early 1980s, most US manufacturers still voiced the view that price would not be a significant determinant of market share as non-price competition (based on image quality, product features, reliability, service) would dominate (Steinberg and Cohen, 1984). But by the 1990s, efforts to reduce purchasing prices were in full swing (Appelbaum et al., 2000). Such efforts included a variety of design changes. But US producers also sought to reduce production costs by drawing on a by now familiar repertoire of tools of corporate restructuring, including outsourcing and downsizing.

Design-based cost reduction strategies have taken several forms:

- Scale down equipment. Less powerful and versatile machines have long been the standard in Asia, but US (and to a lesser extent European) producers historically have targeted a premium market. This is starting to change. By selectively removing less needed or non-reimbursed functions from the equipment, Siemens lowered the price of its Magnetom Open MRI to $1 million. US manufacturers are now trying to market mid- and low-end MRI systems to first-time buyers and imaging facilities that need backup systems. Many of these are designed only to scan specific sites and deliver lower-quality whole-body images. Still, smaller systems require less space and installation costs, which can be important considerations. Philips has managed to reduce the size of its high-end system so that it weighs only 8000 lb, compared to 12 000 lb for a comparable GE model (*Health Industry Today,* 10/94). But GE Medical Systems (GEMS) and other companies have also introduced low- and mid-range models of MR and CT scanners (Morone, 1993).
- Design machines to increase throughput of patients. Fonar introduced an MRI that can scan four people in quick succession. Philips introduced an X-ray machine that can pivot between two rooms, reducing idle time (Naj, 1994).
- Market high-end machines as a way to reduce other costs. GE is developing an MRI that would give surgeons real-time 3-D images as they guide surgical instruments through small incisions, allowing them to avoid nerves, blood vessels and organs. This less invasive form of surgery would save money by minimizing risk of complications and long hospital stays (Naj, 1994; Health Industry Today, 10/94). Producers are working on a number of other, less ambitious multi-purpose machines and enhancements to image quality to pursue a value added strategy, rather than going an economy route (Health Industry Today, 9/95, p. 9; 5/95, p. 11). Moreover, manufacturers are promoting picture archiving communications systems (PACS) as a way to cut down on diagnostic imaging costs themselves (IW, 5/96). One hospital using a Fuji PACS that replaces film with computer storage reports savings of $100 000 per year.
- Enhance the capabilities of the less expensive modalities, so that they can perform functions that currently require more costly equipment. Some believe that improvements in ultrasound imaging, including future development of real-time 3-D imaging, will pose a

challenge to CT and MRI, since ultrasound systems are a fraction of the cost of the other two (*Health Industry Today,* July 1994).

Of course, the 1980s and 1990s were also a time when US corporations in general and manufacturers in particular, were using outsourcing, delayering and downsizing to shrink workforces and drive down production costs (Harrison, 1994). Thus, it is not surprising that restructuring aimed at increasing efficiency diffused among US diagnostic imaging producers.

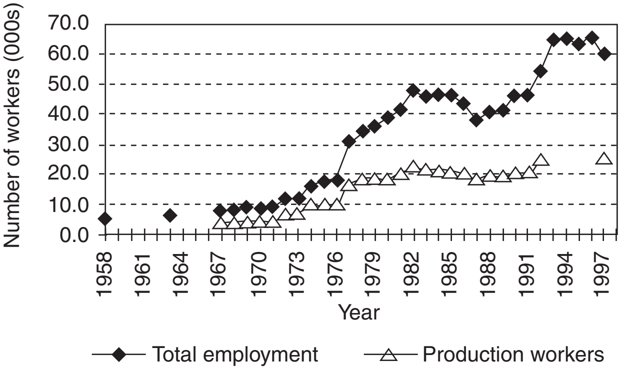
The two US-based imaging equipment manufacturers under study by the author and others took two different approaches to outsourcing. One of the two companies – call it Company A – moved strongly toward sourcing components from outside suppliers. Beginning in the late 1980s and continuing into the 1990s, Company A outsourced thousands of parts and laid off about almost 40 percent of its production workforce. Company A began to outsource some design work as well, reducing the size of its engineering workforce. Company B, on the other hand, has not outsourced components to anything like the same extent. Instead, Company B has outsourced workers, by using temporary agency workers to staff about one-quarter of its manufacturing positions.

One indicator of outsourcing is the growing share of value of US X-ray equipment shipments that is accounted for by parts and accessories, rather than finished equipment. The share of parts and accessories (excluding tubes, which the industry giants continue to produce themselves) rose from 7 percent in 1982 to 18 percent in 1997 (US Census Bureau 1984, 1998).

Outsourcing also offers one possible interpretation of broader industry employment and output trends. After 1977, total employment in the X-ray and electromedical industries more than doubled, but the production workforce remained essentially unchanged (Figure 6.4). From a peak of 61 percent of the industry workforce in the early 1970s, production workers had tumbled to 46 percent by 25 years later. Inflation-corrected value added per employee marched steadily upward from \$60 000 in 1967 to \$149 000 in 1997 (both in 1997 dollars), with the most rapid increase taking place during the 1980s.[7]

A number of possible explanations are consistent with the employment pattern. In addition to outsourcing, it could (and almost surely does, in part) result from automation, offshore production, or simply the increasingly technical nature of the industry. Our limited case study evidence suggests that outsourcing interacts with these other

Figure 6.4 Total employment and production workers in US X-ray and electromedical industries, 1958–97 (in thousands)



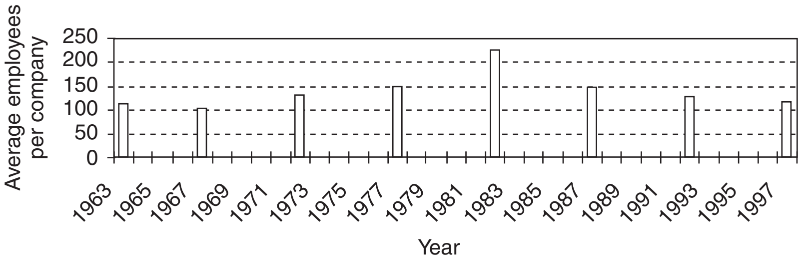
Sources: US Office of Technology Assessment (1984), Table 4; US Census Bureau (1984), Table 1a; (1990), Table 1a-2; (1995), Table 1a; (1999a), Table 1; (1999b), Table 1. Total employment 1993–96 imputed from *County Business Patterns*, (various years), Table 1b.

processes. For example, outsourcing *reinforces* the shift to a more technical workforce. In Company A, the shop floor of 20 years ago swarmed with machine operators, machinists and semi-skilled assemblers, building equipment more or less from scratch. Today, a much smaller number of workers assemble and test sub-assemblies. Since testing is such a large part of the job, most have at least some technical training. The net result is more high-quality jobs in total, but fewer high-quality jobs for people without higher education. Shop-floor testing and technical jobs typically require at least some community college and engineering jobs require at least a four year-degree.

Some outsourcing – for example, purchases of circuit boards, metal cabinets, or computer monitors – shifts production outside the diagnostic imaging industry altogether. But for accounting purposes, production of diagnostic imaging-specific subassemblies stays within the diagnostic imaging industry, simply shifting production to smaller companies. This would lead us to expect smaller firm sizes in the industry.

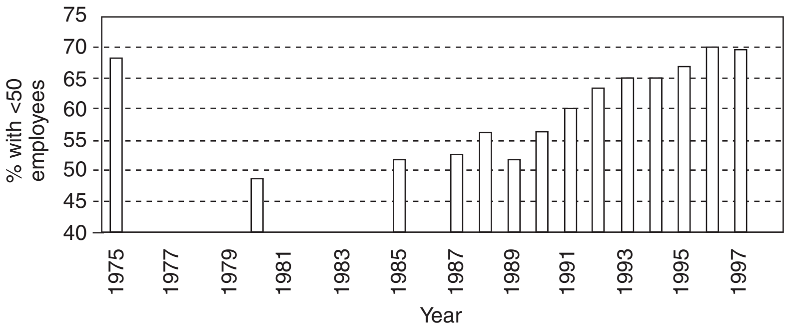
Observed changes in firm size are consistent with this expectation, though other explanations are also possible. Figures 6.5 and 6.6 display the changes. Firm sizes grew from the late 1960s to the early 1980s, boosting the number of employees per company (Figure 6.5) and reducing the proportion of total industry employment in small

Figure 6.5 Average number of employees per company in US X-ray and electromedical industries, 1963–97



Sources: Calculated by authors from US Office of Technology Assessment (1984), Tables 4 and 13; US Census Bureau (1984), Table 1a; (1990), Table 1a-2; (1995), Table 1a; (1999a), Table 1; (1999b), Table 1.

Figure 6.6 Percentage of diagnostic imaging establishments with fewer than 50 employees, 1975–97



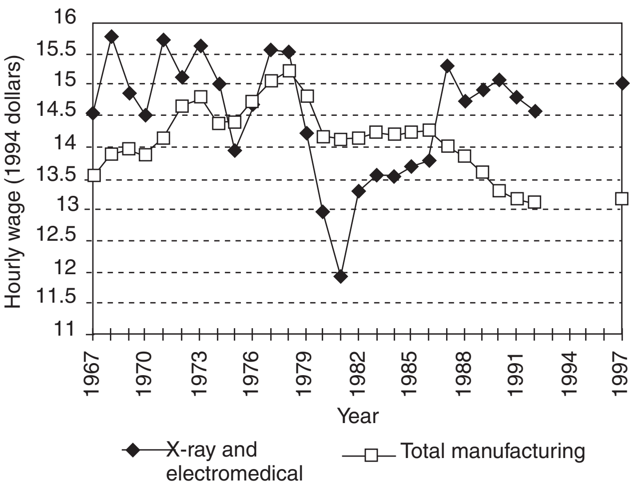
Source: US Department of Commerce, *County Business Patterns* (various years) Table 1b.

establishments (Figure 6.6). From the early 1980s onward, the direction reversed and firm sizes diminished.[8] The numbers appear to reflect a history in which first larger companies grew their workforces by acquiring smaller companies and expanding market share and then with outsourcing in the 1980s, the process reversed: the large companies shrank and a growing fringe of small companies emerged to supply sub-assemblies. However, the downturn in firm size could also simply reflect entry of small competitors, rather than suppliers. More definitive explanations of industry changes in employment and firm size await additional case study research.

Outsourcing in itself need not imply negative – or positive – effects on job quality, nor on innovative capacity. Every company purchases some inputs from other businesses and shifting a given activity from 'make' to 'buy' can have quite varied impacts depending on other circumstances. Nonetheless, there is strong evidence that, on average, smaller firms pay lower wages (Brown et al., 1990), so wage patterns in diagnostic imaging merit a closer look.

As it turns out, the effect of outsourcing and firm size changes on production workers' wages in diagnostic imaging has been ambiguous. Figure 6.7 tracks these wages over time. Production workers' wages in the X-ray and electromedical industry are considerably more volatile than average manufacturing wages, since they are affected greatly by a few union contracts and the fates of a few companies. Their wages plummeted in the 1980–81 recession, but they managed to work their way out of that hole as the economy expanded once more. (The 1980–81 wage decline probably is due at least in part to compositional changes – such as greater layoffs of high-paid than of low-paid workers – rather than simply a drop in the wages paid to individuals.) The real

Figure 6.7 Hourly wages of production workers (1997 dollars) in US X-ray and electromedical and all manufacturing, 1967–97



Source: Computed by authors from US Census Bureau (1984), Table 1a; (1990), Table 1a-2; (1995), Table 1a; (1999a), Table 1; (1999b), Table 1;US Council of Economic Advisors (1998). Wages adjusted using CPI-U.

story is not that sudden drop, but rather the long-term stagnation of wages, which fluctuated around $15.50 per hour (in 1997 dollars) as of the early 1970s and around $15.00 per hour from the late 1980s to the late 1990s. Stagnation, of course, was also the fate of US manufacturing wages in general and indeed US wages in general. Over the 1970s and 1980s, US workers lost ground relative to their counterparts in Europe and Japan (Freeman, 1994, Table 1.2). Compared to manufacturing workers as a group, production workers in X-ray and electromedical equipment have done relatively well. Meanwhile, the real hourly wages of non-production (professional, technical and managerial) workers in the industry, which had hovered between $20 and $25 from 1967 to 1982, climbed to $27 between 1982 and 1992 (not shown; US Census Bureau 1984, 1990, 1995; all figures in 1997 dollars; calculations assume these employees worked 40 hours per week).[9]

What, if anything, can we conclude about the impact of outsourcing on production worker wages? Unfortunately, we cannot conclude much. Based on available data, we do not have a reliable way to distinguish between supplying and purchasing companies within the diagnostic imaging industry and we have no way of knowing what businesses outside of the industry are its suppliers. Within X-ray and electromedical manufacturing, there is little systematic difference between the wages of small and large businesses. Establishments with 500 or more employees pay production workers an hourly wage only 5 percent higher, on average, than those with 499 or fewer. The smallest establishments (those with fewer than 20 workers) actually pay an hourly wage 33 percent above the wage offered by the largest (calculated by authors from US Census Bureau [1999a, 1999b]). Looking at wage change within the industry over time, we see that during the period of outsourcing, production worker wages within X-ray and electromedical were climbing from their early 1980s low and pulling ahead of the manufacturing average, though they have not yet re-attained their 1970s peak. This would be expected if low-end production work was being shed, but the unanswered question is who was now performing this low-end work and at what wages? Reaching conclusions about the wage effects of outsourcing will require additional case study work.

Downsizing and outsourcing affect managers and engineers as well as production workers. The stated purposes of restructuring are to allow companies to focus on their core competencies and to outsource where other producers can do the job better or at lower cost. ‘Our goal is to be competitive,’ commented one top Company A manager. ‘That means everything is on the table.’ However, some managers interviewed at

Companies A and B expressed the fear that excessive outsourcing and downsizing – and in particular outsourcing that is overly targeted on cost reduction rather than on tapping suppliers' innovative capabilities – may harm the long-run competitive strength of their respective companies. At Company A, managers complained that excessive outsourcing has resulted in quality problems. 'Quality is a continual struggle,' commented one manager. 'It is clear why: we expect a lot and don't want to pay much. The supplier base is under pressure to give on the price to get in the game.' Some also worry that outsourcing results in the loss of in-house engineering competencies: 'We're just outsourcing and outsourcing and outsourcing. We used to have a lot of knowledge about the products. Once you outsource, you lose the competencies.'

A number of Company A managers commented that repeated rounds of downsizing and escalating performance goals had exhausted the remaining management and engineering workforce. 'The business is … in the red zone on the tachometer,' commented one. He added that a certain amount of redundancy and slack is necessary to allow room for organizational memory and learning. These concerns about organizational learning offer some support for Lazonick and O'Sullivan's (1996) hypothesis that insufficient organizational integration of various layers of the workforce has weakened the competitive advantage of US manufacturers.

Company B has made far more strenuous efforts to retain its workforce, keeping company-wide turnover among permanent employees down around 5 percent. But part of their formula for doing so has been to buffer long-term employees with a ring of temporary agency workers. This strategy brings its own contradictions. One Company B manager commented on tension between regular and contract employees. She added, 'It may not be such a good idea to have contract employees. You want to have people you can count on' – given quality goals and extensive training requirements.

Have outsourcing and downsizing actually weakened the competitiveness of US-based diagnostic imaging companies? To begin to answer that question, let us examine the US industry in international context.

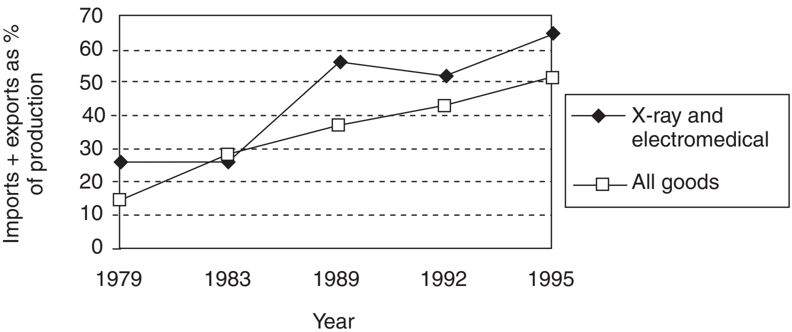
Globalization and the rise of Japanese producers

As we commented earlier, diagnostic imaging was born as an international industry. General Electric and Siemens were both present at the creation of commercial X-ray machines in 1896. As of 1958, the US diagnostic imaging market was dominated by these two, along with US-based Picker and Westinghouse and the Dutch company Philips. Together the five companies controlled 70 to 75 percent of the American market. Thirty years later in 1988, GE, Siemens, Picker (now owned by the British GEC) and Philips controlled 70 percent of the US market; only Westinghouse had dropped out (Mitchell, 1988).

Despite this apparent stability among industry leaders, globalization has in fact increased markedly. Consider two indices of globalization. First, Figure 6.8 tracks the ratio of imports plus exports to US domestic production, for the X-ray and electromedical industry and for all goods. This index computes a ratio of global production and consumption to domestic production. (Note that this index can exceed 100 percent, since only exports, not imports, are a subset of domestic production.) Globalization in X-ray and electromedical products has surged, nearly tripling between 1979 and 1995 and outpacing the similar trend for all goods.

Second, Table 6.2 shows the breakdown of diagnostic imaging equipment sold in the United States by nationality of ownership of the company. Between 1958 and 1994, sales by US-owned companies tumbled from three-quarters of total equipment sales to well under one-half, with the difference being roughly equally split between European and Japanese companies. However, this table does not accurately reflect changes in the location of production. Most of the rise in the European share results from the purchase of US companies by

Figure 6.8 Sum of imports and exports as a percentage of US domestic production, X-ray/electromedical and all goods, 1979–95



Sources: US Office of Technology Assessment (1984) Table 18; US International Trade Administration (1995), Table 1508; US International Trade Administration (1999) and US Council of Economic Advisors (1998)

Table 6.2 Percentage of diagnostic imaging equipment sales in the US, by nationality of ownership of company, 1958, 1986 and 1996

Nationality of ownership	*1958*	*1986*	*1996*
United States	75	45	40
Europe	20	45	37
Japan	3	6	20
Other	2	4	3

Note: 1996 just gives percentage of sales within top 10 companies (which accounted for 91 percent of industry sales).
Sources: Mitchell (1988), Figure 8–4; *Medical and Healthcare Marketplace Guide* (1997/98).

European ones. Most notable among these purchases was the 1981 acquisition of Picker by GEC. However, Philips and Siemens also absorbed US producers: for example, Philips purchased Rohe Scientific, the ultrasound company that perfected the gray scale technology, in 1976; Siemens acquired American producers of equipment for ultrasound (Searle) and nuclear medicine (Quantum) producers (Friar, 1986; Mitchell, 1988). Thus, the rising European share largely tracks continuing US-based production under new ownership. (For that matter, US companies have also acquired European ones, as when GE Medical Systems absorbed France's Thomson-CGR in 1987.) On the other hand, the septupled Japanese share understates the growing portion of production taking place in Japan, since, as will be discussed further below, Japanese companies produce increasing amounts of equipment sold by US-owned businesses.

Table 6.3 shows imports, exports and trade balances for the US X-ray and electromedical industry. It is difficult to discern any long-term trend. However, between 1989 and 1996 (though the years in between are not shown in the table), the US X-ray industry has run a trade deficit or at best broken even, whereas the US electromedical industry has consistently posted a somewhat larger trade surplus. The year 1996, the most recent for which data are available, was a banner export year for the electromedical industry.

How are these deficits and surpluses distributed across trading partners? As Table 6.4 demonstrates, the largest source of imports *and* exports of diagnostic imaging and related equipment is the 15–member European Community. Second is an East Asian market consisting principally of Japan and China. In X-ray equipment, the United States runs a substantial trade deficit with Europe and breaks even with Japan.

Table 6.3 Imports, exports, and trade balances in US diagnostic imaging equipment manufacturing (in 1997 dollars), 1979–97

	1979	*1983*	*1989*	*1992*	*1997*
X-RAY AND ELECTROMEDICAL					
Value of imports (millions of 1997 dollars)	451	816	1 942	2 413	2 852
Value of exports (millions of 1997 dollars)	1 177	1 297	2 263	3 100	4 916
Trade balance (millions of 1997 dollars)	726	481	322	687	2 064
X-RAY APPARATUS (SIC 3844)					
Value of imports (millions of 1997 dollars)			920	1 117	1 161
Value of exports (millions of 1997 dollars)			548	793	1 286
Trade balance (millions of 1997 dollars)			–372	–324	125
ELECTROMEDICAL (SIC 3845)					
Value of imports (millions of 1997 dollars)			1 022	1 280	1 691
Value of exports (millions of 1997 dollars)			1 716	2 287	3 630
Trade balance (millions of 1997 dollars)			694	1 007	1 939

Sources: US Office of Technology Assessment (1984), Table 18; US International Trade Administration (1995) Table 1508; and US International Trade Administration 2001.

(Sixty percent of the trade imbalance with Europe results from exchange with Germany and most of the rest from trade with the Netherlands – pointing to the importance of Siemens and Philips in the US market.) In electromedical equipment, the category that includes MRI and ultrasound scanners, however, the United States is a net exporter to both areas. Whereas in 1992 the United States was running a net trade deficit with Europe and Japan across the two categories (US International Trade Administration, 1995), in 1996 US companies had converted this to a surplus.

Also noteworthy is the high level of cross-trade – exports *and* imports of equipment to/from the same region. This points to the need to understand which companies and countries are dominating which activities within the diagnostic imaging equipment industry, which we cannot determine from these aggregate data. Such detailed information could tell us a great deal about the loci of learning and sustained competitive advantage across companies and nations.

Even without additional details, these trade figures focus attention on Japan. Japanese companies participating in the US diagnostic imaging market include Toshiba and Hitachi, but also 'Shimadzu, JEOL, Mitsubishi, Matsushita, Aloka and at least 15 others' (Mitchell, 1988, p. 8.4) as well as Japan-based General Electric Yokogawa Medical

Table 6.4 US trade in diagnostic imaging equipment by partner, 1996 (in millions of 1997 dollars)

Region	*X-ray apparatus and tubes (SIC 3844)*					*Electromedical equipment (SIC 3845)*				
	Exports		*Imports*		*Surplus*	*Exports*		*Imports*		*Surplus*
	Value ($m)	*Share (%)*	*Value ($m)*	*Share (%)*	*Deficit ($m)*	*Value ($m)*	*Share (%)*	*Value ($m)*	*Share (%)*	*Deficit ($m)*
Canada, Mexico	107	9	21	2	87	329	9	169	11	160
Latin America	80	7	0	0	80	218	6	6	0	212
European Community	477	40	884	76	–407	1579	44	528	36	1 051
Japan	233	20	232	20	1	725	20	498	34	227
Chinese Ec. Area	75	6	1	0	74	167	5	81	5	87
Other Asia	94	8	4	0	90	201	6	125	8	76
Other	111	9	23	2	89	315	9	68	5	248
Total	1176	100	1164	100	12	3535	100	1475	100	2060

Notes: 'Chinese Economic Area' comprises China, Taiwan and Hong Kong. Figures are not consistent with those in Tables 6.3 because they come from different sources. Figures in Table 6.3 are more recent and therefore probably more reliable.
Source: DRI/McGraw-Hill (1998), Table 46–12, adjusted to 1997 dollars by authors using PPI for machinery and equipment.

Systems. As Mitchell (1988) describes, Japan-based production has become increasingly important in the US market in four ways:

(a) Supply of components – a role played by Japanese firms since the 1950s.
(b) Supply of systems to be sold under US and European companies' labels. Japanese companies have sold systems under these terms since the late 1960s. In some niche markets the Japanese presence is sizable: for instance, the Acoma X-Ray Industry Company, Ltd produced one-quarter of all X-ray mammography systems sold in the United States in the late 1980s – all of which were marketed under US and European labels. Hitachi currently produces a substantial portion of Philips branded CT machines (Lazonick and O'Sullivan, 1998).
(c) Direct and indirect distribution of Japanese companies' branded products. Toshiba was the first Japanese company to set up its own sales force in the United States in 1976, but other companies have since followed suit.
(d) Joint ventures between Japanese and US or European companies. General Electric formed the Tokyo-based Yokogawa Medical Systems (YMS) joint venture with Yokogawa Electrical Works in 1982 (Tichy and Sherman, 1994). GE also has joint ventures and subsidiaries in China, India, Korea and Vietnam. Picker created a joint venture with Toray Industries and Fuji Electric Company and that joint venture now produces most of Picker's ultrasound and nuclear medicine equipment. Siemens, as well, has launched a joint venture with Asahi in the late 1980s. The reverse phenomenon has also occurred – for example, Toshiba acquired the MRI division of US-based Diasonics in 1989 after selling Diasonics machines under its label for a number of years – but is far less common (*Medical and Healthcare Marketplace Guide,* 1996).

According to Mitchell (1988, p. 8.5), YMS (now GEYMS) manufactures most of GE's ultrasound products, much of its CT product line and some MR products as well. GEYMS currently produces high-end CT and MR equipment, as well as lower-priced models (Lazonick and O'Sullivan, 1998). GEYMS sales doubled as a percentage of total GEMS sales between 1985 and 1995, rising to 44 percent of the total (though part of this is an artifact of GE's increase of its share of YMS from 51 percent to 75 percent in 1986). GEYMS production (excluding goods imported to Japan and sold by GEYMS) also rose as a share of GEMS sales, though not quite as steeply (climbing from 20 to 33 percent) (calculated by authors from Lazonick and O'Sullivan, 1998 and Medical and Healthcare Marketplace Guide, 1986, 1996). Despite the fact that General Electric holds a 75 percent stake in GEYMS, GEYMS remains a Japanese company committed in many ways to Japanese organizational practices and run for the most part by Japanese managers (Lazonick and O'Sullivan, 1998).

Beyond the particular forms by which Japanese producers have expanded production, it is important to note that these companies have also gradually widened the range of modalities in which they produce and have expanded their product lines both up- and down-market. Because of Japanese companies' particular focus on producing lower-cost systems, they seem very strongly positioned to capture the lion's share of the exploding Asian market.

Visits to GEYMS and Hitachi Medical Corporation (Lazonick and O'Sullivan, 1998) revealed significant differences in the organization of production, relative to US-based companies. Among them were:

- A higher degree of vertical integration of production, despite substantial recent movement in the direction of outsourcing. One Company A manager, when describing his company's outsourcing, noted that 'The Japanese are the antithesis of this – they make everything.' The Japanese managers, on the other hand, reported high levels of outsourcing by their standards. It will require additional case study work to adequately compare the degree of vertical disintegration in the two settings.
- Closer, longer-term, more consultative relationships with suppliers.
- Standard Japanese practices of lifetime employment, substantial on-the-job training and opportunities for production worker input into management decision-making.

Such high commitment employment and contracting practices do not imply that Japanese companies are failing to pursue efficiency improvements. Japanese diagnostic imaging equipment manufacturers, like Japanese manufacturers in other products, have a reputation for high quality and extremely efficient production processes. Between 1983 and 1995, GEYMS sales per worker increased by 38 percent in yen (129 percent in inflation-adjusted dollars); the GEYMS head count leveled off and even declined somewhat after 1993 while sales continued to climb.

Engineering managers in one company expressed low opinions of Japanese companies' capacity for innovation. But Mitchell (1988) warns against dismissing the Japanese diagnostic imaging industry as imitative, noting that many Japanese companies have strong in-house capacity and that technology transfer has flowed from Japan as well as to it. Japanese academic researchers began studying X-rays in 1898, only a few years after their European and US counterparts. Shimadzu began commercial manufacture of X-ray machines in 1911, followed shortly thereafter by Toshiba. And innovation by Japanese companies continues. For instance, Toshiba created the first continuous (as opposed to step) scanning CT. Hitachi pioneered permanent magnet MR systems, as well as developing the DICON data transmission and integration interface that has become the international standard at the heart of PACS systems (Lazonick and O'Sullivan, 1998). From available evidence, it is not clear what is the relative importance of quality, price and innovation in explaining the inroads gained by Japanese manufacturers.

Other Asian companies have more recently begun following the lead of Japanese imaging equipment manufacturers. South Korean and Taiwanese producers are expanding their capacity to manufacture sophisticated diagnostic imaging equipment (DRI/McGraw-Hill, 1998). For example, Medison, the first manufacturer of diagnostic ultrasound equipment in South Korea, saw sales rocket at 60 percent per year between 1986 and 1995, fueled by the Korean government's drive to modernize its health care system (Dongsuh Securities, 1996). Meanwhile, General Electric and Philips have also entered the Korean imaging equipment market through joint ventures (with Samsung, in the case of GE). And China's booming market for diagnostic imaging equipment is served by joint ventures established by GE, Siemens, Toshiba, Hitachi, Hewlett-Packard and numerous others (Chan, 1994a).

Despite the growing Japanese and other Asian presence in diagnostic imaging, US companies remain powerful contenders in the competitive battle. The US trade balance in X-ray and electromedical equipment is positive and in fact rather large – and has grown over the last several years. GEMS, which held a 22.5 percent market share in 1974, continued to lead the market with a 28 percent share in 1996 (though of course the latter figure includes GE's Asian and European joint ventures and subsidiaries, all acquired since 1974). However, second-tier US producers have lost ground. The five US companies among the top ten producers in 1974 accounted for 60 percent of global sales; the five US top ten companies in 1996 account for 44 percent. (This counts

Picker as a US company both times, despite its intervening acquisition by a British multinational. If we exclude Picker in 1994, the US share drops to 37 percent of total industry sales; as Table 6.2 shows, this is 40 percent of top ten company sales.) Meanwhile, Japanese top ten companies' share of total industry sales expanded from 2 percent in 1974 to 19 percent in 1996. It would require more detailed case study analysis to determine the extent to which US dominance is likely to continue to erode.

Organizational integration in US diagnostic imaging companies

Lazonick and O'Sullivan (1996) define 'organizational integration' as the integration of productive actors into a business organization's learning and decision-making activities. They argue that though US manufacturers have integrated managerial and technical workers, they have established a variety of forms of segmentation within this upper-level workforce and have for the most part failed to effect organizational integration of production workers. In contrast, many manufacturers based in Japan and Germany have attempted to reduce managerial segmentation, and to integrate shop-floor workers into organizational learning processes as well. Consequently, Lazonick and O'Sullivan hold, US companies have been less successful in developing the skill base of their workforce and promoting organizational learning. Among the results of this shortfall are losses of competitiveness in US industry and the diminution of high-quality jobs in the US economy.

To what extent does the diagnostic imaging equipment industry conform with this narrative of industrial change? First of all, we repeat that US diagnostic imaging companies continue to be internationally competitive. Even so, the reduced share of second-tier US manufacturers and the dramatic expansion of Japanese production bear further examination. So it is still of interest to consider the degree of organizational integration in the industry. In a high-technology industry such as medical diagnostic imaging, organizational integration can apply to a wide range of actors. Consider five: doctors and hospitals, government agencies and laboratories, suppliers, engineers and production workers. Pending completion of detailed case studies, the following observations are preliminary.

Doctors and hospitals

Doctors and hospitals are important to diagnostic imaging manufacturers in two ways. First, they are sources of academic research. In the 1950s and 1960s, most imaging companies maintained personal contacts with academic researchers (Mitchell, 1988). Because of the uneven nature of this contact, the businesses learned about advances in academic research primarily through journal articles (Foote, 1992)! But from the 1970s onward, manufacturers have invested much more heavily in institutional contacts with universities and research hospitals, with foreign producers such as Toshiba (which lacked informal channels for personal contacts) relying particularly heavily on this approach. Second, doctors and hospitals are customers and manufacturers count on them to offer design advice and to try out prototypes. Deep, longstanding connections between imaging manufacturers and businesses date back to the beginnings of the X-ray industry and there is no evidence that US producers have invested less in this form of organizational integration than producers in other countries. However, according to Hitachi Medical managers, a key difference is that Japanese hospital staffs include engineers who can participate directly in product development, whereas in US hospitals equipment producers can only interact with doctors and physicists (Lazonick and O'Sullivan, 1998).

Government agencies and laboratories

Again, health care in every industrialized country has had a long history of government involvement in research, as funder and in some cases as the site of research. And again, in this form of organizational integration, the United States is on a par with other industrial powers – at least in the health care industry. Japan's diagnostic imaging sector was promoted by MITI, the Ministry of International Trade and Industry. In addition to funding specific research projects, MITI established and supported academic societies devoted to the development of biomedical instrumentation (Mitchell, 1988). In the United States, the National Institutes of Health funded research in CT, MRI and ultrasound (Foote, 1992). Other US federal agencies aiding research and development in diagnostic imaging have included the National Science Foundation, the National Institute for Standards and Technology, the Food and Drug Administration and even the Department of Defense, the Department of Energy and the National Aeronautics and Space Administration (US Office of Technology Assessment, 1978, 1981, 1984).

Suppliers

In an industry in which outsourcing is advanced, relations with suppliers are critical. Here US manufacturers appear to diverge from their counterparts, though evidence is mixed. Picker's CT Division, in a World Wide Web posting (Picker International, 1997), claims that Picker has 'extremely close relationships' with 20 out of 80 suppliers, resulting in 'long-term (three years) contracts' and based on 'tight communications.' It is difficult to assess such claims in the abstract, but practice at Company A paints a mixed picture. While managers at Company A speak of 'strategic relations' with a core of suppliers, Company A's vigorous pursuit of lower costs has colored these relationships. Managers from Company A's purchasing organization did tell of efforts to teach suppliers better methods of quality control and inventory management: 'We're pretty systematically training our suppliers in statistical process control and other quality programs,' stated one manager. But the constant drive to slash costs came through in interviews at Company A as well. On the other hand, the three Japanese companies appear to maintain long-term relationships with suppliers, not infrequently sacrificing short-term cost advantages in order to preserve the benefits of mutual learning.

Engineers

Until recently, engineering employment at larger US high-technology companies was essentially lifetime employment. But downsizing and outsourcing (especially outsourcing for design and innovation) have increased turbulence in engineering careers. Managers at Company A commented on widespread feelings of job insecurity and dissatisfaction among engineers, undermining company loyalty. They also complained of high turnover, especially among software engineers. One Company A manager spoke of sitting in a meeting with engineers from a European company and estimating that the typical engineer from that company had been with the company 15 to 20 years, compared to five years at Company A. 'It may be expensive,' he said of the other company's senior engineers, 'but they know what they're doing.' Japanese companies have maintained the lifetime employment guarantee for engineers and, like Siemens, tend to retain engineers for long periods.

Production workers

Japanese and US companies diverge once more in the degree of organizational integration of production workers. The three Japanese producers use a system of lifetime employment, in-house training and substantial scope for employee involvement in decision-making. Most US companies offer no long-term employment guarantees. They do voice a rhetoric of continuous learning and employee involvement. Again, Picker's Web posting sets the tone, stating that 'On average, each employee receives between one and two weeks of training each year.' Picker describes formal and informal problem-solving teams as well as self-managed production teams and a flattened management structure that 'has resulted from the increased empowerment that employees now have' (Picker International, 1997).

But first-hand observation of US companies conveys a different impression. At Company A, managers reported that outsourcing and downsizing have created a climate of insecurity, not only among production workers, but also among engineers. For most high-level managers interviewed in Company A, the production workforce is essentially invisible, particularly since outsourcing has pushed increasing amounts of production activity beyond the corporation's boundaries. Company A's costs consist overwhelmingly of materials costs and it is these costs, not labor, that attract most attention. As described above, aggregate data for the US diagnostic imaging industry suggest that outsourcing may be a widespread strategy, though we do not have enough evidence to conclude that Company A is representative of US-based producers.

Even at Company B, which *does* attempt to guarantee long-term employment for its core employees, organizational integration of production workers appears to be falling short. Company B has shored up its guarantee by expanding the temporary workforce. But as noted above, the size of this temporary workforce has impeded organizational integration of rank-and-file workers.

Thus, while US diagnostic imaging equipment manufacturers avidly pursue organizational integration with doctors, hospitals and government agencies, they show mixed results at best in organizational integration of suppliers, engineers and production workers. In addition, the presence of engineers in Japanese hospitals creates a research and development linkage apparently unavailable in the United States.

Conclusion

Change has been a constant in the US diagnostic imaging equipment industry. Over the last several decades, rapid technological change has fed explosive growth for this industry. But growth may be reaching a plateau in the United States and other mature markets, as the bite of health care cost controls intensifies. The most rapidly growing markets will probably be in Asia, Latin America and Eastern Europe. This critical juncture in international competition arises at a time when Japanese producers have been steadily gaining market share in the world market and are well equipped to compete in Asia. While the market share of General Electric Medical Systems, the world leader, has so far remained secure – in part due to major acquisitions in Europe and Japan – the shares of second-tier US companies have shrunk.

As US companies rise to this challenge, they have engaged in over a decade of downsizing and outsourcing, with the aim of increasing efficiency. Based on the limited evidence at our disposal, we cannot fully assess the impact of this restructuring on wages and employment, nor its impact on international competitiveness. But some managers interviewed at US manufacturers expressed concerns that the restructuring weakened loyalty, heightened turnover and took a toll on the capacity for organizational learning. US firms have invested heavily in organizational integration with physicians, hospitals and government agencies. But there is some evidence that, compared to their Japanese counterparts, they have invested less in integrating suppliers, engineers and production workers.

The existing case study literature on diagnostic imaging equipment offers little help in sorting out the causal relationships among these patterns. This literature (for example McKay, 1983; Friar, 1986; Mitchell, 1988, 1995; Morone, 1993; Steinberg and Cohen, 1984; Trajtenberg, 1990) focuses squarely on innovation and corporate strategy. But overwhelmingly, for these analysts, the workforce remains invisible. Appelbaum et al's (2000) case studies of high performance work systems in the medical electronics industry offer a useful starting point, but do not include diagnostic imaging cases in particular (and address a somewhat narrow set of issues).

Additional case study analysis is needed to flesh out the story of the diagnostic imaging equipment industry. Case studies could illuminate a number of questions that have arisen in this report:

- To what extent the US industry's changes in employment and firm size reflect widespread outsourcing, as opposed to other changes.
- The wage effects of outsourcing, through examination of wages at suppliers as well as at the outsourcing companies.

- The specific types of products in which particular countries and companies enjoy competitive advantages.
- In addition to the market regions and product lines in which Japanese imaging equipment companies have been able to expand their market share, the reasons for this increase in share.
- The relative degree of vertical integration and outsourcing in US as compared to Japanese diagnostic imaging companies.
- A more careful assessment of the degree of organizational integration, particularly as regards suppliers, engineers and production workers, in US and Japanese equipment companies.

Through all of these component parts, additional case study research could take the next step in examining the connections among organizational integration, competitive success and the number and quality of jobs in diagnostic imaging equipment manufacturing firms.

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Notes

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2. The project is headed by Harold Salzman of the Center for Industrial Competitiveness at the University of Massachusetts at Lowell, and includes Philip Moss and Chris Tilly of the University of Massachusetts at Lowell as senior investigators.
3. This description of the modalities draws on Medical and Healthcare Marketplace Guide (1995).
4. Unfortunately, the US Census Bureau has suppressed information about MR production in subsequent publications (to maintain the confidentiality of individual companies), so it is not possible to update these figures.
5. This figure totals the output of SIC code 3844 (X-ray apparatus and tubes) plus magnetic resonance imaging equipment and ultrasound scanning devices. Information from US Census Bureau.
6. The Producer Price Index for machinery and equipment was used to adjust sales figures for inflation.
7. Economic Census results (1997) have been released for the X-ray industry, but not yet for the electromedical industry. For X-ray and irradiation equipment manufacturing, these trends have continued. Between 1992 and 1997, production workers fell from 50 percent to 41 percent of the workforce, and value added per employee climbed from \$134 000 to \$145 000 in 1997 dollars (US Census Bureau, 1995, 1999).
8. Again, 1997 Economic Census results have been released for the X-ray industry, but not yet for the electromedical industry, so that we cannot fully update Figure 6.5. However, for X-ray and irradiation equipment manufacturing, between 1992 and 1997, average company size fell from 130 to 100 (US Census Bureau, 1995, 1999).
9. However, these trends did not continue in X-ray and irradiation equipment between 1992 and 1997. Over this period, real hourly wages rose 35 percent for production workers, and fell 2 percent for non-production workers.

7

Earnings Inequality and the Quality of Jobs: Current Research and a Research Agenda

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Aside from recessions in 1980, 1981–82 and 1991–92, the United States has experienced impressive growth during the 1980s and 1990s. The 1999 *Economic Report of the President* trumpets almost 18 million new jobs since January 1993, bringing the unemployment rate to 4.3 percent, its lowest rate in three decades (Council of Economic Advisors, 1999). The last few years, from 1996 into 1999, are particularly notable. After two decades of decline, real wages at the bottom rungs of the wage ladder have risen, in part due to the exceptionally low rate of unemployment, a reduced rate of inflation, and a rise in the statutory minimum wage. And they rose more quickly than wages at the top of the distribution, nudging down indicators of wage inequality (Mishel et al., 1999).

Nonetheless, there are many indicators of serious concern. Real average hourly earnings declined from 1978 until the early 1990s, stagnated at the level achieved in 1965, and have only turned up with the extraordinarily tight labor market conditions of the past couple of years. Inequality of earnings and income rose over the same extended time period, again reversing the trend only very recently with a particularly hot economy. Further, the rise in earnings inequality has been pervasive, within occupations and industries, within age groups, within education groups, and markedly across education groups. Several measures of the quality of jobs other than their wage rate, for example stability and security, upward mobility, percentage of the workforce working under a contingent contract, and growth of benefits signal stagnation or deterioration.

Both the level and the rise of earnings inequality are significantly greater in the United States than in other advanced countries. Only Great Britain has had an increase in inequality in the neighborhood of what has occurred in the United States. Workers in the United States have less job security, less representation at work, and lower benefits than is the case in Japan and the industrialized countries of Europe.

There is a long list of suspects to explain the worsening distribution of earnings and job quality. Most economists have concentrated on changes in market forces, implicitly assuming that firms have been forced to respond to these market forces by moving up or down labor demand curves, or shifting or twisting their demand curves in favor of persons with more skill. Market shifts such as changes in the relative supply of college-educated workers, increases in the supply of immigrants, a rise in the relative demand for more skilled workers caused by increased use of computers and other advanced technologies, or a relative fall in the demand for low-skilled workers caused by increased international trade are the explanations most frequently put forward by economists.[1] Other economists have analyzed the weakening of particular institutional restraints on the forces of the market, including the drop in the density of union coverage of the workforce and the decline in the real value of the minimum wage. And some have tried to incorporate both market and institutional changes into their analysis (Katz and Autor, 1999: Card and Lemieux, 1999).

A few economists and industrial relations specialists have emphasized a set of factors that have worsened the bargaining position for labor, and reduced job availability and job security in mainline US industries.[2] These analysts are the exception, however. This is true despite evidence that changes have taken place in many US firms' competitive strategies in the 1970s, 1980s and 1990s. Wage setting and job security norms have changed for many companies, as have cost and job-cutting strategies. Growing and profitable firms now shed workers and resist wage increases. Other examples include restructuring outsourcing; relocation of jobs within the country and abroad; lowered training investments; and a shift in orientation towards stock market performance over other firm goals (Cappelli et al., 1997; Lazonick and O'Sullivan, 1996; Lazonick, 1997).

Indications of divergent strategies being adopted by US firms within the same industry – some taking a 'high road' strategy of greater skill investment, employee participation and better wages, and many more taking the 'low road' of squeezing labor costs through lowered wages and job security and increased task demands – suggest that there is discretion in the face of exogenous market forces.[3] Corporations play a significant role in allocation of resources in the economy. In allocating these resources, they do not act mechanically or uniformly in response to changes in technology or in the relative supply of college-educated labor. Rather they invest strategically not only in plant and equipment but also in the organization of work and in the capabilities of people to produce particular products using particular processes. How these corporations develop and utilize the productive resources in which they invest influences the skill needs as well as the incomes, job security and skill development associated with jobs.

The project, funded by the Jerome Levy Economics Institute, from which this book and this paper derive explores the dynamic interaction of the investment and competition strategies of important US industries and enterprises, and the institutional structures that characterize different nations in generating sustainable prosperity. Sustainable prosperity, in the framework of this project, is the ability to distribute the benefits of economic growth to more and more people over a prolonged period of time.[4]

This perspective opens new possibilities for research, and, if valid, offers important insights into possible remedies for the deteriorating distribution of earnings and job opportunities at the middle and lower rungs of the ladder. If changes in the distribution of earnings are the result of largely exogenous market and technology forces, improvements in the distribution may involve trading off economic growth. Observed changes in the earnings distribution may not be due exclusively to market forces, however, as the sustainable prosperity perspective developed in this project argues. It may be possible, therefore, to restructure social institutions to influence corporate investment strategies so that increasing equality of earnings and economic growth go hand in hand.

This chapter provides neither an exhaustive review of the empirical literature on changes in earnings inequality nor a major elaboration of the skill-base hypothesis and its bearing on the distribution of earnings. There have been several very good and detailed reviews of the literature on earnings inequality (Levy and Murnane, 1992; Danziger and Gottschalk, 1995; Kodrzycki, 1996; Mishel et al., 1997b; Gottschalk and Smeeding, 1977; Katz and Autor, 1999).

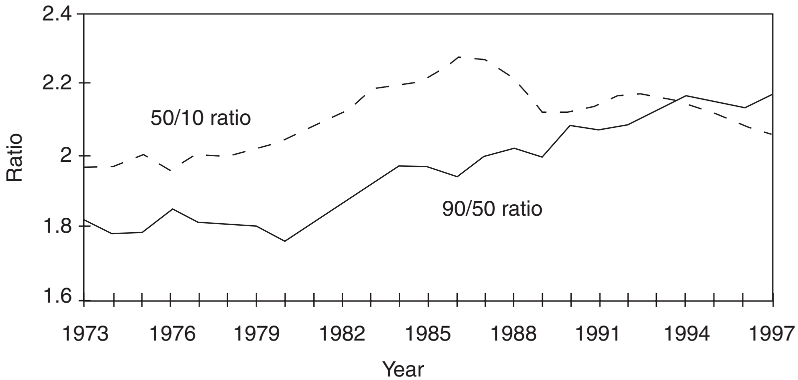
In the next section of the paper, the stylized facts of the worsening distribution of earnings and job quality in the United States are detailed. The section following is the heart of the paper – an assessment of the empirical literature that seeks to explain these facts. The last section of the paper provides a synthesis of problems in the existing literature and an alternative framework, focusing on the strategic behavior of enterprises, consistent with the sustainable prosperity approach.

What needs to be explained: the stylized facts of earnings and job quality

Inequality

That earnings in the United States have become significantly more unequal in the last 25 years is now well accepted. Earnings of the top decile have risen, those of the bottom deciles have plummeted, and those in the middle deciles have stagnated or declined. Workers in the bottom groups have faced not only a relative decline, but a significant fall in absolute terms as well. The rise in inequality occurred both for men and for women, but there were differences as well. For men, during the 1980s the very top of the distribution gained relative to the middle and the middle gained relative to the bottom. The ratio of the calculated hourly wage of the 90th percentile worker to that of the 50th worker rose from about 1.7 in 1980 to about 2.1 in 1990. The ratio of the calculated wage of the 50th to the 10th rose from about 2 in 1980 to a peak of about 2.3 in 1986–87 and declined to about 2.15 by 1990. In the 1990s, inequality for men continued to increase, but it was the top percentile that pulled away from everyone else – the 90/50 ratio continued to climb to almost 2.2 by 1994, dipped and was back at about 2.2 by 1997. The 50/10 ratio wiggled up and down somewhat during the 1990s and has declined in the last few years, but in 1994 it was essentially at the same level as in 1990 (Mishel et al., 1999).[5] Figure 7.1 shows the pattern in inequality of men's earnings.

Figure 7.1 Wage inequality: men, 1973–97



Source: Mishel et al. (1999), Figure 3.G.

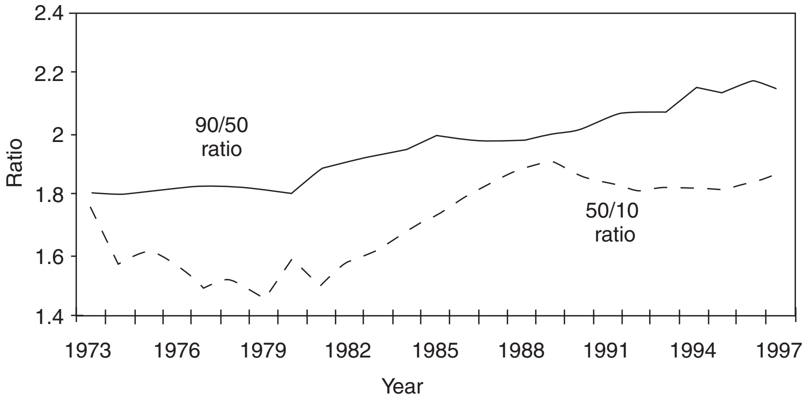
For women, the trend in the 90/50 ratio was steadily upward throughout the 1980s and the 1990s from about 1.8 in 1980 to a little less than 2 in 1990 to almost 2.2 in 1996. There was a tiny dip in 1997. The 50/10 ratio grew sharply in the 1980s, from about 1.5 in 1980 to over 1.9 by 1989. It declined slightly until 1992, since when it has been stuck at a bit over 1.8. The evolution of earnings inequality for women is shown in Figure 7.2.

Wage levels

The trend in the level of wages is also very disheartening. Real wages fell until the last year or so for every decile group of men below the 90th. The rise in the 50/10 ratio, noted above, resulted from a much faster decline among the bottom groups. The real wage (in 1995 dollars) of the median male worker slipped from \$13.66 in 1979 to \$12.41 in 1989 to \$11.62 by 1995, a 14.9 percent descent over the period. Male workers in the bottom two deciles watched their wages plunge by over 18 percent.

Wages for women at the median grew modestly in the 1980s and then fell modestly in the 1990s, leaving the median wage in 1990 4 percent above its level in 1979. Wages of women in the bottom decile fell precipitously in the 1980s (over 18 percent) but reversed very slightly in the 1990s (1.6 percent by 1995) (Mishel et al., 1997a). The

Figure 7.2 Wage inequality: women, 1973–97



Source: Mishel et al. (1999), Figure 3.H.

result of the wage trends for men and women was to lessen the gap between what men and women are paid.[6]

Timing and the changed pattern of cyclical response

The time paths of inequality and wage level measures indicate that the major loss of ground occurred in the early 1980s and secondarily in the early 1990s. The indicators of inequality had their sharpest rise from 1980 to 1982. While rising through the 1980s, the rise turned steeper again from 1990 to 1992.

Measures such as inequality, real wages and poverty levels have for the most part been countercyclical. Both the early 1980s and the early 1990s were periods of recession, so a rise in inequality and stagnation of wages was not unexpected. The sustained growth in inequality and continued slide in real wages through the recoveries of the 1980s and the 1990s marks a break from historical patterns and calls out for explanation. The particularly steep descent in the real wages of workers in the bottom deciles reversed the historical inverse relation between growth in GNP and employment and the rate of poverty (Blank and Card, 1993; Blank, 1997a).

A number of factors made the recessions of the early 1980s distinct. The 1981–82 recession followed quickly on the recession of 1980, and was especially harsh, the worst since the 1930s. The value of the US dollar was very high during the early and mid-1980s, which handicapped the US competitive position in international trade. The election of Ronald Reagan and his stance towards the Professional Air Traffic Controllers' Association (PATCO) strike signaled a change in public policy towards labor. There is no firm consensus on the degree to which these factors, or other changes in the economy, discussed below, altered the historical relationships between growth on the one hand and inequality and wages on the other.

The 1991–92 recession was milder, but marked a change from past patterns as well. Unemployment and long-duration unemployment spread into the white-collar ranks to a much greater degree than in previous recessions. Although the increased rate of job loss of managers and professionals attracted a lot of attention, lower-paid white-collar workers in technical, clerical, sales and administrative jobs suffered much more seriously than in the past as well. Their unemployment rates were higher and their unemployment was more permanent then in previous downturns. It should be noted that blue-collar workers, while losing jobs at a significantly lower rate than in earlier recessions, still suffered greater rates of job loss in 1991–92 than any other occupational category.

Job quality

Along a number of dimensions, in addition to the tumble in wages, the quality of jobs has worsened.[7] Some analysts have tried to soften the blow of declines in real wages by noting that total compensation, the sum of wages plus fringe benefits, did not fall, but rather grew very slightly from 1979 to 1994. However, the rate of growth in the 1980s and 1990s slowed significantly from its rate in the previous decades, reflecting a decline in the growth of benefits. Benefits grew by 6.4 percent in the 1960s, 2.3 percent in the 1970s, 1.3 percent in the 1980s, and a paltry 0.6 percent in the 1990s (Mishel et al., 1997a). Benefits, in fact, went down, on average, from 1994 to 1997 (Mishel et al., 1999).[8] The distribution of benefits, in particular employer-provided health care, is more unequal that the distribution of wages. Further, the distribution of benefits worsened as the fraction of employees with health care coverage and pension coverage declined. The loss in coverage was felt relatively more in the bottom quintile of earners (although the next quintile up from the bottom was also hit hard), compounding the sharp decline in wages felt in this quintile. The distribution of total compensation, as a result, is more unequal than that of wages (Little, 1995). Katz and Autor (1999), reviewing several other studies, indicate that not only does the addition of benefits reinforce the movement toward greater inequality in wages (Pierce, 1997), but accounting for the rate of occurrence of worker injuries and unattractive work times (other than 9 to 5) (Hamermesh, 1998) furthers the spread of inequality.

The decline in union coverage, plus inconsistent application of state laws barring 'wrongful discharge,' has reduced the access of US workers to due process. Job flexibility has increased, but mainly for employers, not employees. Families are supplying more work hours, chiefly from increased hours of women, and multiple job holding has increased (Mishel and Bernstein, 1994, cited by Tilly, 1996). Although there is a lot of movement up and down over the business cycle, the fraction of the workforce employed part-time has trended upward since the 1950s. Since the 1970s, the increase has been fueled primarily by persons working involuntarily part-time. The contingent or non-standard workforce has grown substantially.[9] Companies now report use of temporary workers throughout the occupational distribution (Carré, et al., 1995, Mishel et al., 1997a). Mishel et al. (1999) show that nonstandard work situations comprised approximately 30 percent of all work arrangements in 1995 and 1997.[10] Further, their research indicates that these nonstandard work situations have lower average wages than full-time work, and are less likely to provide benefits.

Job security and job stability have declined. Daniel Aaronson and Daniel Sullivan (1998, cited in Mishel et al., 1999) point to the distinction between the two. Job stability refers to long-term relationships between employer and worker, while job security denotes the situation where workers can remain in a job as long as their performance is satisfactory. From the point of view of sustainable prosperity, it is job security that is the major issue, because changes in job stability might reflect more opportunity for wage and skill growth from job mobility (Mishel et al., 1999). Most data, however, measure job stability.

Job tenure decreased for men in the 1970s and 1980s, as did industry and occupational attachment. Women's job tenure lengthened, counterbalancing to a degree the circumstances of men (Farber, 1995; Rose, 1995, 1996, quoted in Tilly, 1996). Median tenure, of course, varies by age. Young men's (aged 25–36) median tenure fell very slightly between 1987 and 1996, but for men aged 35–44 and 45–54 median tenure fell more markedly; the decline was greatest for the middle group (Mishel et al., 1999, based on Aaronson and Sullivan, 1998). The proportion of employed workers currently in a job that has lasted ten years or more or in a job that has lasted 20 years or more declined from 1979 to 1988, and by even more from 1988 to 1996 (Mishel et al., 1999, based on Farber, 1977b).

The rate of displacement from jobs increased in the 1980s and 1990s. The workforce experienced greater rates of job loss during 1993–95 (11.4 percent) than during 1991–93 (10.9 percent), and the rate was lower still during 1987–89 (7.9 percent). The rate during 1981–83 (12.3 percent) is not so much higher than the rate during 1993–96 (Mishel et al., 1999, based on Farber, 1998). This is quite remarkable considering 1982 was the trough of a very severe recession, and 1993 was the beginning of recovery from a milder recession and 1996 marked the middle of a sustained expansion.

The earnings loss associated with losing a job was higher at the end of the 1980s than at the beginning (Farber, 1997, cited by Tilly, 1996 and Mishel et al., 1997a). The rate of job loss (the fraction of the labor force that reports having lost a job in the previous three years) increased for white-collar and service workers during the 1980s (Mishel et al. 1997a using work of Farber, 1997). In the 1991–92 recession, managers experienced the greatest percentage rise in the rate of job loss, but professional, technical, administrative and sales workers' rate of job loss jumped as well (Mishel et al. 1997a).

Downward mobility became more likely and the prospect of upward mobility lessened. A greater fraction of workers experienced a downward slide in earnings during the 1980s. Men's probability of an earnings loss increased while women's declined. However, both groups experienced a heightened chance of a drop in hourly wage (factoring out the effect of changes in hours per week and weeks per year – Rose, 1996, cited in Tilly, 1996 and Mishel et al., 1997a). In general, the variability of earnings went up during the 1980s (Danziger and Gottschalk, 1995).

Disputing the idea that job quality has been declining, the Council of Economic Advisors issued a report claiming that the jobs generated in the economy in the last few years have been good-quality jobs. Two-thirds of net job growth has been in occupation/industry categories whose average wage is above the overall median wage (Council of Economic Advisors, 1996). The Council's 1997 *Economic Report of the President* repeated this claim. Several analysts have criticized the Council's assertion. The major point, however, appears to be that if job quality and wages paid are equated, then creating more good-quality jobs should appear as rising average wages, which has not occurred.[11] The Council implicitly assumes that wages within occupation/industry cells are constant, and then shows that higher-wage cells are expanding employment. The catch is that wages have been falling within these and most other cells.

International comparisons

The level and trend in inequality among industrialized nations shows that the United States began the 1980s with a level of earnings and income inequality above that for other countries. Canada and the United Kingdom were also higher than the rest of the others, but both trailed the United States. The growth in income inequality was greater in the United States than in any other of the industrialized countries, and again, the countries whose rise in inequality was closest to the US were the United Kingdom and Canada. Most countries had very modest rises in earnings inequality or no rise at all (Atkinson et al., 1995; Freeman and Katz, 1994).

The sharp decline in wages that US workers on the bottom rungs of the ladder experienced was not observed elsewhere, even in the countries that experienced increases in wage inequality. In the UK, wages rose for low-wage workers, as they did in Japan (Freeman and Katz, 1994). Most industrialized countries experienced a substantial rise in unemployment during the 1980s and early 1990s, however.[12]

A number of indicators of job quality other than inequality also leave the United States trailing other advanced nations. Productivity growth and wage growth were slower in the United States in the 1980s than in other countries. Job security in the other countries, except the UK, did not drop anywhere near the degree it did in the United States. Union coverage declined in most countries, except Canada, to some degree, but not by nearly as much as in the United States. Further, in Europe, mandated works councils assumed a greater role in maintaining worker representation as union influence diminished. The social safety net in Europe, already stronger than that in the US, was questioned and weakened to a modest degree in some countries in the 1980s and 1990s, but was not assaulted and lacerated to anywhere near the same extent as it was in the US (Freeman, 1994).

How current empirical research explains the facts

The most frequently and most widely accepted explanations given for the worsening labor market outcomes can be characterized as falling into three groups: those on the supply side; those on the demand side; and those related to certain institutional changes, in particular the decline in unionization and the falling real value of the minimum wage. Explanations based upon changes on the demand or on the supply side of the labor market assume fairly competitive conditions in the labor market, so that wages paid by skill level are determined in a market for skill levels. And changes in the wages paid by skill represent shifts or a 'twist' in either the demand for different levels of skill or the supply of different levels of skill. Within the supply/demand framework, institutions represent restraints on competitive market forces. The institutional explanations analyze changes in the level or strength of these restraints.

The perspective of sustainable prosperity suggests a fourth category of explanation. These explanations look at enterprises and changes in their choice of strategy with respect to pay structures, skill formation and implementation of technology. US blue-collar workers were well paid in the 1960s and 1970s by historical standards and by comparison with similar workers in other countries given their education and skill. When faced with new competition from abroad and/or domestically, US corporations could have chosen to invest in skill development for their workers and their organizations or seek to invest in activities and technologies that could dispense with these workers. The choice to do the latter was influenced by the economic and institutional environment in the United States, but was not a deterministic response to market changes.

The remarkable pervasiveness of the rise in earnings inequality weakens the case of any individual supply or demand factor used to explain it. Inequality has risen substantially within essentially every relevant subset of the labor market – within industries, within occupations, within education groups, within experience level groups, within age groups, within gender groups, within racial groups, within regions. Groups, or industries, or regions that did not feel the force of one of these explanatory factors experienced an upswing in inequality nonetheless. In fairness, one can't expect to explain everything with a single factor, taken alone. Nor should the failure of any one factor to be consistent with all or a majority of the observed changes in inequality invalidate it as part of a more complicated explanation.

Supply side

Three supply-side developments have been linked to increased inequality. The first is a slowdown in the growth rate of more educated workers in the 1980s compared to the 1970s (Katz and Murphy, 1992). Katz and Murphy estimate that the supply of college-educated workers relative to high-school-educated workers increased at a rate of 5 percent per year from 1971 to 1979. The annual rate of increase slowed to 2.5 percent from 1979 to 1987 (cited in Freeman and Katz, 1994). Reaction to the falling college wage premium in the 1970s, and the smaller cohorts of high-school graduates as a result of the 'baby bust' appear to be the main causes of the diminished growth of the relative supply of college graduates in the 1980s. This slowdown in the growth of relative supply, and an asserted increased demand for more educated workers (elaborated below), is averred to be an important cause of the rise in the wage premium for a college degree over a high-school degree, and hence a cause of the widening divide in wages.

It should be noted that the growth of the relative supply of college graduates picked up again in the late 1980s and into the 1990s. That this development did not moderate the widening of the distribution of earnings has been explained by a purportedly greater rise in the demand for higher-skilled workers (proxied by college-educated workers) that has outpaced the increased relative supply. There are many problems with this explanation that will be discussed below with the demand-side explanations.

Card and Lemieux (1999) present new analyses that they claim strengthen the case that changes in relative supply are a very important part of the explanation for changes in college to high-school wage premium. They show that the rise in the premium is almost entirely attributable to increases in the relative earnings of successive entering cohorts of college-educated workers that began their careers from the early 1970s on. These successive cohorts maintain a permanent premium as they age. The wage premium for older cohorts of college-educated workers, those who began their career before the early 1970s, has not seen an increase in the distance between their wages and the wages of non-college-educated workers of their cohort. They show that the timing of this 'permanent' cohort effect coincides with a decline in the rate of college completion and the rate of enrollment in post-graduate education. They estimate that the demand for college-educated labor has been steadily increasing during this period (except for a short dip in the late 1970s) and that, therefore, the change in the rate of increase of relative supply of college-educated labor is a major cause of the rise in the college wage premium.

Second, increased immigration of low-skilled workers, legal and illegal, is alleged to have stretched the wage distribution. Borjas (1994, cited in Mishel et al., 1997a) shows that the flow of legal immigration increased sharply in the 1980s, and that legal immigrants are less likely than native-born US residents to have a high-school education. Briggs (1993) indicates that the rate of illegal immigration shot up in the 1980s as well. Case studies (Moss and Tilly, 1996, 1999; Waldinger, 1992, for example) provide additional evidence of increasing employer preference for immigrants over native workers for low-end jobs, and the transition of the occupants of certain occupations from native-born, typically black, to immigrant groups. Case study appears to a very fruitful way to understand how particular kinds of immigration can affect particular groups of workers in particular strata of jobs. It also helps understand the persistence of low pay and low skill development strategies of particular industries.

The statistical literature on the effects of immigration on wages is very mixed (Borjas et al., 1992). The case for immigration having an effect on inequality is bolstered by research that shows that inequality increased relatively more in the West, where there was a relatively higher flow of low wage immigrants (Topel, 1994) but, again, there are important counter examples. Although labor economists claim to have found some national-level effect of immigration on earnings inequality, immigration cannot explain the widening inequality in the regions and cities that did not experience significant immigration. And no pronounced effect appears for Los Angeles or Miami, two cities that experienced significant immigration (Freeman, 1996).

The effects of immigration require further study. It will be hard to produce an overall statistical estimate of the national effect of immigration on wages and inequality in which policy makers might have confidence. As mentioned above, case studies have been effective in generating an understanding of the role immigration has played in maintaining low-paying industries. This understanding is useful for thinking about education and training, or school-to-work policies for low-skill workers who might compete in these industries. It would also be very useful to understand the role of immigration of college-degree seekers and highly educated and skilled individuals in maintaining the competitive position of several high-technology industries in the United States that generate relatively high pay and job security.[13]

Third, a negative demand shift at the middle and lower strata of the wage distribution may have affected supplies at lower levels. One would expect the increased amount of middle- and lower-middle-level earners who lost jobs in the 1980s would swell the number of people looking for lower-paying jobs (Howell, 1997). Job losers have suffered earnings losses of larger and larger amounts during the 1980s and 1990s. Average earnings losses were 9.2 percent in 1981–83, 10.5 percent in 1989–91, 11.2 percent in 1991–93, and 14 percent in 1993–96.

Demand side

The general story about demand and its effect on wage inequality is that the demand for labor has twisted – raising demand for more skilled workers and reducing demand for lower-skilled workers. Evidence from a variety of sources has been amassed in support of this argument. Because skill itself is so difficult to measure in large-scale survey data, it rarely is. Most of the statistical analyses rest on the assumption that level of education is reasonably synonymous with skill – more educated people are assumed to be more skilled. Therefore, if there is an increased use of more educated people (controlling for the relative supply), there must have been an increase in the demand for skill on the job.

One piece of evidence is the wage premium to more education – the earnings of college-educated workers relative to high-school-educated workers. This premium has soared. Men with college degrees earned about 22 percent more than high-school-educated men in 1979 (having fallen from about 32 percent over the 1970s). The bonus rose to about 45 percent by 1994. For women the trend was from a little over 40 percent in the early 1970s to about 30 percent in 1979 to approximately 53 percent by 1994. This has not occurred because college-educated workers have seen large rises in pay; in fact, they have not. College-educated workers' wages tumbled during the 1970s as the relative supply of them increased, and advanced modestly during the 1980s and 1990s back to the level achieved in the early 1970s. The reason for the continued rise in the education premium is that the wages of high-school and less-than-high-school-educated workers nosedived from 1979 to 1995 (–12 percent over the period for high school – 23 percent for less than high school – (Mishel et al., 1997a).

At the same time, the share of employment of more educated workers has increased within occupations and within industries. In a supply/demand framework, that both relative price and relative quantity have gone up indicates an increase in demand. Industries that employ more educated workers have grown relative to those that do not. Within industries, occupations that require more education have become more important, and within occupations, the share of workers with more than a high-school education has increased. The decline in goods-producing industries that use, on average, relatively less educated workers, and the rise of service-producing industries that use, on average, relatively more educated workers is now well known.

Recent studies have attempted to decompose the effect of within-industry increases in the use of more educated labor and the across-industry compositional shift. These studies are fairly uniform in arguing that the within-industry rise is the more important explanation for the overall increase in the use of more educated labor (Berman et al., 1994; Murphy and Welch, 1993, reviewed in Kodrzycki, 1996; and Katz and Autor, 1999). Berman, Bound, and Griliches also chart the non-production worker share in total employment in manufacturing. They interpret the observed rise in this share during the 1980s to be a further indication that demand is twisting towards higher-skilled workers, presumably exacerbating the spread in earnings between skilled and less skilled. Gordon (1996) gives an alternative explanation. He argues that upper management 'fattened' the ranks of managers and supervisors to more closely monitor line workers so as to extract more effort from them. The increased number of supervisors would then help explain the increased number of more educated workers.

Howell (1997) notes, however, that within manufacturing, the non-production share shot up in the 1980–82 period of recession, but remained stable after that. This weakens the case for either of the two causal stories for the rest of the 1980s and 1990s, when the earnings distribution continued to widen. Nonetheless, the simultaneous rise in the 1980s of the wage premium to education, the relative employment of more educated workers, and earnings inequality, has proven to be a very potent association in economists' and policy makers' minds.

The explanations given for the rise in demand for more skilled (educated) labor and the fall in demand for less educated labor center on technological change, increased international trade in goods and services, and globalization of production. For technological change, in particular, skill-biased technological change, to be the major explanation for the surge of inequality in the 1980s, it must be the case that the pace of technological change and induced skill demand has accelerated from its historical trend in the 1980s.

One aspect of technological change, greater use of computers and computer-driven processes, has accelerated in the 1980s and 1990s. Krueger (1993), in a very frequently cited paper, used Current Population Survey data and found that people working with computers were paid a significant amount more, on average, than those who were not working with computers. He also found that the likelihood that a person used a computer rose with his level of education and the payoff to the use of computers rose with education as well. The fractions of workers using computers rose between 1984 and 1989 even as the premium paid to workers who use them did not diminish, leading Krueger to infer that the technology of computer use was driving demand for workers with computer skills faster that the supply was increasing.[14]

It is interesting that Krueger found the particular computer skill associated with the highest wage premium to be use of electronic mail.[15] Krueger explains this by saying that "high-ranking executives often use electronic mail." Anyone who uses electronic mail knows that it does not involve a lot of skill or require more than very minimal training. Second, it is pretty far-fetched to believe that a 'high-ranking' executive becomes yet more high-ranking once he masters the skills of electronic mail. It is much more likely that high-ranking executives have experienced a surge in pay for quite other reasons, discussed below, and that they also have tended to be more likely to use electronic mail because US firms have tended to concentrate new skill training at the managerial ranks.

The evidence from employer data is less robust on the wage premium for computer use. Cappelli (1996), using a large-scale national survey of employers, found that among manufacturing firms the percentage of non-managerial workers using computers was associated with higher pay for production workers, although the effect was very small. There was a similar association between the percentage of managerial workers using computers and production workers' pay. Cappelli also found a positive association between the fraction of workers using computers and the probability that a firm reports that skill needs are rising, but the measured effect is, again, very small.

Berman et al. (1994) discovered that the use of more educated labor was correlated with greater investment in computer technology. This, combined with the swell in investments in computer technology occurring in the 1980s and 1990s, has led Berman et al., and almost all other analysts, to conclude that computer-related technological change has caused an upsurge in demand for more skilled labor, and a sag in demand for low-skilled workers.

Autor et al. (1998) have extended this line of analysis. They show that a larger proportion of employees using computers at work is correlated with a larger proportion of college-educated labor within both manufacturing and non-manufacturing industries. In addition, they find a positive relation between the increased use of college educated labor and several other indicators of implementation of new technology, including the amount of computer capital per worker, the rate of computer investment, research and development expenditures, and changes in capital intensity.

The demand twist has overwhelmed any supply changes, according to the argument, and has thus stretched the earnings distribution. There are a number of serious problems with this explanation, as discussed in the next section. This notwithstanding, increased technological change – primarily the use of computers – has emerged, among economists, as the leading causal culprit for the skill demand twist, which, in turn, is the favored explanation for widening earnings inequality.[16]

The increased level of international trade of the last two decades, and the emergence and increased size of the trade deficit for the US are also alleged to have twisted the demand for skill. Trade deficits mean that US buyers are buying more imported products and therefore labor demand has shifted labor toward foreign labor. By examining the factor content (the amount of different skill types of labor implicit in US exports and imports), Borjas et al. (1997) estimate the effect of the growth of US trade with less developed countries from 1980 to 1995 on the implied relative supply of high-skill (college-educated) and low-skill (high-school) labor in the United States. They find that trade has increased the implicit relative supply of low-skill labor, but that the size of the effect is not that large. Katz and Autor (1999) translate Borjas et al.'s finding into an effect on the college to high-school wage premium. Their estimate is that trade from 1980 to 1985 can account for approximately 1 percentage point out of a 19 percentage point increase in the college wage premium.

Heightened international competition and loss of domestic and world market share has also caused job losses among US manufacturing workers in a number of industries that have historically been characterized by jobs with relatively good pay, but have demanded relatively modest skill (education). There is controversy over the size of the impact of greater trade flows on earnings distributions. In the econometric research, most analysts have admitted great difficulty in separating the estimated effects of trade and the estimated effects of technological change (see Freeman, 1995 for a good review of the theory and empirical evidence).[17]

Increased international competition has had two further effects. It has weakened the bargaining position of the US workers remaining in the industries faced with this competition. Closely related, it has encouraged firms to look for cost savings by trimming their workforce, becoming more strident in wage negotiations, and seeking lower-cost, typically non-union, facilities and locations in which to operate or from which to purchase intermediate products.

Changed skill demand *within* groups

If skill is measured by education, as is done by most of the research on technological change, trade and globalization, then the substantial rise in earnings inequality that has occurred within education groups is a puzzle necessitating new or amended arguments about skill and inequality. The thrust of the modified argument is that within occupations there is an increased need and premium paid for skill beyond what is measured simply by education. This has been researched indirectly using the standard large household data sets that have no measure of skill other than education, essentially equating skill with wage (Juhn et al., 1993, for example), or by trying to measure necessary job skills directly. The first method is not satisfying because the assumption that wage level equates with skill level assumes a lot of what needs to be researched and relies on unobserved heterogeneity among individuals as the key explanatory variable. The second approach is very hard with representative data sets because longitudinal data on necessary job skills are so scarce. There is some interesting evidence, however, from case studies and studies that involve survey data gathered from employers.

Michael Handel (1994) and Peter Cappelli (1996) have surveyed the literature on the extent of skill upgrading within job categories (as opposed to compositional shifts) in the United States. Both Handel and Cappelli show how varied this literature is, the significant problems with the data sets that are used, for example the Dictionary of Occupational Titles (DOT), and the conflicting results that have emerged. A good deal of the literature measuring the change in skill in large data sets, such as the DOT, indicates that the degree of skill upgrading has been modest and uneven.

The popular vision of widespread and sharp increases in skill demands driven by an exogenous surge of high technology certainly does not fit the evidence. Howell and Wolff (1991, 1992), analyzing Census occupational data, argue that the overall rate of skill increase in jobs, while positive, slowed in the 1980s from the pace set in the 1960s. Handel (1999) finds that trends in skill measures derived from the DOT indicate that skills demand has increased steadily from the 1960s into the 1990s, but did not accelerate in the 1980s and 1990s as is required for the skill-twist hypothesis. Cappelli's research with data from Hay Associates (a firm that rates the task content of jobs to help client firms set compensation) shows that most production worker jobs experienced rising skill demands from the late 1970s to the latter half of the 1980s. The results for clerical workers were quite mixed, however, with as many jobs showing less skill need as the reverse (Cappelli, 1993).

Employers themselves report fairly consistently increased need for skills (for example, see Osterman, 1995; Holzer, 1996; Moss and Tilly, 1999; Cappelli, 1996; Murnane and Levy, 1996). Most of the studies report modest increases in skill demands, and none reports dramatically increased demand for computer or other technological skills. Holzer, for example, in a survey of roughly 3200 firms in four major metropolitan areas, and representative of all sectors, finds only 40 percent of the firms reporting an increase in skill needs. His sample is of firms whose entry-level jobs require only a high school education. Each of these studies offers some insight into the nature of changing skill demands – soft versus hard, whether related to use of computers or other technological changes, organizational changes, or more basic reading and writing skills and so on. The weight of the evidence points to increased demands at the level of quite basic skills – reading and writing – and soft skills such as motivation and communication, and to some degree team and group problem-solving skills.

Murnane and Levy show that controlling for a person's mathematics or reading skill when they were high-school seniors eliminates a substantial portion of the growth in the college to high-school wage premium in a later period (for women essentially all, and for men about one-third). This indicates to them that it is basic high-school-level skills that are in demand, and employers are increasingly using college completion as a screen to get the people who are more likely to have them.

Taking these studies together, there is no evidence of a roaring technological locomotive leaving those lacking advanced computer skills behind. In fact, in Holzer's survey data, over half of the firms report that workers in jobs that require no more than a high-school degree *use computers*. This suggests that computers, at least in many occupations, complement the skills in jobs that less educated people hold. Krueger's study presents evidence from the CPS and from surveys of placement firms and of secretaries employed by Kelly Services all showing that secretaries with knowledge of computers receive a higher wage. Since secretarial occupations are concentrated in the lower half of the earnings distribution, computer use that raises their wages should raise the earnings of lower-educated and lower-paid workers, compressing the earnings distribution, not the reverse. Handel (1998) has done a simulation analysis of the CPS data Krueger used and generated results that indicate computer use has been very mildly *equalizing* on the distribution of wages.[18]

Several recent studies, including Osterman (1994), Cappelli (1996), Bassi (1992), Lawler et al. (1992), EQW Educational Quality of the Workforce (1995), Gittleman et al. (1995) indicate that a significant fraction of firms (ranging from 20 percent to over 50 percent of all firms, and higher for manufacturing firms) report some type of activity associated with high-performance work such as teams, cross-training, job rotation, quality circles, or employee participation.[19] Some of these studies provide evidence that firms that engage in these activities are more likely to invest in training, and pay relatively more to their employees than firms that have not initiated one or more high-performance work activities. Cappelli, as well as others, makes the inference that use of these forms of organization are likely to be associated with more skill needs, and therefore, because these organizational developments are relatively new and spreading, skill needs must be rising.

These inferences are not directly tested, however, and Cappelli notes that other studies have shown that such workplace changes do not always involve skill increases. The data for these studies are all one-time cross-sections, and while they ask a question about change over time – whether skills are rising – they do not track pay over time. Therefore it is not possible to connect changed skill demand with changes in pay, or with changes in inequality of pay. Further, the introduction of high-performance work activities is relatively recent and probably cannot be a consequential factor explaining either skill change or earnings changes that occurred as far back as the early 1980s. Appelbaum and Batt (1994), having analyzed the existing case study evidence report that experiments in high-performance work often wither and result in little real change or new skill development.[20] The national survey data from firms, nevertheless, do indicate some association between these initiatives and wage levels, although the causality cannot be determined in the cross-sectional data. It is possible that such initiatives result in workers learning more skill that then, through market competition, results in higher wages. It is more plausible, however, that many firms that launch high-performance work changes are doing so as part of an investment strategy to improve productivity and quality. The strategy includes skill development and better pay levels, which may in turn have an 'efficiency wage' effect of inducing more cooperation and effort from workers.

Taken as a whole, the studies that attempt to look directly at skill changes indicate that skill demands appear to be increasing, but not at the pace suggested by the statistical literature that looks to skill changes to explain the within-education or within-occupation and industry group increase in inequality. Recall that the within-group change dominates the between-group change in accounting for the increase in earnings inequality. The change in skill demand does not seem to have occurred at a pace commensurate with the importance placed upon it by economists, and not in a way that is so concentrated on computer use as the technological change argument requires.

Institutional changes

Two changes in the institutional context of wage setting in the 1980s, the drop in the fraction of the workforce covered by collective bargaining, and the decline in the real value of the minimum wage have been researched extensively (see Freeman, 1996; DiNardo et al., 1996, for two good examples). Both unions and the minimum wage restrain market forces from pushing down wages. The weakening of these restraints, therefore, should have diminished wages in the middle and lower levels of the wage distribution where union coverage has been important and where the minimum wage is relevant.

The impact of shrinking union and/or collective bargaining coverage of US workers on earnings inequality has been estimated using several techniques (see Freeman, 1996 for a very accessible review of his and others' work in this area). Among the techniques are statistical comparisons of the US levels of coverage and earnings inequality with those of other industrial countries; time series estimates, using US data, of the impact of changes in coverage on inequality; shift-share simulations that apply regression estimates of the union/non-union wage differential to the percentage drop in union/collective bargaining coverage of workers; more complex simulations that refine the estimation of the hypothetical earnings distribution that would be in place had union/collective bargaining coverage not waned. All of the studies find an important impact of reduced union/collective bargaining coverage on earnings inequality – explaining in the neighborhood of 20 percent of the overall change. DiNardo et al. (1996) adopt a different econometric procedure and find even stronger effects of changes in unionization on wage dispersion. Fortin and Lemieux (1997) use a similar though somewhat simplified approach and show quite similar results. They also show that the effect of lower union density had a larger effect on men's wages than women's wages.

All the research on the effect of dwindling union coverage assumes that the effect of unions on firms in which they are present does not spill over to non-unionized firms.[21] If non-union firms tend to imitate union firms, or if some fraction of non-union firms takes the decline in union coverage as a harbinger of more latitude to reduce labor costs, then current estimates are likely to underestimate the true effect. Further, to the degree that combating union presence is part of a larger strategy by firms to reduce labor costs and increase flexibility to hire, fire and deploy labor, estimating the effect of reduced union coverage, *ceteris paribus*, is missing the dynamic causal mechanism behind the results.

The impact of the decline in the real minimum wage has been estimated with similar simulations or with regressions using variation among states in the change in the number of workers covered by the minimum wage and the change in inequality. Almost all studies find a significant impact, but the estimates vary much more widely across studies than do the estimates of falling union coverage. The decline in the minimum wage in the 1980s is estimated to be responsible for 10 percent to

50 percent of the total change in earnings inequality for adult men, and 30 percent to 60 percent for women. The impact on earnings inequality is estimated to be greater for women because more women work at or near the minimum wage.[22] Although the variation in estimates is large, Freeman (1996) concludes 'that maintaining the minimum wage at historically plausible levels relative to the average would have helped limit the near free-fall in wages at the bottom of the earnings distribution that characterized the U.S. job market in this period.'

The importance of changes in institutions to wage movements in the United States is underscored by a comparison across industrialized countries. Other countries have been subject to many if not all the factors alleged to have shifted labor demand and supply in the United States (in particular availability and use of computers, and increased international trade with less developed countries). While some countries experienced modest increases in inequality, their experience was not at all commensurate with what befell the United States. These countries have not experienced the same surge in inequality, or plunge in the wages of lower-wage workers. There is evidence, however, as one would expect, in many European countries of changes in earnings consistent in direction with supply and demand changes, if not nearly as large as the changes in earnings in the United States (Gottschalk, 1996).

DiNardo and Lemieux (1997) compare US and Canadian wage distributions and argue that the much larger decline in unionization seen in the United States explains a large portion of the difference in inequality growth between the two countries. Many have argued that the European countries have adjusted to changes in labor demand from technological change and increased international trade through higher unemployment because their wage-setting mechanisms are more rigid than those in the US. The evidence does not support a simple tradeoff between unemployment and wage inequality, however. The attempts to disassemble social protections and labor market restraints in the United Kingdom and several other countries, including Germany and France, have not affected employment growth. Further, the fairly constant composition by skill of the unemployed in Europe is not consistent with declining demand for low skill and increasing demand for higher skill (Blank, 1997b discusses these issues).

The research on the effects of institutional changes highlights the limitation of looking at individual phenomena piece-meal. Considering how market forces were changing and how much political, policy and management strategy was changing in the United States during the 1980s, it is problematic to assume that changes in union density and the minimum wage were exogenous to changes in earnings inequality. Katz and Autor (1999) raise the issue that the supply and demand shifts they estimate are likely to reduce union strength in wage setting. In-depth, and/or comparative case study work will be particularly useful for understanding the impacts of institutional changes in context with other changes occurring inside and outside of firms.

Evaluating, reinterpreting and extending current research

Each of the existing explanations for widening earnings inequality, taken one at a time, has difficulties. All suffer from statistical problems and limitations, as well as conceptual problems and troublesome counter examples and exceptions. Changes in the supply and demand for labor are undoubtedly part of the explanation for worsening inequality. But the case for the particular factors, notably computer technology, alleged to have shifted demand is certainly weakened by all the difficulties and inconsistencies with the evidence. Given the problems, its hegemonic hold on thinking about inequality is surprising.

Taken as a whole, the body of research has not sufficiently explored a set of promising factors or explanations for the loss of good jobs and widening inequality. In addition, other methods of research, in particular, historical, comparative and case study methods highlight further problems with the existing body of research and suggest encouraging areas for research.

The previous section mentioned several difficulties as the different factors were discussed. This section attempts to integrate them to a degree and bring them into sharper focus, so that a productive research agenda can be developed. The causal argument related to computers, technological change and demand for skill is taken up first because it is so central to existing research and policy thinking.

Technology and skill

It is very interesting that faith in the advance in technology (mainly computer use) – twist in demand away from lower skills to higher skills – wage inequality argument appears unlimited. This argument, now referred to as the skill-biased technological change (SBTC) thesis, persists as the dominant explanation, not only among economists, but also among politicians and policy makers, and in the popular press. For example, the noted academic and policy economist Paul Krugman wrote in 1994, 'It seems undeniable that the increase in the skill premium in the advanced world is primarily the result of skill-biased technological change.'[23]

Yet problems abound with this thesis, several of which were mentioned in the previous section. There are questions about the robustness of the statistical evidence. Further, a set of problems arises when in-depth, historical and comparative studies of technological change are juxtaposed with the inferences drawn from the statistical literature.

A fundamental problem with the existing body of statistical evidence, as Mishel et al. (1997a) point out, is that the argument about the nexus of technological change, skill and wages is based on *inferences* from data that measure neither the nature nor the magnitude of technological change, nor skill, nor the relation of technological change to skill change. The key causal and mediating variables are *unobserved*. The belief in the causal argument, in spite of the lack of direct confirmatory measurement, appears to rest on the simultaneous increase in the supply of more educated workers and in their *relative* (not absolute) wage – a *prima facie* case for demand forces to be at work, as noted earlier. The absence of direct measurement in existing surveys points up the need for case study research both as a basis for understanding the nature of recent technological change and its relation to skill, wages and jobs, and as a basis for informing productive measures of these phenomena that could be used in future specialized surveys.[24]

That the timing of the major investment surge in computer technology does not line up with the timing of major changes in the skill mix of employment (measured by education, or by occupations) and in earnings inequality is a pretty serious strike against the skill-biased technological change argument. According to Howell's calculations (1997), the early 1980s saw the greatest degree of skill change, as measured by education and composition of high- and low-skill occupational categories, and the sharpest rise in earnings inequality. Computer investment did not surge until the latter half of the 1980s. This difficulty with timing is also mentioned and further explored by Mishel et al. (1997a) and DiNardo and Pischke (1997).

Mishel et al. (1997a) look at trends in several indicators of implementation of new technology, including equipment per worker, R&D expenditures, computer equipment per worker, and multifactor and labor productivity. Their results further damage the basic argument. The time patterns in these indicators, and increases one might expect in multifactor and labor productivity, do not show an acceleration of technological change in the 1980s over their trends from the 1960s and 1970s (Howell, 1997 corroborates this view). Further, when these indicators are related to the change in employment shares of more and less educated workers, or higher- and lower-wage workers, the 1970s show a stronger impact than the 1980s. The measures of technological change are associated with a larger increase in high education/wage workers and decrease in lower education/wage workers in the 1970s than in the 1980s. Note that while productivity has not accelerated off its trend line from the 1970s, as the technology story suggests it should, there has been productivity growth. What is different in the 1980s and 1990s is that the gains from productivity growth have not been shared with production workers in the form of wage increases as they have been in the past. This suggests that whether or not the pace of technological change has altered, the norms of wage setting have changed, as elaborated below.

Mishel and Bernstein (1996) and Mishel et al. (1997b) further analyze the timing of changes in inequality and the pace of technological change over the last several decades. They find that the impact of technology on the utilization of more educated or higher-paid workers was not higher in the 1980s than it was in the 1970s.[25]

Several economists have now acknowledged that increases in skill demands as measured by increased use of college-educated labor, and measures of investment in technology and other capital, do not show an acceleration in the 1980s as the argument that skill-biased technological change caused the upsurge in inequality in the 1980s requires (Autor et al., 1998; Katz and Autor, 1999). Using a longer span of data that dates back to the 1960s, they assert that skill-biased technological change has steadily increased, with some ups and downs (including some acceleration in the 1980s), from the 1960s. It is therefore still an important part of the explanation of increased relative demand for skill. However, they do find that demand growth for college-educated labor decelerated in the 1990s. This is difficult to reconcile with the rest of their argument. They, along with Card and Lemieux, assert that changes in the relative *supply* of college-educated labor, in particular, a slowdown in the rate of growth of the supply of college graduates, juxtaposed with this continued rise in demand is a primary explanation for changes in the college to high-school wage premium. As Michael Handel (1999) points out, fluctuations in relative supply, which in turn are driven by demographic changes in cohort size and rates of college graduation, do not have a lot to do with the forces of the information age. Further, the timing of the slowdown in the growth of relative supply does accord with the spike in the rise of inequality in the short period of the early 1980s.

Mishel et al. (1997a) reveal another problem – the location of the changes in the earnings distribution is, for the most part, not consistent with the technology story. The nose-dive in wages at the bottom of the distribution is consistent with the story to a degree (but remember that retail clerks, cashiers and other low-wage service workers who are working with new computer technology saw a sharp drop in their wages). College-educated workers, typically earning well above the median wage, should have seen their wages bid up; but instead, practically all men below the 90th percentile saw their wages languish. While top managers (those above the 90th percentile) are involved in the implementation of computer-driven technologies, they are not the ones who must use them (other than electronic mail). The connection between technological change and bidding up the pay of top managers or other top professionals – the top few percent of the earnings distribution – seems rather attenuated. The skill-biased technological change framework has no theory as to why the very top group in the earnings distribution has pulled away from almost everybody else. Nor has it a convincing explanation as to why top executive salaries are so much higher relative to median worker wages in the United States than in other countries and why this ratio skyrocketed in the 1980s.

Mishel et al. (1997a) punch one more hole in the technology story by pointing out that the *within*-industry rise in earnings inequality was no higher in industries where technology use grew the most than in industries where technology use expanded little. Further, Howell (1997) notes that among the lower-skilled occupations that suffered particularly sharp declines in earnings were truck drivers and construction workers where there is essentially no use of computers, and retail clerks and cashiers, where implementation of computers has been extensive.[26] Introduction of computers among low-paid occupations such as retail clerks and cashiers, which are low-paid occupations, may have resulted in productivity increases that reduced demand for numbers of workers, but the productivity increases should have also raised the earnings of the workers who remain.

DiNardo and Pischke's careful econometric work points up several other problems with the statistical evidence. Comparing German data with US data, they find that use of computers on the job is associated with a similar wage premium in both countries. The big surprise is that in the German data, use of other tools, such as pencils, calculators and telephones, as well as working while sitting are associated with similar wage differentials! They, and presumably most others, do not believe that the use of pencils or sitting while working would produce an increase in productivity to merit this wage premium. They caution, therefore, that the widespread belief that computers have generated a productivity increase that, in turn, has generated a wage increase is not justified. Further, DiNardo and Pischke show that when longitudinal data are used, or a time series of CPS cross-sections is used to look at the *change* in computer use and wage *growth*, the coefficient on computer use becomes unstable. This method of differencing (using a fixed effects model) is a way to control for *unobserved* differences in skill levels (and/or job characteristics). They conclude, therefore, that the cross-sectional relation between wages and computers does not represent a causal relation between computer use and productivity. The relation, they claim, is due to heterogeneity among individuals in their unobserved levels of skill associated with computer use, and/or to the possibility that computers have been introduced more quickly into more highly skilled occupations or where wages have grown more rapidly, that is, unobserved heterogeneity among jobs. Given the nature of the data, these propositions concerning heterogeneity cannot be directly tested. Nor can the skill level of occupations be directly measured, as is the case in other research, it must be inferred from education levels or wage levels. Unfortunately, therefore, the implications of these interesting findings must rest on unobserved variables whose validity is hard to establish or disprove.[27]

In fact, the unobserved heterogeneity in skills and jobs that DiNardo and Pischke propose may not be all the relevant heterogeneity to consider.[28] First, the heterogeneity may well be in job rank or status, not simply skill. Sitting down while working, in itself, probably has little to do with productivity, but it is likely to be related to the rank of one's job. Rank or status does have something to do with pay and with the likelihood one uses computers. Second, even if the heterogeneity is indeed about skill, it may well be that it reflects heterogeneity among organizations in the degree to which they have invested in organizational skill and organizational learning which is shared among the individuals within the organization. Organizations, as case study evidence on high performance work, skill development, and implementation of technology has shown, differ in their strategies for employee involvement in learning and participation in design and implementation of technology. Thus, some organizations may have paid their workers a premium as part of a strategy of implementing computer technology.

Different strategies about shop-floor and organizational skill development may also help to explain DiNardo and Pischke's findings regarding the relationship between years of education, computer use and wages in the United States and Germany. For the US data, when they interact years of education with use of computers, they obtain a positive coefficient which, although somewhat unstable across studies, suggests that the return to computer use is greater for more educated (presumed, by the authors, to be more skilled) workers. This interaction term is negative when data for Germany are used, suggesting that less educated workers realize a greater relative return from computer use. The authors are stymied by the result. In-depth comparative study of the introduction of computer technology in the two countries might help interpret and extend the authors' findings. In particular, investment in shop-floor skill development to utilize technology is different in the United States and Germany, as is the relation of education and level of (particularly post-secondary) education to shop-floor skill.[29]

Evidence from two of the industry case studies contained in this book (Forrant and Almeida Chapters 4 and 5) perforate the simple argument that technological advance and increased computer use caused a demand twist that in turn exacerbated wage inequality. Machine tools and aircraft engines are industries that employ highly skilled workers, both in production and in engineering. New technology has been introduced either in products or processes in both industries in the last two decades. The standard story suggests that the new technology should have shifted demand away from less skilled toward more skilled or educated workers, and these firms would have paid higher wages to secure them. Instead, the case studies indicate that most US firms, for a variety of reasons of history and in response to a new set of competitive challenges, reduced engineering and skilled labor and attempted to hold down wages and other costs through downsizing, relocating production, and outsourcing. These findings put in high relief the usefulness of case study research to understand how technology is actually implemented.

Other case studies (reviewed in Handel, 1994 and Cappelli, 1996) similarly show that the implementation of technology in the United States results in wide variation in the degree of upskilling and deskilling or simply skill transforming (without a clear increase or decrease in skill). Case studies have also shown quite different strategies for combining technology, training and workplace organizational changes across firms within the same industries. Small numbers of firms have taken the high road of greater skill investment and greater responsibility for shop-floor workers along with the introduction of technological changes. Others have pursued a wage and effort squeeze of their workforce as their competitive strategy (Lazonick and O'Sullivan, 1996; Lazonick, 1997; Appelbaum and Batt, 1994; Cappelli et al., 1997). Case study research has also helped understand sectors where the low-road strategy seems pervasive and quite stable.[30]

Finally, the case study evidence indicates that the implementation of technology, including computers and computer-driven production technology, has been very different in different countries. Robots and computer assisted design or computer-assisted manufacturing are two recent examples. These technologies have been implemented very differently in different countries, with very different implications for the skill content of the jobs, earnings levels and the success of the use of the technology (Forrant, 1997; Lazonick, 1997). The pattern is long-standing in many US industries to implement technology to reduce skilled labor input. In other countries, notably Germany and Japan, the introduction of technology has involved substantial investment in shop-floor skills (Lazonick, 1990, 1991).

While not explicitly stated, the statistical literature that advances the skill-biased technological change thesis treats technology deterministically – as the exogenous driver of the process. The case study literature on the implementation of technology emphasizes that firms make strategic choices about how technology can be introduced and integrated with their broader competitive strategy. Implementation of technology is endogenous. For example, in the case of the use of robotics, the causal relation appears to run from the existing skill base to the choice of how to develop and implement advanced technology.[31] Like much economic research, the statistical literature is very weak on what firms actually do (as opposed to just responding mechanistically to changed market forces).

Considering the range of problems and criticisms, the central thesis of the technology story seems a weak foundation on which to base the diagnosis of and policy strategy to moderate the rise in earnings inequality. With the technology story battered, one needs to look elsewhere to understand why the structure of or strategy towards wage setting, employment and job quality altered in ways that sustained and continued the inequality damage begun in the recession. Within the statistical literature, work on the decline of unionization and the real value of the minimum wage appears to be the most robust across studies, and to have suffered the least injury from criticism by other analysts. However, the decline in institutional restraints on wages and job protections must, in turn, be explained. A more comprehensive theoretical framework is needed.

Expanding the research agenda

Aside from specific empirical problems, the focus on market responses to exogenous supply and demand forces has also neglected other factors that may be equally or more important. In particular, changes (or lack of changes) in the strategy, behavior and organization *inside of firms*, in norms and power relations between employees and management, and changes, other than increased international trade, that have affected the competitive environment facing firms in most sectors, have not received the research attention they likely deserve. Although these factors are discussed separately below, the most fertile way to look at theme, in all probability, will be an integrated approach, most understandable with case study and comparative research across time and across countries. The treatment here of these various developments is very brief, as Lazonick and O'Sullivan deal with them in much greater detail in their chapters in this volume.

The recession of the early 1980s coincided with a major change in national politics ushered in by the election of Ronald Reagan. The recession was caused, in part, by the federal government's new willingness to endure a high level of unemployment to wring inflationary pressure out of the economy. The government's new stance towards labor was made manifest by President Reagan's decision to break the strike by PATCO. This stance fostered a much tougher posture by private sector management, according to Daniel Mitchell. He finds that the wage concessions of the post-PATCO, recessionary, high-value-of-the-dollar days of the early 1980s persisted through the decade, long after economic conditions had reversed (see Mitchell, 1985, 1989; and Kochan et al., 1984 for further analysis).

Expanded international trade and more intense international competition are not the only changes that have affected the competitive environment for US firms. Key sectors such as transportation, banking, financial services, insurance and telecommunications have been deregulated in the last couple of decades, resulting in sharply increased competitive pressures among firms in those sectors. The emergence of large discount retail firms with new methods of distribution, and 'just-in-time' relations with vendors, has placed strong new competitive and cost pressures horizontally through the retail industry and vertically down the entire retail value chain. Taxpayer unrest and mistrust of government has boiled up, putting pressure on traditionally secure public sector employment and pay. Some firms in these sectors appear to have learned from the experiences and tactics of large manufacturing firms that were hit by international competition.[32] Certainly the same language of harsh new competition, and its use to justify a strategy of downsizing, outsourcing and relocating operations, spread throughout the economy.

Financial demands placed on firms in the 1980s and 1990s from takeover bids and pressure from large institutional investors sent top management in many firms on a hunt for rapid increases in share prices. This, in turn, legitimized a very tough stance towards labor. The focus on stock market pressures and stock market indicators of success caused many firms to seek short-term profits through cost reductions that took a toll on wages and employment.[33]

The challenge from foreign competition in combination with these additional factors stiffened the back of many US firms towards costs and labor costs in particular. The cost-cutting strategy responses by firms proceeded way beyond the conditions that spawned them. Downsizing and outsourcing was not the only possible response, as international comparisons demonstrate; nor did all US firms uniformly adopt it. The strategy of response of many US firms has antecedents in past decisions concerning the skill base in which they chose to invest (Lazonick, 1997). As we suggest below, finding out why some firms squeezed their labor force and others took a higher road should be an important item on the research agenda about sustainable prosperity.

The supply-side explanations for changes in earnings and the earnings distribution, discussed in the previous section, are based primarily on a count of persons at different education levels or occupational levels. But the supply of labor by skill is composed of numbers of people and their productive capacities. Productive capacity is certainly not well measured in the existing surveys, and where productive capacity comes from certainly cannot be understood from the existing research.

We need a closer look at skill, and the means by which skill is developed.[34] At a first cut, we need to understand how much training firms provide. In 1983 and 1991, the Current Population Survey included questions on whether an individual needed specific skills or training to obtain his or her job, and whether the individual received training to improve his or her skills once on the job. Tabulations from these surveys prepared for this paper indicate a very small decrease in the proportion of workers who report having needed specific skills or training to obtain their current job, and again a very small *decrease* in the proportion receiving training once on the job. The sample is all workers. The BLS, using the same data (Amirault, 1992), reports a tiny increase in the first proportion and a slightly larger increase in the second proportion. Constantine and Neumark (1994), again using the same data, also find increases in the two proportions, but even smaller than the small ones found by the BLS.[35] Clearly, these data show no significant increase in skills or training needs to get a job, and no evidence of any appreciable increase in training obtained while on the job.

This survey also indicates that the proportion of individuals reporting that they needed training to obtain their job or who received training once on the job is highest for the highest occupations (executives, managers and administrators) and for the highest educated individuals. Given this concentration, one might argue that, on average, less training was provided to most workers. The lack of any significant increase in reported training received or specific skills needed to obtain a job is very surprising given the alleged increase in technological change and skill demands. Why haven't firms been investing in training when the needs seem to be high and when the payoff appears so manifest?[36] This is an area where the case study research in this book of skill investment choices made by firms sheds important light. Future case study research on this topic should be very productive.

More can be learned from careful econometric work on existing data sets. But, as this chapter has tried to show, this type of work is significantly limited, and many of the key issues can only be investigated with more in-depth case studies, and comparative and historical methods. The implicit framework of most of the mainstream research on inequality sidesteps what actually goes on inside firms. The behavior of firms is modeled as being determined by exogenous forces of the market and of technology. If such forces are exogenous, then the role of policy must be to offset, in part (and in smaller part all the time, it seems), the income and unemployment consequences of these largely 'unavoidable' forces. This black-box framework deflects attention from the endogenous nature of technology and investment in skill. This limits the scope of policy analysis. Most discussion of policies to remedy earnings inequality centers on education and training provided, in large part, outside of firms. This is consistent with a view that the path of technology development is in large part exogenous to firms. Within this view the role of public policy is to provide workers with the education and training necessary to use the new technology.

Skill development, however, takes place to a very large extent within organizations (Lazonick, 1997). Who gets what skills and how the skills are utilized depend on organizational strategy and organizational integration. A better understanding of firm strategy and integration, and the connection of strategy and integration to the quality and pay of jobs, should help in the design of policies that will be effective in promoting the growth of good jobs and incomes.[37] Policies relying purely on providing more education and training without benefit of a better understanding of firm strategy, and a better organizational connection to firms themselves, will be less effective.[38]

Because technology and skill are to a large extent, embodied in organizations, it is understandable that it is hard to measure technology or skill external to their implementation in an organizational setting. In-depth case studies are needed to help researchers understand technological change as it occurs within firms so that satisfactory measures that might be used in surveys can be designed.

Given the range of choice in how technology can be implemented and how skills can be developed, case study analysis over time, and comparative work on different firms within the same industries and on the same industries in different countries, will greatly help clarify the connection between technology and skills. The case study of diagnostic imaging equipment in this book (Tilly with Handel, Chapter 6) shows that firms in the same industry in the US and in different countries have adopted different strategies regarding skill development and the integration of workers, suppliers, or customers into the design of the technology. The different strategies have different implications for the quality, security and pay of jobs. The case study of machine tools (Forrant, Chapter 4) also illustrates how the decisions to invest in skill in the major US firms have changed over time, and how new technologies have been implemented very differently in the US and Japan, again with divergent implications for the quality, security and pay of jobs.

Case study research is particularly helpful in understanding *adaptations* in firm strategies. There is potential conflict between short-term cost-cutting goals and long-term goals of growth and innovation. Downsizing, outsourcing and squeezing effort from employees reduces costs, but such strategies disrupt internal labor markets, sever lines of organizational information exchange, and dampen employee moral and loyalty. Innovation and quality benefit from employee input, information interchange and the skill development that internal labor market processes can provide. This potential conflict suggests that many firms may be experimenting with modifications to pure cost reduction strategies. Case studies in progress by the author and other researchers at firms in high-tech manufacturing and insurance and financial services are generating insights into the drawbacks of the cost-cutting approach, and the emergence of new strategies.[39] Respondents have spoken of the limits of outsourcing, and the need to invest in the skills and organization of suppliers to whom they had turned to save on labor costs.[40] Whether or not firms are led to make such investments will have implications for wages and job quality. Other respondents said that stress puts a cap on the possibility of continuing to raise production goals – a consequence of downsizing that expands the tasks assigned to the remaining employees.[41] High-ranking managers within the interviewed firms both in high-tech manufacturing and insurance and financial services are recognizing a need for new organizational models and job designs to foster innovation in product development and market penetration. Several interesting models are being designed. It remains to be seen whether the legacy of the cost-cutting, efficiency and speed-up strategy can be overcome, whether the jobs will have significant investment in skill, and whether better pay and security will be attached to the jobs.

The creation of more inequality of earnings and less secure jobs is a strong indictment of the US economy. The conventional wisdom about the causes of these developments, in part reinforced by much of the current body of research, appears to merit less confidence than seems now placed in it. Case study and national institutional research, including the studies in this book, have contributed to building a better framework for understanding the roots of these troubling economic outcomes. More such research is needed to generate policies that can support sustainable prosperity.

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Notes

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1. See Katz and Autor (1999) for a careful and balanced review.
2. See, for example, Kochan et al. (1984), Bluestone and Harrison (1982 and 1988), Harrison (1994), Gordon (1996), Howell (1997), and Cappelli et al. (1997).
3. See, for example, Appelbaum and Batt (1994).
4. Lazonick and elaborate the theoretical framework underlying the concept of sustainable prosperity in their chapters in this volume (Chapters 1 and 2).
5. The *Economic Report of the President* (Council of Economic Advisors, 1997) calculates these ratios with the earnings of full-time, full-year workers and reports similar results.
6. Robert Lerman (1997) disputes the conventional view that earnings inequality continued to rise in the 1990s. He argues that the trend in inequality is sensitive to the measure of earnings used (whether annual earnings are used or the hourly wage rate), the data source used, the sample chosen (in particular, whether both men and women are included in the sample or analyzed separately), and the way earnings at the top of the distribution are measured. He finds that when the wage rate is used as the earnings measure, and men and women are analyzed together, data from the Current Population Survey and from the *Survey of Income and Program Participation* show no significant increase in inequality after 1986. Bernstein and Mishel (1997) address some of Lerman's criticisms. They find that the trend in the 90/50 ratio continues to rise in the 1990s although the 90/10

ratio shows less movement (as Lerman finds). In addition they argue that analyzing men and women separately is appropriate because of the continued differences in treatment of men and women in the labor market.

7. This section draws significantly on Tilly (1996) and Mishel et al. (1997a and 1999).
8. Some of the decline in the amount of benefits paid by employers may be due to the increased use by employers of Health Maintenance Organizations for health benefits.
9. Mishel et al. (1999) define non-standard working situations as all jobs that are not regular full-time employment. The major component is regular part-time work, but also included is work through temporary agencies, self-employed, independent contracting, and several others.
10. Mishel et al. (1999) use the 1995 and 1997 Contingent Work Supplements to the *Current Population Survey* (CPS). Unfortunately, there are no comparable data for early years by which to gauge changes.
11. This point was made to me by Michael Handel and developed in conversation with Chris Tilly.
12. Many analysts explain the difference between the experience in the U.S. and that in Europe or Japan as different countries have 'picked' a different point along a continuum of choices that trade off employment against the level of wages. That is, in the face of market changes, the US experienced more employment growth, but at a price of stagnant wages, while other countries' wages did not fall, but at a price of low job growth and rising unemployment.
13. William Lazonick suggested this point. The Alfred P. Sloan Foundation has funded some studies of immigrant scientists and engineers which may help our understanding of their impact on the US labor market. A study is at present under way to create a more complete statistical profile than currently exists of high-skill immigrants in the United States.
14. Much of the force of Krueger's analysis comes from the impressive size of the coefficient on the use of computers. As Michael Handel (1998) points out, the size of this coefficient is unreasonable. It translates to the value of two years of education.
15. In fact, as Michael Handel (1998) notes, the coefficient on the use of email is twice the size of the coefficient for programming computers or using CAD software.
16. A poll was conducted of the attendees at a colloquium on US wage trends in the 1980s held in November 1994 at the Federal Reserve Bank of New York, which included, along with several chief executives, an all-star roster of economists working in this field. The attendees were asked to rate the relative importance of various explanations for worsening earnings inequality. Technological change garnered three times the support of the next explanation (Klitgaard and Posen 1995).
17. See also the other papers in this volume of the Journal of Economic Perspectives.
18. He calculates a decomposition of the wage distribution by taking the correlates of computer use in 1984 and using these to create a simulated distribution of computer users in 1989. He then gives these people the estimated wage premium associated with computer use.

19. The latter three studies are cited and reviewed in Cappelli 1996.
20. Appelbaum and Batt's work extends previous studies by Kochan et al. (1984) and Walton (1985). Lazonick (1990) discusses these studies and the historical context of the antecedents in the 1970s to the high-performance work efforts in the late 1980s and 1990s.
21. DiNardo et al. (1996), Fortin and Lemieux (1997), and Freeman (1996) acknowledge this difficulty with their estimation procedures, and recognize that the true effect may therefore be larger than their estimates.
22. The relatively larger effect of the fall in the real minimum wage on the earnings of women than on the earnings of men is shown very clearly by the insightful graphical analysis presented in Fortin and Lemieux (1997).
23. DiNardo and Pischke (1997) noted this quotation.
24. Levy and Murnane (1992) conclude their careful and widely cited review with a call for case studies to understand interfirm earnings differences because, 'Finding a way to get 'inside the black box of firms' may be critical to learning more about the factors that influence firms' choices of technology and their consequent demands for different types of skills. The decisions firms make are difficult to understand, but they will play a large role in determining the distribution of earned income in the years ahead.'
25. Mishel et al. (1997b) use wage quantities instead of education quantities (which other analysts have used) as the statistical measure to which technological change is correlated. They find that technology may have been more favorable to the bottom half of the distribution of male workers in the 1980s and 1990s than in the 1970s. Their results are contradictory to the prevailing wisdom and to the recent paper by Autor, et al. (1998).
26. The wages of truck drivers and construction workers were undoubtedly affected by deregulation and declines in the size and power of unions in the two sectors.
27. Michael Handel (1998) has analyzed a previously unexamined special supplement to the Current Population Survey that contains additional job content measures other than computer use. He gets results that conform to those of DiNardo and Pischke. Each job content measure when entered into a regression equation generates a significant estimated wage premium of comparable magnitude (and comparable to the effect of use of computers). If these measures are put into the equation, the coefficient on computer use falls by 40 percent from the level estimated by Krueger.
28. Chris Tilly suggested to me several points in this paragraph.
29. Forrant's chapter in this volume (Chapter 4) takes a historical, comparative approach that illustrates these points.
30. See for example Bailey and Bernhardt (1997) for an insightful case study of the retail trade industry.
31. Lazonick (Chapter 8, this volume) suggests that the Japanese success over the United States with the utilization of robotics was predicated on a deeper skill base that was not just a combination of individual skills but was the result of investments in cumulative and collective learning in the Japanese firms.
32. Through in-depth interviews with firms in manufacturing in manufacturing, insurance, retail and the public sector, Moss and Tilly (1999) found that most firms outside of manufacturing reported some version of the increased competition and cost pressure story. Further, they were demand-

ing more skills and more effort from their employees and trying organizational models to improve employee performance that paralleled models under way in manufacturing firms.

33. This is analyzed in detail by Lazonick and O'Sullivan (1996). See also Useem (1996) and Chapter 2 in Capelli et al. (1997).
34. Lynch (1994 and in other work) has done extensive research on training in the United States and in other advanced countries.
35. Michael Handel prepared the tabulations for this paper. The difference between Handel's results and those of the BLS and Constantine and Neumark are small, and appear to be due to differences in the samples analyzed.
36. Lynch (1994) summarizes her own and many other studies that show a high return to company-provided training.
37. Murnane and Levy (1996) are an exception. They try to connect educational reform to what they have learned from companies about the skills that are actually useful in the workplace.
38. Policy makers need to be careful, however, not to think that a successful partnership with firms in the design and implementation of education and training policy means letting firms control the design and implementation of such policies. The same pressures that have induced so many US firms to adopt 'low-road' human resource and wage strategies will induce firms to press for low-road education and training policies that are congruent with their strategy. If firms are pursuing a strategy of a very narrow and segmented skill base for their employees, they will encourage education and training policies that conform to such a skill base. There is pressure from firms, for example, on community colleges to provide very narrow training that is specific to narrowly designed jobs. See for example Luria (1997) and Traub (1997).
39. The project, entitled 'Corporate Restructuring, Skill Formation, and Earnings Inequality,' is funded by the Alfred P. Sloan Foundation. It is managed by Harold Salzman, formerly of Jobs for the Future and now at the University of Massachusetts Lowell, and includes Chris Tilly and Philip Moss of the University of Massachusetts Lowell.
40. See the report of some of these interviews in Chris Tilly's chapter in this volume (Chapter 6).
41. Moss et al. (1999) argue that the push to reduce costs and promote operational efficiency is the second wave of corporate restructuring, following a first wave of determining and focusing on 'core competencies' (itself a reaction to the mergers and acquisitions that preceded it). The third wave is the emergence of strategies for growth – a search for organizational forms and job designs that promote innovation and expansion of market share. See also Salzman (1997).

8

The Japanese Economy and Corporate Reform: What Path to Sustainable Prosperity?

*William Lazonick**

Japan's economic problems

In the 1980s, as Japan reaped the rewards of its extraordinary economic development of the post-World War II decades, companies around the world sought to learn from Japanese managerial practices. Even as in the United States, financial interests, including a growing number of corporate CEOs, were more aggressively advocating 'maximization of shareholder value' as a managerial ideology; within American industrial corporations slogans such as 'total quality management' also vied for attention (Goldstein, 1997). But the collapse of Japan's bubble economy in 1990 and the persistence of recessionary conditions during the 1990s have raised doubts about the viability of the 'Japanese model', particularly in the West but increasingly in Japan as well. Japan's negative rates of economic growth in 1997 and 1998 have prompted calls for Japanese corporations to embrace the corporate governance principle of maximizing shareholder value.

Most vocal have been the foreign investment bankers, business analysts, and management consultants whose presence in Japan has been much increased, and influence much enhanced, by their involvement in 'Financial Big Bang'. Foreigners accounted for a record high of more than 40 percent of trading value on the Tokyo Stock Exchange in fiscal 1998 (*Nihon Keizai Shimbun* 1999c), and increased their holdings of outstanding stocks from a pre-bubble high of 6.3 percent in 1985 to 9.8 percent in March 1997 and 13.4 percent in March 1998 (Tokyo Stock Exchange 1998, p. 115; Furukawa, 1998). During the winter of 1999, announcements of significant staff cuts by some major Japanese corporations kindled the hope among the expatriate financial community that Japan would at long last shed its 'retain-and-reinvest' system of corporate governance, based on the institutions of lifetime employment and cross-shareholding, and opt instead for a 'downsize-and-distribute' regime. Much of the 20 percent rise in the Nikkei 225 stock index during the first three months of 1999 was attributed to stock purchases by foreigners who, inspired by the exuberance of the foreign press over planned staff cuts by major Japanese companies, believed that a new era of corporate restructuring was at hand (Strom, 1999).

Under a retain-and-reinvest system, a corporation emphasizes the retention of corporate revenues for the purpose of reinvesting in the physical and human resources of the enterprise. Such investments, when successful, generate an augmented stream of revenues that can increase the returns to stakeholders while still permitting renewed investment. Retain and reinvest is the normal orientation of a corporation when it is growing in scale and scope. Indeed, a new venture that seeks to transform itself into a going concern typically has no other choice. But an enterprise that has already experienced sustained growth can if it so chooses downsize its operations – which generally means shedding labor – and distribute corporate revenues in the forms of dividends and stock repurchases to shareholders.

When, in the 1990s, Western financial analysts called for Japanese companies to engage in 'corporate restructuring', they were really advocating a change in corporate strategy from an emphasis on retain and reinvest to a focus on downsize and distribute. For example, in March 1999, Alexander Kinmont of Morgan Stanley Japan opined: 'If Japanese firms conduct drastic restructuring as they have announced so far, the Nikkei index will rise to as high as 18 000 points toward the end of this year. Otherwise, it will waver in the 15 000s' (Shimizu, 1999). A strategist at Merrill Lynch Japan, commenting on the continuing net stock purchases by foreign investors, stated: 'Foreigners are probably encouraged by the recent restructuring efforts of Japanese companies, which involve staffing cuts, a measure rarely employed in the past' (*Nihon Keizai Shimbun*, 1999d; 1999h).

The fact is that Japan experienced serious economic difficulties throughout the 1990s that, if not acted upon, could have plunged the nation, the region, and even an already fragile global economy into depression. As in other advanced economies, the resource-allocation strategies of established corporations are central to resource allocation in, and the economic performance of, the economy as a whole. In a world of industrial and corporate change, the issue is not whether Japanese corporations should alter the ways in which they allocate resources and returns. What is at issue is the principle of corporate governance that determines for whom, by whom, and in what ways such reallocations are carried out.[1]

Japan's economic problems are well known. When the rate of unemployment reached 4.9 percent in June 1999, it was the highest level that had been recorded since the compilation of monthly statistics began in 1953. There were 3.3 million people unemployed in June 1999, 450 000 more than 12 months earlier. Among the unemployed in June 1999, a record 1.18 million people had left jobs involuntarily, as their former employers went bankrupt or restructured (*Nikkei Weekly*, 1999c).

An unemployment rate of under 5 percent is low by the standard of cross-national experience but high by the standard of Japan's experience over the last half century. Most worrying is the fact – much noticed and indeed acclaimed by the proponents of shareholder value – that a number of Japanese corporations that were central to the nation's phenomenal postwar development were in the late 1990s making significant cuts in employment.

Meanwhile the banking system, which played a major intermediary role in the mobilization of financial resources that enabled Japanese businesses to grow and prosper, found itself in the 1990s burdened with mountains of bad debt. The recent efforts to restore the liquidity of, and confidence in, the banking system have been at the significant cost of curtailing credit to many businesses that desperately need infusions of funds to keep people productively employed. Over the course of 1997 and well into 1998 increasing numbers of bankruptcies of companies with more than 10 million yen in liabilities were attributed to the unavailability of bank credit (*Nikkei Weekly*, 1998; Ishibashi, 1998). Government intervention helped to reduce these figures during the last quarter of 1998 and into 1999, but in historical perspective bankruptcies remained high (*Nikkei Weekly*, 1999b).

That, throughout the recessionary conditions of the 1990s, modest growth in household earnings was maintained, and that, at the end of the 1990s, the rate of unemployment was still as low as it was, mean that there was still plenty of consuming power in the Japanese economy. But, with rates of household savings out of disposable income about 13 percent during the 1990s, much of this potential demand was not being translated into effective demand. In a developing or inflationary economy such abstemious consumer behavior is much admired. But in recessionary conditions, higher savings rates mean less consumer demand to prime the pump that can get the springs of prosperity flowing again.

Of longer-run importance to the achievement of sustainable prosperity in Japan is the problem of maintaining the disposable incomes of people who do not have employment incomes to translate their consumption needs into effective demand. In Japan the problem is much less poverty-stricken armies of unemployed and unable – although the encampments of the homeless in Shinjuku Station provide very real and visible examples of what at the end of the twentieth century was possible even in Japan. Rather it is much more the problem of supporting the world's most rapidly aging population. The proportion of the Japanese population aged 65 or older increased from 5 percent in 1950 to 15 percent in 1995, a period during which the proportion of the US population aged 65 and over rose from 8 percent to just over 12 percent. In 1995 Japan's elderly population was still a smaller proportion of the total than in most Western European nations. But, with the elderly rate expected to rise to 20 percent by 2010 and 25 percent by 2020, Japan will have the most aged society in the world within the next generation (Seike, 1997:152; *Nikkei Weekly*, 1997b; p. 143; Bosworth and Burtless, 1997, p. 11).

Driving this rapid aging of Japanese society is a combination of longer life expectancies and declining birth rates. In 1955, on the eve of the era of high-speed growth, average life expectancy at birth was 64 years for a Japanese man and 69 years for a Japanese woman. By 1987 these figures were 76 years for men and 81 years for women – the highest average life expectancies in the world, a distinction that Japan still maintains (Statistics Bureau, 1989, p. 55). Meanwhile, the birth rate has declined persistently, reaching a record low of 1.39 in 1997, down from 1.50 in 1990. The Japanese birth rate has plunged so low that since 1995 the absolute number of births per year has been lower than at any time since records began to be kept in 1899 (*Nikkei Weekly*, 1997a, p. 142).

These demographic trends have generated a long-run problem of intergenerational dependence. In 1990, 17 percent of the Japanese population were in the 20–29 age group, while only 12 percent were in the 60–69 age group. The proportion of the younger group rose to 19 percent in the mid-1990s but will decline steadily into the early decades of the twenty-first century. Around 2005 the proportions will be about equal at between 15 and 16 percent, but then the proportion of the older group will become increasingly greater than the proportion of the younger group. In 30 years, it is expected that the proportion of those receiving government pension payments will increase to over 40 percent from the current 20 percent. Yet, already in Japan, recessionary conditions have forced the government, corporations and life insurers to reduce the levels of old-age pension benefits and increase the ages of eligibility for receiving these benefits from those that had earlier been promised (Suzuki, 1996; Ogura, 1994, pp. 146–8, 170; Seike, 1997, p. 153).

Indeed, a major objective of Financial Big Bang, launched in 1997 and still ongoing, is to transform the Japanese financial sector into a highly efficient machine for financial asset management that can generate higher returns on the nation's massive retirement savings. Toward that end, Financial Big Bang regulatory reforms have enabled various types of previously specialized financial institutions to enter into each other's lines of business, permitted the setting up of financial holding companies, given unrestricted access of households to foreign exchange, opened the doors for the integral involvement of foreign financial enterprises in the management of Japanese financial assets, and, most recently, facilitated the privatization of pensions by supporting the growth of stock-based mutual funds (Ishizawa, 1997; Shimizu, 1997). Given the extremely low rates of returns on corporate securities in Japan, including a dividend yield rate on First Section TSE stocks that has remained below one percent since 1985 (Tokyo Stock Exchange, 1998, p. 114), the generation of higher returns on Japanese corporate securities offers a prime means for increasing the rate of return on household savings. Largely through these market-oriented changes in the organization and orientation of Japan's system of saving and pension provision, the ideology of 'maximizing shareholder value' has been introduced into the Japanese corporate governance debates.

Origins of Japan's economic problems

Cogent proposals for reforming Japan's system of corporate governance to generate sustainable prosperity require a perspective on the postwar development of the Japanese economy that can explain the relation between the nation's phenomenal success from the 1950s through the 1980s and its economic problems in the 1990s. Japan's economic problems of the 1990s – unemployment, unstable banks, underconsumption and underfunded pensions – are largely the direct results of the nation's rapid and successful economic development in the previous four decades. An understanding of the transition of the Japanese economy from the boom of the 1980s to the stagnation of the 1990s is essential for assessing how the institutional foundations of Japanese economic development can be reformed to generate economic growth that is both stable and equitable over the next generation.

Although some of the conditions for Japan's postwar success – in particular its accumulation of technological knowledge and skill – go back to the Meiji era, the basis for its rapid catchup to the United States and Europe in the postwar decades was its ability to develop and utilize productive resources to become a world leader in a range of technology-intensive industries (Lazonick, 1998b). The Japanese corporations that led this development process did so by continuously reinvesting in plant, equipment and people to generate innovative products and processes, and then shared the gains of their competitive successes with their employees, suppliers, distributors, and communities. Through a variety of government policies aimed at creating a greater equality of incomes throughout the economy, the gains of the successful business enterprises in the high-value-added sectors also supported the reallocation of returns to those employed in lower-value-added sectors of the economy. In the 1990s, as a result of this development process, the Japanese people enjoy one of the highest levels of per capita income and one of the most equal distributions of income across households in the world. Despite the recessionary conditions of the 1990s, Japan remains a world-leading innovator, exporter and creditor.

So why do I argue that Japan's problems in the 1990s are largely the results of its success in the previous decades? That an unemployment rate of less than 5 percent is unacceptably high in Japan, but is now viewed as admirably low in most of the other advanced economies, is a legacy of Japan's ability to generate productive opportunities for the population that kept the unemployment rate very low from the 1950s through the 1980s. True, it did so, and still does so, by highly segmenting male employment from female employment and by strictly limiting the employment of foreigners in Japan (Lazonick, 1995). A challenge that faces Japanese society is to make more productive and creative use of its female labor force than has heretofore been the case – a process that was begun amidst labor shortages in the 1980s but that was disrupted when the bubble burst. As for foreign labor, during the past two decades Japanese companies have employed large numbers of non-Japanese employees through foreign direct investment, so much so that during the 1990s such employment has raised fears of 'hollowing out' in Japan. The fact that these fears of hollowing out have not materialized is in part because of the fundamental strength of Japanese industrial corporations both at home and abroad throughout the 1990s and their commitment to keep their domestic labor forces employed (Okina and Kohsaka, 1996; Yahata, 1996, p. 5). In particular, during the first half of the 1990s, influenced by the strengthening yen, Japanese foreign direct investment in Asia was part of a dynamic of growth in the region as a whole that created new export markets for Japanese capital goods (Hobday, 1995; Hatch and Yamamura, 1996).

Japan's relatively low unemployment rates are also partly the result of massive government spending in the 1990s. Given the importance of the Fiscal Investment and Loan Program, administered by the Trust Fund Bureau of the Ministry of Finance, to Japanese development over the past half century, large-scale government involvement in resource allocation is not new to Japan (Endo, 1996; Nakamura and Yamada 1996). What is new in the 1990s is the extent of budgetary expenditures, as are the levels of taxes and bond issues that are needed to support these expenditures. With a high rate of domestic savings, the Japanese economy can afford these government budgetary expenditures. But if the corporate system that remains central to resource allocation in the Japanese economy should falter in its incentive and ability to maintain employment, the burden cast on government spending to support the economy could become untenable, both politically and economically.

In the era of high-speed growth, the main role of Japan's 'developmental' state was less to exercise direct control over the allocation of society's productive resources and more to mobilize the nation's savings through the banking system to 'developmental' enterprises. Within these enterprises, corporate managers controlled the allocation of resources to investments in particular products and processes. Retained earnings, protected by the system of cross-shareholding, provided the foundation for what Mary O'Sullivan and I call 'financial commitment': the sustained access of a business enterprise to the financial resources required to develop and utilize productive resources until the enterprise can generate products of sufficiently high quality and low cost to be competitive on markets and to generate returns (Lazonick and O'Sullivan, 1996, 1997a, 1997b). But the pace of Japan's development and the capital requirements of the sectors in which Japan's competitive success occurred meant that, to secure the requisite financial commitment, retained earnings had to be highly leveraged through bank loans under the 'main bank system'.

Influenced by Western agency theory, many economic analyses of the role of the main bank system in Japan's postwar development contend that the banks played a major role in monitoring the performance of the industrial corporations, thus making the banks rather than the corporations the critical loci for control over corporate resource allocation (Aoki and Patrick, 1994; Miyajima, 1996; Sheard, 1998). But, given the complexities and uncertainties of the industries in which Japanese corporations achieved success, it was corporate managers, not bank managers, who had the knowledge of organizations and technologies required to make informed allocation decisions. Moreover, as these corporations, through the development and utilization of productive resources, transformed these investment decisions into sustained competitive advantage, their reliance on their main banks – and on bank debt more generally – loosened. Indeed, by the late 1970s and even more so over the course of the 1980s, successful industrial corporations were able to restructure their balance sheets using retained earnings or, especially in the late 1980s at the peak of the bubble, stock and convertible or warrant bond issues to pay off bank debt (Nakamura and Yamada, 1996, p. 139).

Thus the competitive success of these corporations on international markets in the 1970s and 1980s laid the basis for the financial problems of the Japanese banking system in the 1990s. As the wealth of the Japanese economy grew in these decades, the banks were flooded with corporate and household deposits. Yet at the same time, the bank's biggest and best borrowers – the successful industrial corporations – were able to scale back their reliance on bank finance. The banks – including the much-admired main banks that the agency theorists had deemed to be such excellent monitors of economic activity – now became sources of easy money, often accepting the market value of the borrower's stocks and land as collateral (Ziemba, 1991; Shimizu, 1992). That stock prices and land prices were rising in the 1970s and 1980s was in large part the result of the very real success of Japan's industrial economy. In the late 1980s, however, bank lending helped fuel the speculative bubbles in stock and land prices until, as the 1980s ended and the 1990s began, these bubbles burst. The recessionary conditions of the 1990s ensured that existing problem loans would become more problematic and that many new loans, even those more prudently extended, would turn bad. But the origins of the banking crisis of the 1990s can be found in the changed relation of the banking sector to the industrial sector in the 1980s. Successful industrial corporations were able to reduce their bank debt, thus diminishing the need for the banks to play their traditional intermediary role at the same time that these banks were awash with loanable funds – funds that, when lent, permitted the land and stock speculations of the bubble economy.

During the 1990s, the banking system still had a central role to play in channeling investment finance to business enterprises, and especially to small and medium-sized enterprises that were able and willing to grow. But there is no doubt that, given its changed relation with its major industrial clients in a rich economy, the banking system that emerged from the 1980s and that was so troubled in the 1990s needed to be reduced in size and transformed to perform new functions. In terms of the banks' traditional intermediary functions, a major overhaul of the banking system – including consolidation of banks, writing off of bad loans, stricter adherence to Bank of International Settlements capital-adequacy ratios, and closer financial supervision – has been under way since the government permitted the Hokkaido Takushoku Bank to fail in November 1997 (Yokota, 1997). At the same time, under Financial Big Bang, the banking system is being transformed into an integrated financial system that, in addition to channeling savings to businesses for the sake of productive investment, can participate in managing the savings of the Japanese population for the sake of financial returns.

Alongside corporate disintermediation, the massive accumulation of savings by Japanese households was one reason why in the 1980s Japanese banks had too much money to lend. Not that Japan in the 1980s was not a consumer society. Indeed, since the 1950s, it had been through serving domestic consumer markets that Japanese industrial companies developed the productive capabilities and financial resources that then enabled them to compete successfully for high-income international markets in the 1970s and 1980s. At a point in time, what a household does not consume, it saves. But over time, when incomes are rising, a household can both consume more and save more. When during the postwar decades the incomes of Japanese households were rising so rapidly and persistently, these households greatly increased their levels of consumption even as they continued to accumulate savings out of disposable income at a high rate (Katz, 1998, p. 210–13).

During the 1990s, with their employment incomes and retirement incomes much more uncertain than had been the case in the past, Japanese households have increased their rate of savings as compared with the late 1980s. But as a percentage of GDP, private consumption is actually somewhat higher in the 1990s than it was in previous decades. In 1985 private consumption was 58.5 percent of GDP, whereas in 1995 it was 60.0 percent. Moreover, as a proportion of GDP, Japan's allocation to private consumption is in line with that of continental European countries, although lower than in the United States and the UK; in 1995 private consumption as a proportion of GDP was 60.1 percent in France, 57.2 percent in Germany, 68.0 percent in the United States, and 63.8 percent in the UK (OECD, 1999). But then one might argue that, for sustainable prosperity, the Americans should save more and the British should invest more.

An increase in Japanese consumer spending may well help to increase production and employment in the short term. But over the long term it is not at all clear that an increase in the propensity of households to consume will keep growth rates up and unemployment rates down. Rather, sustainable prosperity requires continuous productive transformations that generate higher-quality goods and services at prices that large sections of the population can afford. Given the maturation of many of the industries that made Japan a rich nation, it can be argued that what Japan needs now is not a quick fix of more consumption but rather new definitions of high-quality goods and services whose unit costs can be lowered through continuous process improvement and achievement of scale economies, while maintaining high and stable earnings for the producers who are also Japan's consumers.

The overly optimistic promises of pension benefits to Japan's households are also a product of the rapid rate of economic growth before the 1990s. The postwar transformation of Japan from a poor nation into a rich nation created expectations concerning not only employment incomes but also the retirement incomes that could be yielded by that growth on a sustainable basis. Even in the boom years of the 1980s, the Japanese government recognized that the unexpectedly rapid aging of the population would require that people spend more of their lives in productive employment if intergenerational dependence was not to overwhelm the pension system even in good times. In fact, the Japanese remain in the labor force much longer than is the case in any other advanced nation. In the early 1990s, the labor force participation rate of men aged 60–64 was 75 percent in Japan, compared with 55 percent in the United States and 35 percent in Germany (Seike, 1997, p. 155).

Although high by international standards, the current labor force participation rate of Japanese men aged 60–64 represents, however, a sharp decrease from the rate of 84 percent that prevailed in the 1960s. It appears that, as in other countries, Japanese workers responded to increases in pension benefits by retiring earlier. The labor force participation rate of men aged 60–64 declined to 71 percent in the late 1980s, primarily because of an increase in real pension benefits – in 1973 the government began indexing public pension benefits to inflation – but also because of a decline of the self-employed proportion of the population, who have a higher labor force participation rate of older workers. When combined with the government policies from the mid-1980s to reduce pension benefits, the recessionary conditions of the early 1990s reversed the direction of the labor force participation rate of 60–64-year-old men, increasing it from 71 percent in 1988 to 75 percent in 1993 (Seike, 1997, pp. 155–7; Seike and Shimada, 1994).

In 1994 the Japanese government revised the public pension system by moderating benefit levels and by gradually extending the age at which people would be eligible to draw the full pension annuity from 60 to 65, effective in 2013. The reform also introduced a new partial pension for those between the ages of 60 and 64 that provides about half of the full pension for those who would like to retire before 65. For those eligible for pensions who still remain employed, the reform increased the amount of permitted earnings to ensure that total income (earnings plus pension benefit) would not decrease as earnings rose (Seike, 1996, p. 4; 1997, pp. 161–2). Public pension policy is therefore working to keep people employed longer. The government and the unions have pressed companies to keep people employed for more years of their lives. The unions tempered their wage demands in the 1999 Spring Offensive, but focused their attention on issues related to severance pay, pension plans and mandatory retirement ages (*Nikkei Weekly*, 1999a; *Nihon Keizai Shimbun*, 1999i). By the early 1990s virtually all large companies and even the vast majority of small companies had increased the retirement age to 60, which in effect meant that, under the system of lifetime employment, companies undertook to keep their workers employed to this age. Starting in the 1998 fiscal year, under the Law Concerning the Stabilization of Employment of Older Persons, in line with the changes in public pension policy, employers were requested to extend the retirement age to 65 by the year 2013 (Seike, 1996, p. 5).

In the late 1990s, the age structure of corporate employment combined with the continuing recession to place a strain on most companies that would seek to keep people employed even longer than is presently the case. The postwar baby boomers were creating a big bulge of middle-aged employees in Japanese companies. But the demographics were changing; the size of the population in their twenties peaked at 19.2 million in 1996, with a predicted drop to 12.5 million in 2015. Over this period, the number of people in their sixties will increase by about four million (Seike, 1996, p. 5). Between 2000 and 2010, the proportion of the labor force aged 15–29 is expected to decline from 23 percent to 18 percent, while the proportion over the age of 55 years is expected to increase from 23 percent to 27 percent (Sugeno and Suwa, 1997, p. 56). Other things equal, employers will find it necessary to employ an aging labor force over the next two decades.

Corporate responses to adverse conditions

But in an employment system that is influenced by corporate strategy, technological change and international competition, other things are never equal. To remain competitive, Japanese companies that employ an aging labor force have to concern themselves with the productive contributions of older workers, relative to both their pay and the productive contributions that could be made by younger workers. In the Japanese case, high levels of education and training, and the good health of the labor force in general, have combined with the prevalence of in-house organizational learning to enhance the productivity of employees over the course of their careers. Nevertheless, the intense effort and commitment that organizational learning demands of workers, particularly in the presence of rapid technological change, places limits on the incentive and ability of older workers to attain higher levels of productivity. To enable companies to fulfill the commitment of keeping workers employed even longer than is currently the case, the employment system must be flexible enough to permit the reallocation of labor resources and restructuring of returns to labor in response to changes in the productive and competitive environments.

During the 1990s the flexibility of the system of lifetime employment increased on a number of dimensions (Kameyama, 1993; Ornatowski, 1998; Takanashi, 1998). The first source of flexibility of the employment system was the ability to maintain employment of existing workers by reducing the number of new hires. The Japanese employment system is noted for the practice, especially among the major companies, of recruiting new employees directly from the educational system (high school in the case of blue-collar workers, university in the case of white-collar workers). In the past, a company that was growing rapidly could hire large numbers of new university graduates and then, after a decade or so, decide who among the cohort were best suited for employment tracks that provided more responsibility, authority and pay.

What was new in the 1990s was that employers had to be more selective about new hires. Hence there was a heightened competition for university graduates with specific capabilities. Japanese companies used to adhere to the principle of hiring new employees at the same time every year to begin work on 1 April. This hiring institution was meant to reduce competition among companies for employees and ensure that the new employees would enter the company and continue their careers in it as a cohort. During the 1990s it became acceptable for companies to hire out of season. According to a 1996 survey by Keidanren of 501 Japanese companies, 13 percent said that they already hire at various times during the year and another 32 percent that they had such hiring practices under consideration (Ishibashi, 1996).

In addition, Japanese companies have traditionally filled all openings for lifetime employment positions with men who were newly graduated from high school or university. These employees would then be trained internally to develop specialized skills. Now, however, many Japanese companies are hiring people who have already developed specialized skills, either through work experience or university training. The Keidanren survey found that 27 percent of the companies it covered were already recruiting people for specific jobs, another 12 percent for specific research jobs only, and 22 percent had such recruiting practices under consideration. At the same time, an increasing proportion of young workers who go to work for corporations are engaging in job-hopping, although the ultimate objective of such labor mobility is still to find the particular company that can offer an attractive lifetime career (Nitta, 1995; Ishibashi, 1996; Ornatowski, 1998).

The second source of flexibility is in rewards. Traditionally, lifetime employees have been recruited to companies from high schools or colleges, and then over the course of their careers have seen their earnings increase primarily on the basis of seniority pay (with supplements for larger numbers of dependants). The main forms of competition among employees were over the pace and type of promotion, although even then seniority bulked large as a criterion for eligibility for promotion over the first two decades of company service. During the 1990s individual performance began to count much more in determining promotion and pay. A 1995 survey of 210 companies based in Tokyo found that 24 percent had introduced merit pay systems and another 28 percent planned to do so in the next three years (Nitta, 1995; Ornatowski, 1998).

The third, and perhaps most important, source of flexibility is the reallocation of labor resources to positions in subsidiary companies that offer lower pay and/or responsibility. As employees reach their late forties and early fifties, major companies, in consultation with their enterprise unions, maintain the right to relocate employees – either through *shukko* (temporary) or *tenseki* (permanent) transfers – to subsidiary enterprises where pay is generally substantially lower (although, especially in the case of *shukko*, the core company often supplements the pay of the transferred worker). Provided they can absorb these employees, the benefit for the subsidiary is that it gets experienced personnel without having to invest in their skill development. In some companies, the core company assigns employees to the subsidiaries, whereas in other companies the subsidiaries recruit employees from the core company. At the same time, a small proportion of managerial employees who are considered to be especially valuable to the company are given the opportunity to continue to work for the company in positions of executive responsibility and at relatively high pay even after the official retirement age.

In theory, under *shukko*, the employee can be transferred back to the core company, but in practice the transfer often becomes permanent, with the subsidiary taking over responsibility for the employee. Most *shukko* and *tenseki* transfers are from larger to smaller companies. Around the mid-1990s, of all companies with 1000 or more employees, about 87 percent engaged in *shukko* and *tenseki*, and these transfers applied particularly to employees in their fifties. Many, if not most, employees who are loaned to another company find that their new employment eventually becomes permanent, their status at the new company being transformed from shukko to tenseki (Sato, 1996, pp. 5–6).

Traditionally, both *shukko* and *tenseki* transfers were from a core company to a related company within the enterprise group. But increasingly in the 1990s, as subsidiaries found it difficult to absorb the number of experienced personnel that the core companies wanted to relocate, the core companies located unrelated enterprises to which they could make *tenseki* transfers. Thus the commitment to lifetime employment on the part of the core company was maintained, but the web of companies at which an employee might end his career became wider. Within this wider web for maintaining lifetime employment, however, transferred workers often accepted late-career pay that was lower and late-career working conditions that were less attractive than would have previously been the case (Harukiyo, 1993; Inoki, 1993; Morishima, 1995; Sato, 1996; 1997).

It is from this perspective of the reallocation of labor resources that enterprise ‘spin-off’ became of increased importance in the 1990s (Odagiri, 1994, pp. 144–51; Ito, 1995). Major companies take people and money, and spin off new businesses rather than keeping this labor and capital under the control of the parent enterprises. Spin-offs can be suppliers or distributors in a vertical *keiretsu* or manufacturers of a new line of products as part of a horizontal *keiretsu*. Spin-off cuts down on layers of management and decentralizes authority and responsibility far more effectively than the multidivisional enterprise structure, in which there is often a decentralization of responsibility at the same time as a centralization of authority (O'Sullivan, 1996, ch. 3). In horizontal *keiretsu*, by creating new units of strategic decision making that are focused on particular products, spin-off facilitates the integration of enterprise strategy and organizational learning. Spin-off increases the number of managerial positions that entail authority and responsibility, without increasing the layers of management, and hence is of great importance to the functioning of *shukko*.

Spin-off, therefore, reflects a system of corporate governance that permits a successful company to allocate both money and people to the creation of a new business enterprise, which then itself has considerable autonomy in the allocation of resources and returns. During the 1970s and 1980s, Japanese companies increasingly used spin-off as an organizational strategy (Odagiri, 1994, pp. 145–6). During the 1990s, it became a particularly effective means for a company to reallocate labor resources in ways that created new opportunities for its employees and potential sources of new employment in the economy more generally.

Although not all spin-offs entail the development of new technology, spin-off often functions as the Japanese form of venture capital (Irie, 1996; Morishita 1996; Nitta 1997).[2] In May 1997, the Committee on Economic Policy of Keidanren proposed such new ventures as one way of meeting the challenges to the Japanese employment system in the 1990s. The company that has taken the lead in spinning off new ventures is Toyota Motor Corporation, whose president, Shoichiro Toyoda, was chairman of Keidanren at the time this policy was promulgated. In the summer of 1996, Toyota set up a 50 billion yen venture-capital fund to provide financial assistance to ventures within its group. In June 1997 it expanded the program to include ventures outside the Toyota group, generally taking equity stakes of 50 percent or more in each company. In so doing, Toyota Motor Corporation became the biggest single source of venture capital in Japan; in 1997 the next largest fund had 20 billion yen. As of June 1997 the Toyota fund had financed eight ventures, and, with applications from about 300 companies, Toyota planned to invest in about ten companies per year in industries such as semiconductors, information and communications, biotechnology, environmental technologies, and services for senior citizens (*Nikkei Weekly*, 1997c; Odagiri, 1998).

Corporate governance and sustainable prosperity

There are no guarantees that these new ventures will achieve success. But then, in the late 1940s and early 1950s, there were no guarantees that Japan would emerge from its devastating economic and political crisis, let alone develop over the next four decades into the world's second largest economy and industrial leader. In 1946 a group of young, forward-looking middle managers founded Keizai Doyukai (actual translation, Meeting of Friends; current translation, Japanese Association of Corporate Executives). The historian William Tsutsui (1998, p. 125) has described the outlook of Keizai Doyukai in its early years:

> In the Keizai Doyukai analysis, the experience of war and occupation was catalyzing fundamental structural changes in Japanese capitalism. The most important of these was the so-called "separation of management and capital," a phenomenon which was said to have derived from the expansion of the modern corporation, with its increasingly diffused pattern of ownership and its bureaucratic superstructure of expert managers. The result of this process, the Doyukai maintained, was a transformation of authority relations within industry, as ownership no longer connoted control and as the capital–labor divide was blurred by the appearance of management technicians as an independent interest group. Not subservient to capital (as the zaibatsu *banto* had been) but likewise differentiated from labor (in that they possessed the ability to lead modern industry and comprehend modern technology), the managers of this intermediate stratum were touted as the agents of a new political and economic equilibrium.

In 1948 the business economist, Eiichi Furakawa, declared that the 'new managers' of the Doyukai 'emphasize benefits to state, society, and the people rather than individual profits. They esteem jobs and labor more than money' (Tsutsui, 1998, p. 125).

Four months after the founding of Keizai Doyukai, the Supreme Commander for the Allied Powers (SCAP) began the dissolution of the *zaibatsu*, a process that not only dispossessed the *zaibatsu* owners but also removed from office the top layers of management of the *zaibatsu* holding companies and major affiliated companies (Bisson 1954; Hadley, 1970; Adams and Hoshii, 1972; pp. 23–5). Hidemasa Morikawa (1997, pp. 319–20) places the number of *zaibatsu* managers who were forced to resign between 1945 and 1948 at about 5000, with the average age of top managers falling from 60 to 50 over this short period. Taking over control of strategic decision making in Japan's industrial enterprises were 'third-rank executives' so called because they were plucked from the ranks of middle management to take leadership positions. The vision that united Keizai Doyukai had been put into practice. Commenting on this elevation of the 'third-rank executives' to positions of corporate control, Yutaka Kosai (1986, p. 26) has argued that 'nowhere was the separation of management and ownership more thoroughgoing than in postwar Japan.'

The control exercised by these 'third-rank' executives was by no means secure. Stockholders who were outsiders to the companies might join forces to demand their traditional control rights as owners. In the aftermath of the *zaibatsu* dissolution and with the reopening of the Tokyo Stock Exchange in 1949, individuals owned 69 percent of outstanding stock, securities companies 13 percent, other financial institutions 10 percent, non-financial companies less than 6 percent, and the government less than 3 percent (Zielinski and Holloway, 1991, pp. 26–7). To finance the growth of their companies, enterprise managers needed to maintain as much control as possible over surplus revenues, both as an internal source of funds and as a financial base for taking on bank loans. Managerial control over the allocation of surplus revenues had been accomplished in the United States earlier in the century through the widespread distribution among the wealth-holding public of the outstanding shares of dominant enterprises (O'Sullivan, 2000b, ch. 3). But in post-World War II Japan, subsequent to the dissolution of the *zaibatsu*, the undeveloped state of the companies and the stock markets left Japanese enterprises vulnerable, if not to takeovers, then to debilitating demands on their earnings from outside interests (Japan Securities Research Institute, 1986, p. 51).

To defend themselves against the demands for 'shareholder value' by these outside interests, the community of corporate executives engaged in the practice of cross-shareholding. Banks and industrial companies took equities off the market by holding each other's shares. Increasingly, business relations among companies, be they industrial or financial, became cemented by cross-shareholding arrangements, with a company that had closer relations with another company being more likely to hold larger amounts of that company's shares, up to the legal maximum of 5 percent of shares outstanding (10 percent in the case of insurance companies) Over time, as business relations among financial and industrial enterprises changed, the web of cross-shareholding became more intricate.

By 1955 cross-shareholding – according to its broadest definition as stock in the hands of stable shareholders – represented 25 percent of outstanding stocks listed on the Tokyo Stock Exchange, and by 1960 it was about 40 percent. It declined slightly in the early 1960s, but after the opening up of Japanese capital markets in 1964, when Japan joined OECD, the business community, fearing foreign takeovers, took steps to increase cross-shareholding. It surpassed 60 percent in 1975, and since then 60 and 70 percent of corporate shares have been kept off the market through cross-shareholding (Hodder and Tschoegl, 1993: 50). In the postwar decades, cross-shareholding has been the institution that has ensured that organizational control rather than market control would govern Japanese corporations (Lazonick and O'Sullivan, 1997b). It is an institution that was designed to ensure, and that continues to ensure, that outsiders to the corporate organization, including first and foremost public stockholders, will be unable to lay claim to the corporate revenues that provide the financial foundation for a company to retain its earnings and reinvest in productive resources.

Corporate resource allocation according to the principles of retain and reinvest does not ensure enterprise growth. How a business enterprise develops and utilizes the productive resources in which it invests will determine whether or not it can remain competitive on markets while still maintaining or improving the conditions of work and pay of those who contribute their skills and efforts to generating corporate products and revenues. In a world of complex technologies and global markets, the enterprises that can remain competitive while enhancing employment opportunities in the economy are those that invest in organizations that can engage in collective and cumulative learning. Such organizational learning requires the organizational integration of the skills and efforts of large numbers of people with different functional specialties and hierarchical responsibilities. It also requires that the enterprise, through its allocation of resources and returns, sustain these collective skill bases so that their learning can cumulate.[3]

When a company makes such investments in improving its organizational capabilities, its employees cease to be commodities whose wages entail a current expense that can be economically justified only by the addition to current income that their employment makes possible. Rather they become assets in whose capabilities the company has invested, and from which the employees as individuals and the company as a collectivity expect returns over a sustained period of time. At the macroeconomic level, it is the sum total of such corporate returns and their distribution to the workforce or their reinvestment in new learning processes that permit an economy to prosper on a sustainable basis.

Corporate governance systems (and the underlying employment and financial institutions that characterize these systems) that promoted prosperity in the past may have difficulty responding to new productive and financial challenges in the present. For a nation to reform its system of corporate governance to respond to these challenges requires an understanding of the character of that nation's existing institutions for mobilizing labor and capital for the development and utilization of productive resources, as well as the character of the productive and financial challenges that it is facing.

A Japanese path to sustainable prosperity?

As I noted at the outset, during the last few years Japanese corporate executives have been introduced to the ideology, imported from the United States, that argues that the most efficient way to govern a corporation is to 'maximize shareholder value.'[4] A number of Japanese companies now include statements concerning their positions on 'shareholder value' in their annual reports. For example, in its 1998 annual report, Sony reported that in 1997 it had introduced stock options for its top management in Japan and overseas as a practice that 'more closely aligns the interests of Sony's management with shareholder value' (Sony Corporation, 1998). In its 1998 annual report, Toyota included a section entitled 'A word about shareholder value', and went on to say:

> We maximize shareholder value over the long term by harmonizing the interests of all of our stakeholders: customers, suppliers, employees, and members of the community at large, as well as shareholders. At the same time, we are stepping up our efforts to address the special expectations of shareholders. (Toyota Motor Corporation, 1998)

A few Japanese companies such as Hoya and Kao have even adopted measures of 'shareholder value' as their most important indicators of corporate performance (Hoya, 1998; *Nihon Keizai Shimbun*, 1999j). Recently, the business daily *Nihon Keizai Shimbun* teamed up with Stern

Stewart, the American consultancy that has created and marketed 'economic value added' (EVA) as a measure of corporate performance, to rank major Japanese companies in terms of their contributions to 'market value added' (MVA), a measure of performance based on the market valuation of a company's common stock (*Nihon Keizai Shimbun*, 1999a; 1999b; 1999j).

Is shareholder value appropriate for Japan? Over the past two decades the maximization of shareholder value has become entrenched ideology of corporate governance in the United States. Even in the United States, the notion that the maximization of shareholder value results in superior economic performance is relatively new, having emerged out of structural changes in the US corporate economy and global competition in the 1960s and 1970s (Lazonick and O'Sullivan, 2000b). The proponents of maximizing shareholder value fail to explain how the US corporations (not to mention corporations in other advanced economies) managed to create value and drive the development of their economies during most of the twentieth century when maximizing shareholder value was not a principle (or even an ideology) or corporate governance (Lazonick, 1992; O'Sullivan, 2000b). While many analysts credit the focus on shareholder value with the boom in the US economy in the late 1990s, the sustainability of prosperity in a national economy in which corporations adhere to this principle of corporate governance has yet to be tested. There exist in the US economy many potential sources of instability – an unsustainable stock market boom, a worsening distribution of income and wealth, a persistent trade deficit, an unprecedentedly low household savings rate and a growing level of international borrowing – that could be related, directly or indirectly, to an obsessive focus of US corporations on maximizing shareholder value (Lazonick and O'Sullivan, 2000b). Japanese corporate executives and public policy makers should recognize that even in the United States there is considerable room for debate concerning the relation between a corporate governance regime that seeks to maximize shareholder value and sustainable prosperity in the economy as a whole (O'Sullivan, 2000b chs 1–6).

In the very recent past, Japan has experienced the problems of letting its economy be overly influenced by the ways in which the stock market values the nation's assets. The recession of the 1990s is to a major extent the result of the failure of Japanese society to control stock market speculation in the 1980s. The bursting of the bubble created a financial crisis, but stability and equity in the economy have been maintained by corporate and government policies that have supported the retention of corporate revenues and reinvestment in productive resources. Even then, to maintain high levels of employment, the Japanese government had been obliged to engage in spending that has given Japan a ratio of gross fiscal government deficit to GDP that is second highest (lower only than Italy's) among the OECD nations (Morishita, 1999). Indeed, when one recognizes that in the 1930s major US corporations cut back employment dramatically and that it took US entry into World War II to get that nation out of the Great Depression, one might ask what the condition of the world economy in the 1990s would have been had Japanese corporations not remained oriented toward retain and reinvest during the decade and had the Japanese government not been able and willing to engage in massive fiscal intervention in the economy.

Nevertheless, there is a need for Japanese corporations to find ways to improve the effectiveness of their strategies to retain and reinvest to ensure that Japanese companies remain internationally competitive and that the intergenerational economic and social needs of the population are met. For a rich nation such as Japan, the immediate challenge is to maintain the stability of the economy while its business organizations and national institutions undergo the structural transformations that will enable them to support sustainable prosperity. The major long-run challenge is to put in place a system of value creation and distribution that can maintain, if not improve, the living standards of both the working and retired populations.

Given these objectives, what types of corporate reform does Japan require? The 'Big Bang' transformation of the Japanese financial sector to engage in asset management and the consequent movement toward the 'securitization' of social security make it possible that a system of corporate governance that relies on the principle of shareholder value will come to play a much greater role in Japan over the next decade or so. Pressures will build in Japan, as has been the case in the United States over the past quarter century, to allow financial markets to determine the returns to households savings, and hence the size of retirement incomes. If industrial corporations succumb to these pressures, they will do so, as US corporations have done, by shifting their strategic orientation from retain and reinvest to downsize and distribute. But should the prevailing low yields on Japanese corporate (and government) securities persist, higher returns on Japanese household savings will have to come from asset management based on portfolio investment abroad – a rather risky business given the volatility of not only securities markets but also foreign exchange rates.

Recently, as a result of the persistence of the recession and in response to calls for US-style corporate restructuring, debate over the path to sustainable prosperity has become a high-profile issue in Japan (see Dore, 1998; 1999). Major business leaders have cautioned that Japan must find its own way forward. In advocating corporate reform that yields a 'market economy with a human face', Hiroshi Okuda, president of Toyota Motor Corporation and newly appointed head of Nikkeiren (the Japan Federation of Employers' Associations) has stated that 'putting unquestioning faith in markets is going too far' and that 'it's a pity that business leaders often equate restructuring with payroll cuts' (quoted in *Nihon Keizai Shimbun*, 1999f). Similarly, Yotaro Kobayashi, chairman of Fuji Xerox and head of Keizai Doyukai since April 1999, has called for a reform process that goes 'beyond the manifesto for a market economy'. As Kobayashi (1999: pp. 3–4) put it in his inaugural address to Keizai Doyukai:

> Companies are being evaluated with increasing strictness by the market. And as corporate citizens, they can maintain their dynamism in the long term only if they earn the trust of society and are responsive to its various needs. It is thus essential, from this point of view, to bring the market-oriented nature and the social nature of business corporations into harmony on a higher plane, within the context of the times. What is needed is a theoretical framework that will underpin the company's relationships with its stakeholders and orderly relations among those stakeholders. Such a framework is essential if we are to develop Japanese corporate management for the new era, beyond the market-oriented economy.

In seeking to resolve the problems of unemployment, unstable banks, underconsumption and underfunded pensions, Japan is now pursuing a 'retain-and-reinvest' path of corporate reform that is in keeping with its own institutional history, and that, if successful, could offer an alternative to the 'downsize-and-distribute' path that has been taken in the United States. As we have seen, major Japanese corporations have been implementing more flexible hiring, promotion, relocation and pay practices in their employment relations without abandoning (despite repeated prognostications to the contrary by Western observers over the past decade) the institution of lifetime employment (see Lazonick, 1998a). Other things equal, the demographics that will prevail over the next generation favor retention of a lifetime employment system, and indeed shortages of educated labor, as well as the growth of services employment, will help to bring women more fully into the paid labor force (Yokoyama, 1999). But one should not expect that it will be existing corporations alone that will regenerate and augment the volume of high-quality employment opportunities that sustainable prosperity requires. The growth of new businesses is and will remain important to the creation of stable and remunerative jobs. During the 1990s the Japanese have become much more conscious of the need to support new business formation, especially in high-value-added activities (see, for example, *Nihon Keizai Shimbun*, 1999g). Japanese new ventures, however, rely much more on corporate venture capital and spin-off than on the American venture-capital model that is largely independent of the resource-allocation decisions of established corporations.

Despite the decline – although as yet not the demise – of the main bank system, the banking sector remains of central importance as a lender to SMEs, including new ventures, that hope to grow (see, for example, *Nihon Keizai Shimbun*, 1999k). The main fallout of the concerted effort from 1997 to resolve the banking crisis by writing off huge amounts of bad debt and applying capital-adequacy standards more stringently has been a credit crunch on SMEs. Besides the financial restructuring required so that the banks can once again play a major role in the inherently risky business of financing the growth of new enterprises, the diminished importance of the banks in providing loans to established enterprises has meant significant downsizing of their labor forces – from a peak of 454 593 jobs in March 1994 to 398 942 in March 1999 (*Nihon Keizai Shimbun*, 1999e) – and, under Financial Big Bang, concerted efforts at diversification into new lines related to asset management, particularly for pension provision.

The Japanese model means, however, that higher returns to household savings through asset management will be hard to come by. An orientation toward retain and reinvest requires low levels of corporate dividends, a policy that the major Japanese corporations have continued to pursue. Nor, given the massive buildup of government debt based on exceptionally low interest rates, can the higher returns come from Japanese government securities. The low rates of returns on household savings, however, are offset by the persistently high rates of savings of households that have resulted in much greater accumulations of savings by Japanese households than by their counterparts in the United States. For example, as a proportion of national income, the value of insurance policies in force in Japan is almost two and a half times the US ratio (Nakamura and Yamada, 1996: 149). But in addition to these high volumes of household savings, what is unique about the Japanese model is its emphasis on *reducing* the dependence of the older generation on younger generations by keeping people employed for more years of their lives. In contrast, in the United States an emphasis on early retirement, often made possible by high returns on accumulated household savings, has had the effect of *increasing* intergenerational dependence. These high returns to savings accruing to a retired population have also helped to fuel the American consumption binge in the 1990s. In Japan, the attempt to solve the problem of intergenerational dependence emphasizes saving and employment; in the United States, it emphasizes finance and consumption.

But keeping people employed for more years of their lives does not solve the problem of intergenerational dependence if these people are not productively employed. Nor can high levels of savings be maintained unless employees in their thirties and forties remain highly productive. Given the structure of the Japanese economy, the Japanese path must look to higher productivity, not to more consumption *per se* (as many Westerners have been advocating), if sustainable prosperity is to become a reality. Given the intensity of global competition in the industries that made Japan a rich nation, higher productivity will come through the continued development of the productive capabilities of the Japanese people and the mobilization of these capabilities to generate higher-quality goods and services at lower unit costs. Government spending, not lacking in Japan, can help support such developmental investments. But ultimately, sustainable prosperity will depend on the incentives and abilities of Japan's business enterprises, both established and new and in support of one another, to develop and utilize the productive resources that they control.

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Notes

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1. For a perspective on the corporate governance system as the institutions that influence the corporate allocation of resources and returns, see O'Sullivan (2000a and 2000b).
2. On the weakness of 'American-style' venture capital in Japan, see Clark (1987).
3. For elaboration of this perspective, see Lazonick and O'Sullivan (1996 and 2000a); Lazonick (1998b); O'Sullivan (2000b: ch. 1).
4. For Western perspectives on Japan that look only at the role of financial interests in corporate governance, see Kester (1991); Gerlach (1992); Schaede (1994); and Sheard (1998). For critiques of this perspective as applied to the United States, see Lazonick (1992); and O'Sullivan (2000b: chs. 3–5). For a perspective on Japanese corporate governance that is broadly consistent with the arguments in this paper, see Abegglen and Stalk (1985).

9

Corporate Governance in Germany: Productive and Financial Challenges[1]

*Mary O'Sullivan**

Introduction

Corporate governance has, in recent years, become a highly charged political issue in Germany. As recently as the late 1980s confidence in the ability of the 'Rhenish system of capitalism' to deliver economic performance without sacrificing social cohesion was running at an all-time high. From the early 1990s, however, as Germany wrestled with the challenges and costs of reunification, and then plunged into its worst recession since World War II, talk of the strengths of German capitalism was replaced by anxious discussion of the viability of *Industriestandort Deutschland* (Germany as an industrial location). Employers warned that German companies would be forced to relocate production abroad if drastic reforms of corporate structures and, indeed, the foundations of the social market economy, were not undertaken to ensure closer attention to the bottom line. Senior German managers seemed to be increasingly influenced by what was happening overseas, especially in the US corporate economy. Indeed, companies such as Daimler-Benz and Deutsche Bank, formerly seen as synonymous with the distinctive German postwar system of managerial capitalism, have emerged at the forefront of a shareholder value movement in Germany in the mid- to late 1990s.

Yet there are also many signs of business as usual in the German corporate sector. Within German companies, even those that are most strident in proclaiming their conversion to shareholder value, corporate resource allocation processes are only beginning to be overhauled to accord with its logic. Among serious proponents of shareholder value, moreover, there is a certain skepticism that German managers know what they mean and mean what they say, when they speak of the merits of shareholder value for enhancing corporate performance. Nor has the recent rhetoric of German managers gone unchallenged at home. Prominent labor representatives have publicly expressed their disquiet with talk of shareholder value and the ideology of casino capitalism of which, they allege, it is a harbinger.

What then is at stake in contemporary discussions of corporate control in Germany? Has the battle been joined that will determine the future of the German system of corporate governance? Or do contemporary discussions of the subject reflect rhetorical sparring among interest groups to secure tactical advantage? To understand why the German system of corporate governance has recently become such a controversial subject, as well as the likely significance of contemporary discussions of the subject in Germany, we must analyze, as I endeavor to do in this chapter, the extent to which recent trends are confronting the foundations of the postwar system of corporate governance.

Debates about corporate governance

In emphasizing the need to 'create value for shareholders' some German managers are now expounding a view that has dominated the Anglo-American debates on corporate governance for more than a decade. Advocates of the shareholder theory of corporate governance contend that shareholders are the 'owners' or 'principals' in whose interests the corporation should be run (see, for example, Alchian and Demsetz, 1972; Fama and Jensen, 1983; Jensen, 1986; Hart 1995; Shleifer and Vishny, 1997). When corporations are run to maximize shareholder value, they argue, the performance of the economic system as a whole, not just the interests of shareholders, can be enhanced.

The proponents of shareholder value have elaborated a theory of corporate governance in which the mobility of financial resources is supposed to lead to optimal economic outcomes. For superior economic performance, nothing should inhibit the free flow of financial resources from one use to another, and any impediment to that flow is deemed an imperfection of the financial markets. The central implication of the shareholder value argument is that the market should ultimately decide the optimal allocation of corporate resources and returns. Shareholders may have to rely on managers to perform certain functions to actually run the corporation, but so long as the system of corporate governance ensures that corporate managers are induced or constrained to act in accordance with the dictates of financial markets, the optimal allocation of corporate resources and returns will be ensured (for a detailed discussion of the shareholder theory, see O'Sullivan, 2000a, ch. 2).

It is more than a little ironic that a perspective that stresses financial mobility is gaining ground among influential German corporate managers, bankers and academics. Only a short time ago the availability of 'patient capital' on the basis of close bank–industry relations was regarded as the critical strength of the German postwar system of governance in comparison with its US and British counterparts (see, for example, Albert, 1991; Porter, 1992). The extent of the retreat from this interpretation of the German system of corporate governance is striking and has been reinforced by the growing concerns about the competitiveness of German industry as well as by the apparent resurgence in the competitive position of US industry in the late 1990s.

How do we explain the retreat from the patient capital position? Was it wrong to begin with? Has it simply become outdated? To the contrary, the patient capital arguments captured an important implication for corporate governance of a critical dimension of economic activity – innovation, or the process through which resources are developed and utilized to generate higher-quality and/ or lower-cost products than had previously been available. The strength of the patient capital argument was that it recognized that investments in innovation take time and hence require a commitment of financial resources to achieve their developmental potential. Thus, it was argued, managers need committed capital to see their investments in productive resources through to competitive success.

The process of innovation is systematically neglected by shareholder value theories that argue that shareholders allocate their financial resources to those alternative investment opportunities that offer the highest expected rates of return. These theories assume that shareholders take alternative opportunities in which they can invest as given. There is no expectation that shareholders are engaged in creating new opportunities for generating returns; like most neoclassical economists, shareholder value theorists ignore the process of innovation as a central phenomenon in determining the performance of corporate enterprises or the economy in which they operate (O'Sullivan, 2000b).[2]

Given the centrality of innovation to the dynamic through which successful economies improve their performance over time as well as relative to each other, the systematic neglect of the innovation process by shareholder value advocates renders their theory wholly unsuitable as a basis on which to understand corporate governance in dynamic economies. But the patient capital argument also has a critical weakness, which has made it vulnerable to challenges from shareholder value advocates. In a system of corporate governance in which patient capital was forthcoming, the perspective provided no basis on which to understand why investments might fail to generate innovation. In the presence of such failure the patient capital perspective thus provided no response to allegations of shareholder value proponents that corporate managers had grown 'fat and lazy'.

This failure of the patient capital argument is rooted in its unwillingness to move the discussion of corporate governance beyond purely financial issues to take account of the organizational requirements of innovation. Underlying the innovation process is a learning process; if we already knew how to generate higher-quality, lower-cost products then the act of doing so would not require innovation. The comparative and historical evidence on the foundations for economic development in the advanced economies supports the proposition that the learning process that generates innovation is collective and cumulative or organizational (see, for example, Chandler, 1977; 1990; Fruin, 1992; Best, 1990; Lazonick, 1990). From this perspective, financial commitment is a necessary but not sufficient condition for innovation. Whether the mechanisms for the channeling of financial resources in an economy contribute to or detract from the development and utilization of resources depends on how they relate to the social foundations of innovation. More generally, to understand the economics of corporate governance we must analyze the interaction between the institutions of governance and the social foundations of the process through which productive resources are developed and utilized in the corporate economy.

A system of corporate governance, if it is to support innovation, must generate the social conditions that permit collective and cumulative learning to take place. Specifically, it must support *financial commitment* – the commitment of resources to irreversible investments with uncertain returns – and *organizational integration* – the integration of human and physical resources into an organizational process to develop and utilize technology. Organizational integration describes the social relations that provide participants in a complex division of labor with the incentives to integrate their capabilities and efforts within organizations so that, potentially, they can generate organizational learning. Financial commitment describes the social relations that are the basis for a business organization's continuing access to the financial resources required for sustaining the development and utilization of productive resources.

Organizational integration and financial commitment represent social conditions that together support 'organizational control' over the critical inputs in the innovation process: knowledge and money. By contributing to the innovation process, however, these inputs are not commodities but reflect the social relations to the business organization of those who supply knowledge and money. Without institutions that support organizational control, business enterprises cannot generate innovation through strategic investment in collective and cumulative learning processes (Lazonick and O'Sullivan, 1996; O'Sullivan, 2000a, ch. 2).

In Germany, the US and Japan, the countries that in the twentieth century have dominated in international competition, a characteristic feature of the organizational transformation of the nation's enterprises that led to the rise of the corporate economy was a managerial revolution that involved the integration of teams of salaried administrators and technologists. What all of these systems had in common, therefore, was investment in managerial learning and the organizational structures that were its basis. These salaried managers were trained by the enterprises for which they worked, rotated through different jobs, and encouraged to make their careers by climbing the hierarchy of the corporation.

There were significant differences across countries in the manner in which corporate enterprises secured the financial resources that they required to pursue innovative investment strategies, but in all cases they ultimately relied on a separation of equity ownership from managerial control. The institutions that brought about and sustained this 'separation of ownership and control' checked the influence of, and indeed transcended, the very traditions of private property on which 'free-enterprise' capitalism ostensibly rests (Lazonick and O'Sullivan, 1997a and 1997b).

Despite these similarities in systems of corporate governance, there were considerable national differences in the social institutions that influenced the allocation of corporate resources. For example, after the war the patterns of organizational integration in US and German corporate enterprises diverged substantially. In German corporate enterprises, skill formation and learning on the shop floor became integral to the strategy and structure of the enterprise as a whole. In the US case, in contrast, the shop-floor investment strategy has been to substitute machines and materials for the knowledge and initiative of workers. As the twentieh century unfolded, such differences developed into distinctive trajectories of corporate development that were reflected in variations in technological evolution and product-market strategies, and ultimately in differences in the competitive performance of US and German enterprises in various business activities.

In the following section I identify the key elements of the German postwar system of corporate governance. The central institutional foundations of prewar managerial control – intercompany shareholding and bank–industry relations – persisted in the FRG. The postwar system of corporate governance was, however, transformed beyond its narrow prewar confines into a contested form of organizational control through the institution of codetermination. These social conditions were complemented by institutions – especially the dual system of apprenticeship – that supported the organizational integration of resources in German business enterprises. On the basis of these social institutions, German companies were to achieve considerable success in industrial sectors in which high quality was more important than low cost as a basis for competitive advantage.

I then analyse the emergence of the pressures now confronting the German system of governance, the most important of which stem from productive and financial challenges that are embedded in the political and economic history of the German corporate economy. First, coming into the 1990s, German industrial companies faced unprecedented competition from their Japanese counterparts in industrial segments in which they had previously been unrivaled. The Japanese challenge was fundamentally an organizational one since it confronted the social foundations on which German enterprise had successfully competed in the past. Second, as Germans have grown wealthier they have been moving their savings out of bank deposits and into more market-based instruments. The trend is likely to increase substantially in the near term in response to existing and forecast problems in funding the existing system of pension provision. As a result, there are growing demands in Germany for higher returns on financial assets in general and on corporate securities in particular. Together, and in combination with forces external to the German economy, these structural changes in the German economy – the one productive, the other financial – are challenging the foundations of the entire postwar system of corporate governance.

The postwar system of corporate governance

From the late nineteenth and early twentieth century, the competitive success of major German enterprises was built on a system that integrated the knowledge of managers in organizational learning processes. Supporting investments in the incentives and abilities of managers was the evolution of a governance system that created the social conditions on which managerial insiders gained control over the allocation of resources and returns in the German corporate economy. The institutions of worker apprenticeship and codetermination have roots that date back to the medieval gilds and the Bismarckian era respectively. These institutions were not, however, systematically integrated into the prewar German system of governance, notwithstanding attempts to do so during the Weimar period; organizational control in Germany before the war was essentially managerial control (Kocka, 1980; Chandler, 1990; Lazonick and O'Sullivan, 1997c; O'Sullivan, 2000a, ch. 7).

Immediately after the war, in reaction to the abuse of concentrated power to which, as evidenced during the Nazi period, managerial control could lead, there was considerable political support for transforming the German system of corporate governance. With Germany's defeat, the declared intention of the Allied Occupation forces, particularly the Americans, was to break up the concentration of economic power in German industry and banking and to replace it with market control. But the onset of the cold war, and the perceived importance of the West German economy as a bulwark against the power of the Soviets, led to a decline in the commitment to this path. Many of the major German industrial enterprises on which the post-World War II German economy relied to undertake innovative investment strategies were those that became dominant before World War II and prime vestiges of pre-World War II managerial control – namely, intercompany shareholding networks and banks' relations with industry (as shareholders, supervisory board members and, most importantly, as trustees for their depositors' shares) – remained strong in the postwar decades.[3]

These institutions played an important role in insulating German enterprises from market control but in Germany, as in all of the advanced industrial economies, the most important source of financial commitment in the corporate sector was the access of the major industrial enterprises to internally generated funds which rendered most of them relatively independent of external sources of finance (Dyson, 1986; Esser, 1990; Edwards and Fischer, 1994, pp. 228–40). In international comparison German enterprises – large firms as well as the producing sector as a whole – are as reliant, and if anything more reliant, on internal funds as a source of investment finance than their counterparts in other advanced industrial economies (Mayer and Alexander, 1990; Hall, 1994; Corbett and Jenkinson, 1996).

One critical difference between the German system of corporate governance before and after the war was that the institution of codetermination shifted prewar managerial control toward a contested form of organizational control. Codetermination is composed of two key elements: employee representation on the supervisory boards of corporate enterprises and on works councils that operate at plant level. The direct control that workers and their representatives exercise over the allocation of corporate resources is restricted. Labor representatives on supervisory boards are constrained by the fact that these boards, in general, play a fairly limited role in corporate decision making (Gerum et al., 1988). As for works councils, their power is proscribed by the statutory ban on strikes to enforce workplace demands and by the fact that works councilors are legally bound to act in a manner that promotes the overall health of the enterprise (Müller-Jentsch, 1986; 1995). Moreover, works councils' codetermination rights are strong with respect to social and personnel matters but weak in relation to financial and strategic issues. Yet even in areas where it does not have formal codetermination rights, a works council can delay management decisions by strategically using its rights in other areas (Müller-Jentsch, 1995; Markovits, 1986). And, whatever the restrictions on the mechanisms of codetermination, as well as the challenges for the labor movement in coordinating them, codetermination has extended organizational control in German industry beyond the narrow pre-World War II confines of managerial control.

The conditions of financial commitment and corporate control that emerged in postwar Germany were complemented by institutions that supported the organizational integration of resources in German business enterprises. Of particular importance in the post-World War II era was the West German system of apprenticeship – the dual system – that provided the institutional support for the integration of workers with managers as members of the processes of organizational learning that generated the innovative capabilities and competitive advantages of German enterprises. The German experience is thus starkly contrasted with that of the US where, to a large extent, workers have been excluded from organizational learning in the postwar decades.

Codetermination of supervisory boards, works councils, intercompany shareholding and bank–industry relations make it very difficult to pinpoint exactly where control resided in major German enterprises in the postwar decades. Who exercised control in a particular German enterprise depended on such particulars as the articles of association that defined the responsibilities of the various organs of the corporation, as well as the organizational structure that a holding company put in place to manage its participations, and in particular on the degree of integration with the operations of the parent company that such a structure entailed. But whatever the variations in corporate control across particular German enterprises, the institutions discussed above, as well as other elements of legal and financial regulation (Franks and Mayer, 1990), ensured that control over the allocation of corporate resources and returns was an organizational rather than a market phenomenon in the FRG in the postwar period.

The institutionalization of organizational control in postwar Germany played a crucial role in the competitive strategies of those West German companies that competed on the basis of quality, and allowed them to develop a competitive advantage in markets such as luxury automobiles, precision machine tools, and electrical machinery – industries that until recently qualified as stable technology. The prevalence and success of high-quality, niche-market strategies in the German economy, and more fundamentally the social foundations of innovation and development in Germany that supported these competitive strategies, are readily seen in the structure of West German foreign trade. In 1979 the leading German exports were electrical and non-electrical machinery which together amounted to DM78.2 billion, chemicals and pharmaceuticals (DM58.8 billion), and road vehicles (DM50.3 billion). Combined these industries accounted for 62.3 percent of manufacturing exports (OECD, 1996a, pp. 146–7). Patent data also reveal similar patterns of specialization (Casper et al., 1999, p. 6).

Where the post-World War II (WWII) system of governance has been least successful is in serving as a foundation for the competitive advantage of German enterprises in computers, semiconductors and telecommunications, industries that came into existence or were completely transformed after WWII by the development of electronics technology. Some German companies competed in these industries, for example, Siemens and Bosch in telecommunications, but in general the Germans failed to establish a national competitive advantage in these sectors in the postwar decades (see Malerba, 1985; Van Tulder and Junne, 1988; Sachwald, 1994). Analysis of patent data, for example, shows Germany's relative weakness in technologies such as biotechnology, information technology and telecommunications.

The system of organizational control had an important influence not only on the patterns of wealth generation in the German economy but also on how that wealth was distributed. It ensured that German employees participated in the fruits of industrial success as well as their generation and that the West Germans maintained a relatively low inequality of incomes as they increased their overall wealth (Streeck, 1995; Abraham and Houseman, 1993). The system of organizational control also facilitated the spreading of the costs of industrial rationalization. Social plans, which provided for the protection of workers in the event of mass redundancies, were pioneered in the Montan industries – in the coal industry in 1957 and in the steel industry in 1963 – where parity representation had been established and unions were strong (Bosch, 1990, p. 31). These plans were to form the basis for the compulsory requirement of the Works Constitution Act of 1972 for all firms with more than 20 employees to negotiate a social plan with the works council in the event of major changes in the firm.

The early social plans relied primarily on financial compensation to sustain redundant employees while they looked for new jobs (Bosch, 1990, p. 31). From the mid-1970s, as the opportunities for redundant workers to find alternative jobs diminished, early retirement schemes became more important as a way of easing the burden of downsizing. Social plans therefore allowed employers to substantially reduce their labor forces without massive labor strife at a cost that was heavily subsidized by federal early retirement schemes. Particularly important was the early retirement program for unemployed workers. If an employee was made redundant at the age of 59 he could draw unemployment benefits for a year and then qualify for a pension from the Federal government at age 60. Employers made extensive use of this scheme by 'firing' workers at 59 and supplementing the unemployment and pension benefits that they received from the government (Bosch, 1990, p. 34; Abraham and Houseman, 1993, pp. 26–7).

The burden of rationalization was also distributed through the use of the state's short-time working program. If employers reduced the work hours of their employees, with the works council's approval they were permitted to pay them only for the hours that they worked; the Federal Labour Office then paid them a prorated amount of the statutory unemployment benefits for the hours that they did not work. The scheme was made increasingly generous in a number of ways during the 1970s. For example, before 1969 short-time benefits were available for a maximum duration of six months; by 1975 the limit had been extended to 24 months. Thus, as Abraham and Houseman pointed out, '[c]ompanies engaged in long-term restructuring have been able to minimize layoffs by using short-time work schemes while their work force was being reduced through attrition and, in many cases, through early retirement, (Abraham and Houseman, 1993, p. 25).

While the German system of organizational control has played an important role in sharing the gains and losses of the process of development, in doing so it has proven most successful in advancing the interests of skilled, male, German workers in industries in which the representation of their interests is strongest and where the organizational integration of their skills is critical to the competitive success of industrial enterprises. These workers gained most from the rising prosperity of the postwar decades. The system was, however, much less of a boon to contingent members of the labor force, those euphemistically described as Gastarbeiter (guest workers) in Germany, as well as to women.

The importance of guest workers in the German labor force grew steadily in the decades after the war to reach 8.1 percent of total employment in 1970 (Giersch et al., 1992, p. 127). These workers have tended to be treated as a buffer stock of flexible labor to insulate the domestic workforce from layoffs, as evidenced by the higher rate of unemployment experienced by foreign workers in the latter part of the 1970s and during the 1980s (Abraham and Houseman, 1993, pp. 124–5). In times of recession foreign workers have often been ‘persuaded’ to return to their citizen countries;[4] indeed, in 1983 the German government offered payments to foreign workers who were unemployed or on short-time work if they left Germany with their families (Abraham and Houseman, 1993, p. 125). Significant attempts have, however, been made to give these workers the chance to improve their employment opportunities, especially by encouraging them to participate in the dual training system. They are, however, still underrepresented in the apprenticeship system compared with their importance in the workforce (Winkelmann, 1996, p. 663).

Nor have women directly participated in the gains of postwar economic development to the same extent as men. Their employment opportunities have, in general, been more limited than those available to men. The workforce participation rate of German women was, at around 40 percent in the 1960s and 1970s, among the lowest in the advanced industrial economies. Moreover, the German women that did participate in paid labor were disproportionately concentrated in low-skilled jobs. This pattern undoubtedly reflects, at least in part, a lower average tenure than their male counterparts which, because of the emphasis on continued education as the means to promotion in the German employment system, is a particular handicap to women’s career advancement (Abraham and Houseman, 1993, pp. 114–23).

Challenges to the German system of governance

Organizational control was thus supported by the social institutions that persisted or developed in postwar Germany and in recent decades the institutional foundations of that control in Germany, as in Japan, have proven to be more enduring than in the United States (Lazonick and O'Sullivan, 1997a; 1997b). Nevertheless, various pressures on the German system of governance have emerged and, in combination, have posed and continue to present a challenge to the sustainability of German organizational control, at least in its postwar form. Some of these pressures emanate from sources external to the domestic economic system, such as the process of European integration and German reunification. The more powerful pressures, however, stem from productive and financial challenges that are integrally related to the political economy of the German corporate sector.

The first challenge to the German system of organizational control is that posed by international competition, especially from Japan. The Japanese competitive challenge is fundamentally an organizational one since it confronts the social foundations on which German enterprises have successfully competed in the past even in high-quality niches in which they have previously been unrivaled. Second, pressures for financial liquidity have increased: as Germans have grown wealthier and accumulated substantial holdings of financial assets, they have been moving their savings out of bank deposits and into more market-based instruments, a trend that is likely to lead to increased demands for higher returns on corporate securities. In recent years, these pressures have been amplified by the striking trend toward growing intergenerational dependence in West Germany and the problems that it has generated for the extant system of pension provision.

Productive challenges

Without institutions that support organizational control, business enterprises cannot generate innovation through strategic investment in collective and cumulative learning processes. Yet, that organizational control is supported by social institutions, as it was in postwar Germany, does not imply that innovation will in fact occur. Innovation is defined relative to the competitive environment in which it occurs; whether certain products are considered higher quality and/ or lower cost depends on the quality and cost of competitive offerings. Since the competitive context varies across industry as well as, in a given industry, over time, so too does the innovation process.

As a result, the financial and organizational requirements of the innovation process differ across industries as well as, with economic development, over time. Particular social conditions that in one time and place support successful investment strategies and organizational learning processes may prove unsuitable as a basis for competition as the investment strategies and the organizational learning processes that generate innovation evolve. To understand the relationship between social institutions and innovation we must therefore analyze the interaction of the social conditions that support economic development with the dynamics of competition.

From the late 1960s and 1970s new industrial competitors, in particular the Japanese, mounted competitive challenges for German industry as they had for the Americans. However, most German producers whose competitive advantage was based on their capacity to produce high-quality products managed to avoid direct confrontation with Japanese competitors. Some other companies, in more cost-competitive segments, like Germany's high-volume car producers, managed to reorganize their production processes to move upmarket to higher value-added strategies to avoid the threat posed by Japanese competition (Jürgens et al., 1993, pp. 59–62; Streeck, 1989).

In industries in which cost competition prevailed, the Germans had failed to develop distinctive bases of competitive advantage. In these industries the relative strength of Japanese producers in process innovation was at the root of their competitive success. In both Germany and Japan, organizational integration was prevalent, but differences in the nature of organizational learning and in the social institutions that supported it were reflected in important variations in the innovative capabilities of enterprises. In Germany the internal organization of the enterprise derived from an industry-wide strategy to set high-quality product standards, whereas in Japan the organizational structure derived from an enterprise strategy to engage in continuous problem solving to cut costs.

In industries such as steel and consumer electronics, for example, the competitive challenge from Japanese companies was to prove formidable and resulted in major job losses in German companies throughout the 1970s. In the early 1980s these industries were hit by new job losses; employment in iron and steel, for example, fell from 624 000 in 1979 to 473 000 in 1991 (OECD, 1996a, p. 142). In contrast, production and employment expanded in sectors of particular German strength. During the period from 1979 to 1991, employment increased from 971 000 to 1 077 000 in non-electrical machinery (excluding office and computing machinery), from 876 000 to 963 000 in transport equipment, from 923 000 to 987 000 in metal products, from 996 000 to 1 118 000 in chemical products and from 578 000 to 677 000 in electrical machinery (excluding radio, TV and communication equipment). The export performance of these industries also proved extremely strong, especially in the second half of the 1980s.

As a whole, the German economy continued to grow during the 1980s and the reunification process prompted a further upsurge in economic performance. However, unemployment rose substantially in the early 1980s, although it remained at a lower level than in the United States for most of the decade and much lower than in most other European countries. When the dust settled in the early 1990s, however, it became clear that throughout the 1980s the competition that German enterprises faced on international product markets had intensified further. Besides the structural problems that reunification posed, key industrial sectors in the former West German economy faced a structural challenge from international and, in particular, Japanese competition. By 1992 the German economy had plunged into its worst recession since World War II. Among the industries that were worst hit were automobiles and machine tools, the great bastions of German postwar industrial strength.

Concerns about the German automobile industry's competitiveness had already been heightened by the publication in 1991 of a German-language version of The *Machine that Changed the World*, the MIT comparative study of the auto industry, particularly when it was revealed that the European plant held up to unfavourable scrutiny for its low productivity was Daimler-Benz's most important assembly plant (Womack et al., 1990). Other symptoms of serious underlying problems were also to be found in the rapid growth of automobile imports to Germany during the 1980s; the share of Japanese brands in total German car registrations had risen from 10.4 percent in 1980 to 25.3 percent in 1991 (Sachwald, 1994, p. 65). Moreover, a substantial proportion of German export gains in the 1980s had been won in European markets that were still relatively protected from Japanese competition (Keck, 1993, p. 136).

The machine tool industry also faced serious challenges from foreign competitors. The traditional competitive advantage of German machine tool producers had been based on their ability to produce high-quality customized machines for which cost considerations were secondary in influencing demand. By the 1990s, however, Japanese competitors had succeeded in developing their standard machines so that they could perform many functions previously possible only with highly specialized machines (Schumann et al., 1994; Herrigel, 1996, p. 37).

Symptoms of emerging competitive problems were discernible in the 1980s. Japanese productivity, measured by value added per employee, was double that of German machine tool companies throughout the 1980s (Englmann et al., 1994, p. 37). In part, the difference can be attributed to the longer hours worked by the Japanese; in 1990 hours worked per employee in Japan were 2 197 compared with 1 604 in Germany. But the Japanese performance also reflected their success at integrating human and physical resources to generate continuous innovation (Finegold et al., 1994, p. 23).

In general in machine-based industries, where process innovation has been important in driving down costs, the Japanese have been able in recent years to generate organizational learning that, even in industries such as precision machine tools and luxury automobiles in which the Germans were previously unrivaled, has permitted the Japanese to move into progressively higher-quality market segments at lower unit costs. The industries in which the Germans were competitively strong and that have historically been considered stable technology have been transformed by the Japanese, who have leveraged their flexibility at the enterprise level as a basis for continuous innovation (Schumann et al., 1994; Herrigel, 1995; 1996, p. 36).

The key organizational advantage of Japanese companies that has allowed them to generate superior performance relative to their German competitors seems to be their capacity to achieve cross-functional integration on the shop floor as well as in management structures.[5] German enterprises, like their Japanese counterparts and in contrast to most American companies, have in the postwar period attained considerable success in organizing the hierarchical integration of technical skills. However, two key features of the German system that facilitated hierarchical integration – specialized skills among production workers and functional divisions within the managerial organization – impeded cross-functional integration (Schumann et al., 1994, pp. 643–64; Herrigel, 1995; 1996, pp. 38–43; Jürgens and Lippert, 1997).

The weaknesses of the German system of organizational integration in facilitating cooperation across functions is rendering them vulnerable in competition with the Japanese. Herrigel argues that the problems with the German system are readily apparent in the development of new products:

> Each time a new product or a new technology is introduced – as opposed to an old one that is customized for a customer – the various roles that each of the categories of skill and management will play in the production and development of the new product must be bargained out. Each currently existing cluster of expertise and institutional power, naturally, wants to participate; each has its own ideas and solutions; each defends its turf against encroachments from the others; each takes for granted that it should have a legitimate place in the new arrangement within the firm. Electrical masters and technicians, for example, will fight with mechanical ones both on the shopfloor and in the design studios over different kinds of technical or manufacturing solutions to problems that have direct consequences for the amount and character of work that each will have to do and on the overall value that their role within the firm will contribute to the value of the product.
>
> (Herrigel, 1996, p. 42)

These problems in achieving cross-functional integration are difficult to overcome within the extant institutional context. Herrigel describes the day-to-day obstacles to such a transformation as forming a dynamic process of 'self-blockage' which involves all stakeholders, be they workers or managers, who have entrenched interests to protect. He argues that:

> [f]ew producers, large or small, have had success up until now in being able to overcome the opposition of entrenched groupings of skilled workers threatened with the loss of status through incorporation into teams that deny the boundaries of former jurisdictional specializations or of independent departments, reluctant to have their functional areas of power within the firms redefined and diluted through recomposition with other areas. It is difficult, after all, to tell workers and managers who with considerable legitimacy understand themselves as having contributed significantly to the traditional success of high quality manufacturing in Germany that their roles have become obstacles to adjustment.
>
> (Herrigel, 1996, p. 43)

There continues to be debate about the extent of the current problems with German work organization as the basis for generating higher-quality, lower-cost products. In their recent study of the German pump industry – which accounted for 25 percent of output and exports in general industrial machinery, one of Germany's critical manufacturing sectors – David Finegold and Karin Wagner found evidence that suggests that functional segmentation is a significant barrier to improving performance in the current competitive climate. Yet they caution against excessive gloom in assessing its implications for the viability of the German system of work organization. They contend that there are countervailing strengths of that system 'that have the potential to help firms develop a new, distinctive German production model' (Finegold and Wagner, 1998, p. 469).

If that transition is to occur, however, there is a need for a widespread commitment among employers, workers and unions in Germany to overcome existing organizational barriers to continuous innovation. In all of the industries in which they have previously been highly effective, German enterprises are currently able to produce and to export quite successfully. They are likely to continue to be able to do so for some time, despite intensified competition, because of the depth of organizational capabilities that reside in these companies. But continuity on the basis of existing capabilities may ultimately be the undoing of the market strength of German enterprises if a strategy of business-as-usual stands in the way of the organizational reform that is necessary if German enterprises are to recreate the foundations on which they can compete effectively in the future. Whether there is sufficient consensus among key interest groups in Germany to meet the challenge of that reform is an open question.

From the early 1980s there were growing concerns within the German labor movement about the continued reliance on early retirement schemes as a peaceable means of contracting the workforce. These arrangements were becoming more difficult in industries in which employment had been falling for some time, such as steel, shipbuilding, coalmining and consumer electronics, because the pool of eligible workers had diminished. There were also concerns that the government was going to tighten the eligibility requirements for these schemes and make them more expensive for individual companies. Employers also seemed less and less willing to use temporary measures, such as short-time work, because they increasingly regarded the challenges that German enterprises confronted as structural problems (Bosch, 1990, pp. 35–6). Moreover, with unemployment on the rise from the early 1980s it was clear that, to generate broad-based prosperity, much more was required than a preservation of existing jobs; new jobs had to be created.

Led by IG Metall, the German trade unions responded to this situation by launching a major campaign for fewer weekly working hours; they demanded the introduction of a 35-hour week without any reduction in pay. When negotiations over working time between the employers' organization and the union broke down, IG Metall struck for shorter hours. The 1984 strike was the worst in the history of the FRG. It lasted for nine weeks and involved about 455 000 workers (Baethge and Wolf, 1995, p. 240). The strike was concluded when the employers agreed to reduce average working hours to 38.5 per week.

From the unions' perspective, an important unintended consequence of the 1984 strike was the decentralization of negotiations over the allocation of working time to the plant level; in return for agreeing to shorter hours, employers were allowed to meet the 38.5-hour target only for the average worker in an enterprise. The growing importance of works councils in negotiating working time complemented a more general increase in the relative importance of the works council in the bargaining process induced by the ongoing reorganization of German enterprises associated with the introduction of new technologies (Katz, 1993).

The Works Constitution Act of 1972 gave works councils information, but not codetermination, rights with respect to rationalization measures undertaken by employers. The councils could, however, use their codetermination rights in other areas to exert an indirect influence on the process of technological change (Müller-Jentsch, 1995; Thelen, 1991, p. 184). In practice, works councils displayed varying capacities to deal with the growing complexity of their tasks and, in particular, with the process of technological change. In many cases, worker representatives' involvement was limited to negotiating with management about plans that had already been developed for the organization of work (Altmann, 1992, pp. 368–70, 377–8). Works councils, especially in small and medium-sized enterprises, often found themselves overwhelmed by the increasing demands placed on their capacities and resources. Not only did they lack the basis on which to resist employers' demands; they also lacked strong incentives because of concerns among works councilors that such resistance would lead to a loss of jobs for themselves and the workers whom they represented (Müller-Jentsch, 1995).

In the 1980s the German unions began to take a much more critical stance toward technological initiatives put forward by managers. In its annual report for 1982 IG Metall made the following statement:

> The economic boom in the Federal Republic in the first twenty-five years of its existence was founded on a fundamental consensus

> between the unions, employers, and the government. The unions did not fundamentally challenge rationalization and new technology; through their collective bargaining and worker protection policy they were able to reap for their members the fruits of productivity gains in the form of wage increases, working time reduction, and job and health protection. Developments in recent years make this social consensus more and more fragile … Rationalization in recent years has been at the expense of workers, in the growth of mass unemployment and worsening working conditions.
>
> (IG Metall, *Geschäftsbericht*, 1980–82, p. 413, quoted in Thelen, 1991, p. 193)

As unemployment rose in the 1980s, such concerns increased and qualitative issues attracted more and more attention in the labor movement. These concerns were heightened by the fact that plant-level negotiations between employers and works councils, to adapt industry-level contracts to local conditions, led to uneven benefits across the workforce as skilled workers were kept on for longer hours at the expense of shorter hours for the less skilled (Thelen, 1991). There were also fears in the labor movement that managerial technological initiatives, or more precisely, their organizational ramifications, would undermine the basis for labor representation (Turner, 1991, p. 113).

Initially, the unions tried to influence the evolving interaction between technology and organization in an indirect way through their support for a 'training offensive' to promote increased training and retraining for workers. They also facilitated an overhaul of the structure and content of traditional apprenticeship programs to take account of recent technological developments (Baethge and Wolf, 1995, p. 247). In pushing for high levels of training throughout the 1980s the unions hoped that the availability of qualified workers would convince employers to reorganize work in ways that would allow them to use their skills (Streeck, 1989). The federal government and the state governments also increased their support for apprenticeship training during this period. Combined with appeals by the government to take on apprentices, and an implicit threat to mandate such training vacancies by law otherwise, employers made more training places available (Winkelmann, 1996, p. 663); whereas the number of apprenticeships available had been 5 percent below the demand for these places in 1984, by 1989/90 there was a surplus of 11 percent (Casey, 1991, p. 206).

One example of the unions' more aggressive approach to training was their promotion of employment plans to replace the traditional social plans. The latter had dealt with mass redundancies in a way that was 'largely defensive or reactive; they do not intervene directly in the mechanisms of the labour market in the event of redundancies, but have mainly been focused on promoting external mobility, which at most cushions the negative effects.' In contrast, employment plans were intended 'by means of training and diversification measures, to act on the "root of the evil" and remove the need for redundancies' (Bosch, 1990, p. 37). In practice, these plans were to prove far less successful than their originators had hoped, primarily because of the absence of a serious commitment from employers (Bosch, 1990; Thelen, 1991, p. 139).

More generally, the effectiveness of the unions' training initiatives was undermined by the ongoing changes in production technologies, and the difficulties for the dual system in keeping abreast of them, as evidenced by shortages of production workers with requisite computer skills. As a result, investments in further training became increasingly important as the basis for the competitive advantage of German enterprises (Mahnkopf, 1991, p. 68). In contrast to initial vocational training, which is heavily regulated and relies on extensive worker involvement through unions' role in governing the system and works councils' participation in the implementation of training within enterprises, further training is, to a much greater extent, at the discretion of employers. The trend toward increased further training meant that:

> the *public* control of initial training is losing its formative function for the occupational biography of the participants. In the future, further training measures organized at plant level, i.e. by *private* economic interest, will decide the distribution of social status, incomes, social privileges and social recognition. Thus, private firms can determine, on the basis of profitability considerations, which groups of employees will receive additional qualifications and who must obtain them during or outside working hours by way of a 'voluntary' commitment.
>
> (Mahnkopf, 1991, p. 77)

To be in a position to do more than merely ratify managerial decisions about investments in skill formation, the unions had to go beyond their traditional channels of representation. In 1984 the DGB launched a 'Codetermination Initiative' which had as its goal the direct participation of employees in the design of their work in a humane manner (Altmann, 1992, p. 378; Fricke, 1986). IG Metall took the lead in formulating a position on labor participation in decisions about the development and utilization of technology. Its strategy emphasized the importance of local involvement, and it relied heavily for its implementation on the cooperation of works councils. The role of the union was seen as providing works councilors with training and materials on issues relevant to technological change based on real-world experiences in selected model plants. The program was also designed to educate works councils about the range of economically viable forms of work organization to encourage them to take a more proactive stance on these issues with employers. By the late 1980s, IG Metall had developed a coherent vision of work organization called *Gruppenarbeit* or 'group work' (Thelen, 1991, ch. 8; Turner, 1991).

These initiatives met with some limited success in the late 1980s, although the majority of employers displayed little interest in group work and were resistant to extending workers' codetermination rights over the development and utilization of technology. In 1989, when the Works Constitution Act was amended to specify more clearly the consultation and information rights of workers with respect to the introduction of new technology, the main employers' organization, the BDA, complained that West German workers and their representatives already had more rights to information, consultation and codetermination than anywhere else in the world and to extend them would interfere unduly with managerial decision making. The amendment did not, however, provide workers with codetermination rights over the introduction of new technology and for that reason was criticized by the unions.

One can find examples of German companies that took an 'anthropocentric' approach to technological change during the 1980s, but the predominant approach during this period seems to have been a 'technocentric' one (Altmann, 1992, p. 367). The main objective of restructuring efforts in German companies during the 1980s was the development of factory automation. By the end of the decade a widespread diffusion of the components of computer-integrated manufacturing systems had occurred in German enterprises although they had not by then been integrated into anything approaching the technocratic dream of a 'factory of the future' (Köhler and Schmierl, 1992; Jürgens et al., 1993).

The appetite of German employers for technological rather than organizational strategies to deal with intensified international competition is reminiscent of the responses of leading American managers in the 1980s. Arguably, German managers, who are much more likely than their American counterparts to be technically trained, were even more attracted to technological 'solutions' to organizational problems.

The attempt by Daimler-Benz to become an 'integrated technology concern' by diversifying its operations into aerospace, aircraft and other sectors that were deemed to be 'technologically related' to its traditional businesses in automobiles and trucks is a well-known example of such a fetish.

German employers also displayed increasing concerns about the costs of production, and, in particular, the labor costs associated with doing business in Germany. The unions had traditionally countered the employers' arguments by pointing to the highly skilled German workforce and the export-market success of German industry. As Germany's competitive position showed signs of deteriorating in the 1990s, however, this argument was rejected by employers who warned that German companies would be forced to relocate production abroad if drastic action were not taken. In the words of Hans-Peter Stihl, President of the Association of German Chambers of Industry and Commerce, and the owner of Andreas Stihl, a chainsaw manufacturer near Stuttgart: 'We have a cost crisis that has caused something of a structural crisis. Either German unions will accept substantial reductions in incomes and wages or we will lose more jobs. We also have the possibility of moving more jobs abroad' (*New York Times*, 13 February 1996).

The recent trends in foreign direct investment (FDI) into and out of Germany have been taken as evidence by many commentators that companies have been voting with their feet on the declining attractiveness of Germany as a place to do business. FDI by German companies has been rising rapidly since the 1980s; from 1984 to 1995 the direct investment of German enterprises abroad rose at an average annual rate of 17.5 percent from US$50 billion to $300 billion. Inward FDI, according to the German balance of payments, was much lower: during the period from 1984 to 1995 total inward investment amounted to just over US$36 billion (Deutsche Bundesbank, 1997, pp. 64, 71).

It is, however, unlikely that the cost of German labor is the main reason for these trends in FDI. The regional distribution of the stock of German enterprises' FDI, and, in particular, the fact that it is almost identical to that of German exports, suggests that German companies are investing abroad to secure market access. In fact, that has been reported as the main reason for investing abroad in surveys of German employers (Deutsche Bundesbank, 1997, p. 66, fn. 5). Despite increases in the US and South East Asia, German FDI continues to be heavily concentrated in European countries which have somewhat lower labor costs than in Germany but can hardly be classified as low-wage countries (Dicken, 1998, p. 55). The changing of the guard in Eastern Europe has, however, created lower-wage location possibilities closer to home for German enterprises than heretofore, although in these countries too German FDI is being partly driven by market-access considerations; the expansion of trade with these countries has already provided German-based exporters with lucrative export opportunities especially in mechanical and engineering products, road vehicles and chemical products (Deutsche Bundesbank, July 1996).

German companies have also been investing abroad to gain access to foreign research capabilities (for the complex implications of the internationalization of German companies' R&D, see Cantwell and Harding, 1998). This is particularly true for the German chemicals industry, which accounted for 34 percent of Germany's manufacturing foreign direct investment in 1994 (Dicken, 1998, p. 55). Moreover, the ongoing process of European integration, and the general propensity towards globalization strategies in business circles, has persuaded many German service companies, banks and insurance companies, as well as those operating in the wholesale and retail trades, of the value of acquisition strategies designed to build up an international presence; these services companies accounted for more than 60 percent of total German FDI in 1994, up from less than 40 percent in 1985 (Dicken, 1998, pp. 54–5).

The sustained appreciation of the Deutschmark (DM) has made all of these FDI strategies relatively cheap for German enterprises. The strength of the DM is undoubtedly also part of the explanation for the relatively low level of inward FDI. Statistical discrepancies are another. In contrast to the figure of US$36 billion reported in the German balance of payments as the cumulative total of direct investment imports from 1984 to 1995, a comparable figure of US$118.9 billion is reported by the balance of payments of investor countries. On the basis of these revised figures, as the Deutsche Bundesbank put it, 'Germany's position as a recipient country of international direct investment appears in a much more favourable light' (Deutsche Bundesbank, 1997, p. 72; *Financial Times*, 14 July 1997, p. 7).

On balance there is little support in the evidence on foreign direct investment for the contention that high costs are the main factor in driving companies out of, or keeping them away from, Germany. Whatever the real reasons for their international strategies, however, some German employers have used the fact of a deficit in FDI, and other arguments about declining German cost competitiveness, to take a much harder line on labor costs at home. In December 1993, Gesamtmetall, the metalworking employers' association, took the unprecedented action of canceling their collective agreement with IG Metall. The action was largely symbolic because the agreement lasted only until the end of 1993, but it was widely interpreted as a signal of a shift by employers to a more aggressive stance toward labor (Baethge and Oberbeck, 1995).

German employers have railed against collectively bargained wage increases and have called instead for plant-level agreements. There had, in fact, already been a strong trend in that direction before the early 1990s (Katz, 1993), but it rapidly gained momentum when the German economy went into recession in 1993. In general, the recession has prompted a process of concession bargaining at the plant or company level (Sadowski et al., 1994, p. 534). Standortsicherungs (location-guaranteeing) agreements have become widespread at the plant and enterprise levels; their common feature is the concession of a reduction in labor costs by the works council or union in return for a guarantee of employment security. These agreements differ substantially, however, with respect to their details. Some are focussed primarily on cost cutting; others include more proactive measures to improve long-term competitive performance (Jürgens, 1997).

Employers claim that they cannot afford to keep high-cost German workers employed given the intense competition that they face on international product markets. According to a survey conducted by the *Institut der deutschen Wirtschaft* of average hourly labor costs in manufacturing in the world's leading economies, West Germany is leading the pack. Wage increases, however, play a smaller role in Germany's relative position than one would imagine from employers' rhetoric. During the period from 1970 to 1994, the country with the lowest wage increases was the US; Switzerland and Germany were the countries with the second lowest rate of growth of pay! One reason for the growth in hourly labor costs was a rise in indirect labor costs, mostly due to increased social security contributions; in absolute terms West Germany had the highest indirect costs of all of the countries surveyed. But the relative increase was also substantially attributable to the appreciation in the value of the DM rather than an increase in domestic costs as such (EIRR, 259, August 1995, p. 13).

In and of themselves international labor cost comparisons do not say anything definitive about the competitiveness of a country, a region, or a nation. German companies have in the past paid relatively high wages and still managed to be competitive on international markets (Carlin and Soskice, 1997). Bringing productivity into the picture to calculate unit labor costs is one way of getting a more accurate reading of competitiveness. A 1993 report by the Deutsches Institut für Wirtschaftsforschung (DIW) research institute contended that only twice in the last 25 years – in 1970–71 and in 1992 – did unit labor costs rise faster than the average for other industrialized countries. For the remainder of that period, the increase in German unit labor costs was below that of its competitors (EIRR, 241). Employers argue, however, that productivity no longer compensates for high German labor costs. According to a survey by the employers' DIW research institute in the period 1985–92, unit labor costs – calculated on the basis of exchange rates against the DM – rose by 30.2 percent in Germany, or more rapidly than in almost any other of the major trading nations included in the survey. The IW did acknowledge that the relative increase had more to do with the growing strength of the DM than with an increase in domestic costs but, whatever the reason, it argued, the fact was that Germany had the highest unit labor costs of any major industrial nation (EIRR, 241, pp. 13–17).

Studies conducted at the industry level generally support the view that the key symptom of the competitive challenge facing German industry is found in productivity rather than cost differences. In the automobile industry, for example, average gross value added per employee was 92 000 DM per year in Germany during the period from 1981 to 1990 compared with 131 000 DM in Japan (Roth, 1997, p. 123). Productivity differences do not, however, explain competitive problems; they are symptoms of them. Moreover, they are only useful in understanding relative competitiveness when studied over the long term. To the extent that enterprises pursue developmental strategies, short-term productivity often has to be sacrificed in the expectation of achieving long-term gains. Once companies move away from traditional ways of doing business, once they start transforming technologies and organizations, productivity measures become muddy, and sometimes quite inaccurate, measures of potential competitive strength.

To really get at the nature of the competitive challenges that German enterprises confront necessitates studying the bases on which companies compete with each other on international product markets. The explanation for the productivity differences between German industry and Japanese industry, as I have already noted, seems to be organizational. Thus, although wage restraint and increased working hours may well be elements of a creative response by German enterprises to competitive challenges, they are unlikely to be enough to lay the foundations for sustainable prosperity in the German economy. It remains an open question whether those with powerful interests in the extant system of governance have the requisite abilities and incentives to bring about organizational transformation in the German economy.

Certainly there is no consensus on how organized labor should proceed. The stronger unions, like IG Metall, have always expressed concerns that, left to their own devices, works councils would contribute to a segmentation of the workforce by consolidating the interests of insiders. But the unions face a similar dilemma themselves. Birgit Mahnkopf casts the current situation facing the unions in pessimistic terms. On the one hand, they run the risk of being denounced as barriers to progress if they obstruct employer strategies. On the other hand, a 'skill-oriented modernization strategy' risks strengthening social inequalities further by entering into 'an ideological alliance between the "hard-working" and "successful" against the "indolent" and "incapable"' (Mahnkopf, 1991, p. 77). As unemployment grows and cuts into union membership, however, even the most powerful unions are displaying a defensive pragmatism in response to employer strategies.

German employers have certainly shown that they are willing to tackle what they consider to be the excessive wages and insufficient working hours of German workers, even when it involves confrontation with the unions, as happened, for example, in 1996 over the issue of sick pay. Nor have wage restraint and productivity gains stopped the unprecedented wave of corporate layoffs that began in Germany in 1991. What is not clear, however, is whether employers have the abilities and incentives to confront the organizational foundations of German industry's competitive problems. Indeed, to focus on technology and labor costs, as many German managers have been wont to do, is to obscure the nature of the problem. In recent years, however, there seems to have been growing recognition among employers of the need for organizational transformation. In the automobile industry, in particular, 'the lean production revolution' which got under way in Germany in 1991 forced a recognition of the importance of organizational issues for enterprise performance. To date progress in confronting these issues has been patchy, as is evident from Jürgens's recent evaluation of the development of teamwork in the automobile industry:

> In the more than five years since the adoption of lean production by German companies, major differences in the degree of emphasis on teamwork have become evident. Some manufacturers have achieved

> almost full integration of their workforces into teams, while others ... are in a pilot stage. The differences cannot be explained by blockades and controversies in the industrial relations arena, however. Rather, operations managers often hesitate to introduce far-reaching changes, while top-level managers have other priorities.
> (Jürgens, 1997, p. 111)

If the German system of governance faced only productive challenges, one could have some confidence that consensus could be achieved to promote the social transformation necessary to regenerate the organizational foundations of innovation in German enterprises. The confluence of productive and financial challenges, however, makes the achievement of this outcome much less likely. It provides scope for those with interests in financial liquidity to use their growing power to live off what has been accumulated in the productive economy in the past rather than to restrain their claims to permit the reallocation of resources necessary to develop the organizations required to strengthen the innovative dynamic in the German economy.

Financial challenges

Critical to the responses of German enterprises to the competitive challenges that they now face will be the extent to which financial commitment is forthcoming from the German system of governance. There are clear indications of an increasing emphasis on financial liquidity in the German system of governance which, if it gains momentum, may well exacerbate the existing organizational problems in German industry. Growing systematic pressures for financial liquidity are rooted in the rising level of savings generated by the country's postwar economic success, pressures that will only grow as the trend toward intergenerational dependence increases in Germany.

The federal government controlled interest rates after the war, thus limiting interest rate competition in Germany not only among different sectors of the banking industry, but also from savings instruments provided by other financial enterprises. The objective of this restriction was to stabilize the banking system and thus protect depositors; its effect was seen in the channeling of the vast majority of German savings through the banks; although the formation of monetary assets was limited during the 1950s, about 75 percent of these assets were channeled into the banking sector (Francke and Hudson, 1984, p. 76).

As their incomes expanded, Germans were able to save more, and the success of public campaigns and state subsidies to promote saving led to the emergence of higher aggregate saving rates in Germany than in the US by the 1960s. Automatic wage deposits for workers helped mass consumer banking to become the major source of expansion in the banking business in the 1960s. Once restrictions on branch banking were removed in 1958, competition in the banking sector occurred primarily through the expansion of branch networks (Francke and Hudson, 1984; Deeg, 1991). In 1970, as Table 9.1 shows, claims against banks accounted for more than half of the financial assets of German households, and over three-quarters of these bank deposits were in savings accounts. In the 1950s and 1960s competition for the rapidly growing funds of German savers took place primarily among the savings banks, the private banks and the cooperative banks. In 1970 the savings banks dominated the market with 58.8 percent of total savings deposits; the credit cooperatives followed with 18.2 percent and then came the private banks with 17.3 percent (Oberbeck and Baethge, 1989, p. 285).

During the 1970s, investors began to move out of bank deposits and into higher-yielding savings instruments. As Table 9.1 shows, the proportion of financial assets held as bank deposits fell from 52.4 percent

Table 9.1 Structure of financial assets of private German households (% of total private financial assets)

Assets	*1970*	*1992*	*1993 Unified Germany*	*1998*
Bank deposits	52.4	40.7	41.7	35.4
Cash and sight deposits	10.6	8.0	8.8	8.6
Time deposits	1.8	8.0	12.6	6.3
Saving deposits	39.1	19.4	20.3	20.5
Savings certificates	0.9	5.3	–	–
Savings and loan deposits	7.6	3.7	3.5	3.1
Insurance[1]	13.3	18.5	19.8	21.7
Fixed-income securities[2]	7.7	20.9	15.9	13.1
Stocks[3]	11.3	5.2	5.4	10.7
Investment fund certs			6.3	9.7
Other receivables[4]	7.7	11.0	7.4	6.3

[1] Incl. life insurance and pensions.
[2] Incl. bond fund shares.
[3] Incl. stock fund shares
[4] Incl. pension claims within the company.
Source: Deutsche Bank *Research Bulletin,* 9 January 1995, p. 7; Deutsche Bundesbank, *Gesamtwirtschaftliche Finanzierungsrechnung*; dies., Kapitalmarktstatistik).

to 40.7 percent between 1970 and 1992. There was a further decline in the mid-1990s to 35.4 percent by the end of 1998. Insurance investments increased from 13.3 percent of private financial assets in 1970 to 18.5 percent in 1992 with a further increase to 21.7 percent by 1998. Especially in the 1990s, stocks and mutual funds showed substantial growth; by the end of 1998 they accounted for 10.7 percent and 9.7 percent respectively of household financial assets.

The changes in the structure of German household financial assets are considerable in historical perspective. Competing for savings has provided German financial enterprises with strong incentives to pursue higher yields on financial assets in the German economy. Germany has one of the most extensive banking networks in the world and all three sectors of the banking industry – the savings banks, the cooperative banks and the private banks (including the big banks) – have been active participants in 'the battle over the piggy bank' that has been under way in Germany in recent decades (Oberbeck and Baethge, 1989, p. 287). Arguably, it is the large private banks – Deutsche Bank, Dresdner and Commerzbank – the alleged 'patient capitalists' of the German economy – that have particularly strong incentives to push for higher returns on financial assets. They have less to lose than the savings and cooperative banks (with a combined total of 80 percent of savings deposits) through the disintermediation that has already resulted and will continue to result from the widespread introduction of market-based savings instruments (Deutsche Bundesbank, 1991). Moreover, with their access to high-income Germans through their retail networks, and their experience in securities markets at home and abroad, they are well positioned to exploit the profit potential of this business. Reflecting these incentives, they have been particularly active in the introduction of these new savings instruments and in attempting to promote an 'equity culture' in Germany. The major insurance companies, like Allianz and Munich Re, have also become formidable competitors for the savings of German people. They have been eyeing the business opportunities in asset management that are growing as competition for yields heats up in Germany.

The incentives of these financial enterprises to stimulate demands for higher financial returns in Germany have been reinforced by similar trends towards heightened competition in all segments of their business. A major overhaul of the regulatory framework of the German financial markets that has been under way since the mid-1980s has facilitated and fostered greater competition (Deeg, 1996; Story, 1997). Margins have thus become very tight in all sectors of German banking, and financial enterprises have been looking to new business opportunities to compensate. Asset management is one such opportunity. For the major German banks, investment banking is another.

In the late 1980s and early 1990s, the big banks, especially Deutsche Bank and Dresdner Bank, seemed confident that they could compensate for slimmer margins in their domestic business by turning themselves into global investment banks. They have encountered serious setbacks in the pursuit of that strategy but they are heavily committed to it. As a result of their expansion in investment banking, the big banks have reduced their dependence on interest income compared with other sectors of the banking industry in Germany: 63.9 percent of the total operating surplus of the big banks came from interest in 1998 compared with 79 percent for cooperative banks and 81.9 percent for savings banks. However, the growth of commission businesses has not stopped the deterioration of their operating results: the operating profit of the big banks declined from 0.69 percent of their average volume of business in 1996 to 0.47 percent in 1998 (Deutsche Bundesbank, July 1999). The level of competition in German finance is likely to increase still further as the big banks and other German financial enterprises struggle with each other and with foreign competitors to regain business and profits in the German market. If the European Commission succeeds in its attempts to sever the ties between the savings and cooperative banks and the public sector, competition will become even more intense ('Monti to challenge Berlin.' *Financial Times*, 22 October 1999).

Given the business conditions that the big banks face, to assume that they can be characterized as 'patient capitalists' seems misguided in the 1990s. As Germans have grown wealthier and competition for their savings has intensified, the banks increasingly see their interests as being better achieved by promoting financial liquidity rather than financial commitment. One important symptom of change, with direct implications for the German system of corporate governance, is the evolution of German financial enterprises' attitudes towards their industrial holdings.

The big banks have been quietly reducing these shareholdings for some time (Deeg, 1991, p. 201). In the 1990s, the reduction of big banks' industrial holdings has continued apace. The major commercial banks, especially Deutsche Bank, have made no secret of the fact that they would like to receive higher returns from these holdings either by managing them more actively or by selling them. Until recently, the German tax system has put a brake on the latter option; a major capital gains tax liability would accrue on most of these holdings because they have been held by the banks for so long. As the banks have come under increasing financial pressures in their own businesses, however, that barrier has no longer proven prohibitive.

In 1997 Deutsche Bank sold off its stakes in a number of important German companies including AMB, Bayersiche Vereinsbank and Karstadt, and substantially reduced its stakes in other leading companies like Continental and Metallgesellschaft. Apparently, the premium paid for these shares was sufficiently high to compensate Deutsche Bank for the tax liability incurred on the transaction. In December 1998, the bank issued euro-denominated bonds, exchangeable into Allianz ordinary shares. The hugely successful issue allowed Deutsche Bank to sell off some of its holdings of Allianz shares at a substantial premium – its stake in Allianz was reduced from 10 to 8.3 percent in the process – and to defer the tax liability until the bonds are exchanged. Later the same month, in what is regarded as a prelude to the pursuit of a more shareholder-value oriented strategy in the management of its share portfolio, Deutsche Bank announced that it would move its remaining stakes in other German companies into a legally separate profit centre, Deutsche Investor. In October 1999, the bank sold off more of its Allianz shares, further reducing its stake in the insurer to 7 percent ('Deutsche Bank sells Allianz shares,' *Financial Times*, 29 October 1999).

Other major German financial enterprises have been following Deutsche's lead. In February 1998, for example, Allianz issued an exchangeable bond to monetize approximately half of its stake in Deutsche Bank. Dresdner has announced that it is moving its portfolio of shareholdings into an asset management subsidiary that will be managed at arm's length from the rest of the bank.

The importance of these transactions to the banks and insurance companies is readily seen in the impact they had on profitability. Notwithstanding the desultory operating performance recorded by the big banks in 1998, for example, they managed to reverse a strong downward trend in their net profitability – their after-tax return on capital was 19.24 percent in 1998 compared with 5.44 percent in 1997, 7.79 percent in 1996, 8.17 percent in 1995, and 8.12 percent in 1994. They did so by recording a massive amount of extraordinary income, to the tune of more than three times their operating result in 1998, as a result of sales of some of their participating interests and the transfer of a large proportion of the others to autonomous partnerships (Deutsche Bundesbank, *Monthly Report*, July 1999). Given the competitive conditions facing the leading financial enterprises in Germany, we can only expect that they will continue to pursue strategies that are considerably different from their historical orientation. It is not beyond the bounds of possibility, therefore, that the banks and insurance companies will unwind most of their shareholdings, at least to the extent that they are unrelated to their core business interests.

One can but speculate about the effect that such a change might have on German corporate governance. German banks, despite all the attention that their industrial shareholdings garner, held only 10.3 percent of the shares of German companies at the end of 1998 (down from 11.2 percent at the end of 1996). Yet mutual funds in the US held only 10.2 percent of US corporate stock in 1996. It is therefore likely that effects on the German corporate economy would be significant if the banks transferred ownership of the shares that they hold or if they managed them in a more aggressive manner. The likely effect of such changes also depends on what happens to the remaining 90 percent of German shares and in particular on the level of support that a stronger shareholder-value orientation finds among other shareholders. In the past, cross-shareholdings among non-financial enterprises in the German economy have acted as an important buffer against interference from outsiders, but the importance of these holdings has declined rapidly in recent years: at the end of 1998 non-financial enterprises held 30.5 percent of all German shares, down from 37.6 percent at the end of 1996. The shares released from the cross-shareholding network seem to have been bought up by foreign investors (whose holdings of German shares increased from 11.7 percent to 15.6 percent during the same period) and investment funds which increased their ownership of German shares from 9.1 percent to 12.9 percent (Deutsche Bundesbank, *Gesamtwirtschaftliche Finanzierungsrechnung)*.

The above account underlines the fact that there are clear signs of changes in the incentives and behavior of at least one group of actors who have the potential to transform a critical element of the postwar German system of corporate governance. And change is not confined to the banks. Major German corporations are singing to the tune of shareholder value to a degree considered unimaginable as recently as the early 1990s, and they display a growing propensity to adopt innovations from executive stock options to stock buybacks that until recently were regarded as anathema in German business circles. The recent success of the Neuer Markt has substantially increased the number of listed companies in Germany and it is 'widely expected that the going public trend will continue since thousands of mid-size companies suffer from a deteriorating equity position and face a succession crisis from company founder to non-familial management' (Deeg, 1996, p. 12). The appetite of German households for equities has also been increasing in recent years: the proportion of Germans owning shares increased from 5.4 percent in the early 1990s to 7.6 percent in 1995 and then again to 8.8 percent in 1997 (*Deutsche Bank Bulletin*, 9 January 1995, p. 9; The *Economist*, 6 December 1997). The financial assets of institutional investors have also risen substantially from 36.5 percent of GDP in 1990 to 57.5 percent in 1997.

It is important, however, not to overstate the degree to which change has penetrated to the heart of the German system of governance. It is still the case today that most companies in Germany, including some of its most successful enterprises, have nothing at all to do with the stock market. Furthermore, notwithstanding changes in the structure of German savings in recent decades, equity holdings as a percentage of private financial assets remain low in international comparison (*Deutsche Bank Bulletin*, 9 January 1995, p. 9). The German financial system has generated nothing approaching the vast liquid funds under management by US financial institutions, whose assets increased from 123.8 percent of GDP in 1990 to 202.8 percent in 1997. The difference in absolute terms is even more striking: in 1997, for example, institutional investors in the United States held financial assets of approximately US$15 868 billion compared with US$1 202 billion for their German counterparts (OECD, 1998, p. 20).

Pension funds account for a substantial proportion of the difference and if there is one area in which substantial change could induce a systemic shift in corporate governance in Germany it is the pension system. The financial assets of German pension funds were, at 2.9 percent in 1997, negligible compared with their American counterparts, which had comparable holdings of 72.5 percent of GDP. There has been a significant increase since 1960 in personal provision for pensions in Germany, with most of it channeled through insurance companies. If we add the holdings of insurance companies we get a somewhat different picture (34.8 percent of GDP in Germany versus 115.6 percent in the US) but the relatively vast scale of US funds under management by institutional investors for pension purposes is still not in question (OECD, 1998). In Germany, moreover, there are restrictions on the proportions of the assets of pension funds and insurance companies that can be held in different types of financial instruments which has limited the pressures for higher yields on equities from this source. For example, the limit for EU equities is 30 percent (increased from a maximum of 5 percent in 1990); it is 6 percent for non-EU equities; in 1994, German pension funds put about 72 percent of their assets in domestic bonds and only 9 percent in equities (Queisser, 1996, p. 14).

The most important reason for the differences between the Germany and the US in accumulated pension funds under management is the relative importance of the state pension system in Germany. As a pay-as-you-go system, the German government pension system generates no reservoir of surplus funds to be allocated. Instead, almost 75 percent of the financing for the system comes from employee and employer contributions on the basis of earnings up to a ceiling of 1.8 times the average gross earnings of all insured individuals; the remainder is paid by the federal government out of general revenues (World Bank, 1994, p. 361).

Since 1960 there has been a steady increase in the contribution rate required to finance the pay-as-you-go pension system; it has risen from 14 percent in 1960 to 20.3 percent in 1997 (Deutsche Bundesbank, September 1997, p. 42). A further increase in the contribution rate to 21 percent in 1998 was forestalled only by the emergency measure agreed in April 1997 to raise VAT by one point to 16 percent. The levy is expected to rise still further in the decades to come as growing life expectancy and a decline in fertility contribute to a 'double aging' process in Germany. The OECD has forecast that by 2040 pension costs in Germany will amount to an enormous 18 percent of GDP (OECD, 1996b).

Demographic trends are not, however, the only source of increased pressure on the financing of the German pension system. They are compounded by labor market pressures. All major OECD countries have experienced a strong decline in labor supply by the elderly but the German participation rate for older people is now among the lowest of the major OECD countries. It is just over half that of the comparable US figure and much lower than the Japanese rate. Some scholars have attributed the striking German trend to the structure of the state pension system which provides generous incentives to retire and, until recently, did not decrease with age in a manner which was actuarially 'fair' (Börsch-Supan, 1991). The low average retirement age also reflects the use of early retirement as a means of contracting enterprise workforces: in 1994, for example, only 29 percent of new pension benefits awarded were paid to those retiring at 'normal' retirement age (Queisser, 1996, p. 18; see also Abraham and Houseman, 1993). The extensive use of early retirement thus increases the pressures on the pension system beyond what the growing old age dependency ratio alone would imply.

How the German government deals with the problem of supporting more and more people in old age will have critical implications for the sustainability of financial commitment in the German economy. The growing concerns that have been expressed in Germany about the funding of pensions suggest that if the pressure for higher yields in Germany, especially from corporations, is to get a major push in the near future it will come from changes in the pension system. To date the initiatives undertaken by the government to improve the funding situation in the state pension scheme have focussed on making adjustments within the framework of the pay-as-you-go pension system, but the financial pressures on the system have increased and the proposed solutions are becoming more radical.

A Pension Reform Commission established by the former Kohl government recommended a move to funded employer pensions along US and British lines, but these proposals were not translated into reform before the government lost office. The legislative framework for a new personal pension vehicle was introduced by the Third Financial Market Promotion Act that took effect in mid-1998. These pension funds were not, however, accorded any tax incentives, making them in practice very little different from ordinary mutual funds ('Pinning Hopes on Pension Reform,' *Euroweek*, April 1998). The SPD and the Greens made the issue of pension reform a central part of their election campaigns in September 1998. One proposal that received considerable attention was the imposition of an energy tax to fund state pension obligations. Since taking office, however, it has proven difficult for the Red – Green coalition to agree on the appropriate direction for reform. Gerhard Schroeder's government has put a brake on the cutbacks to the state pension that were due to take effect in January 1999 but as yet no concrete proposals have been made about pension reform (*Pensions and Investment,* 2 November 1998, p. 16).

The difference in pension funds under management in Germany compared with the US is also greatly affected by the way in which German employers fund the pensions that they provide to employees. Employer pensions were originally introduced as elements in the compensation packages offered to key workers to keep them with specific companies, mainly larger companies, when labor markets became tight from the mid-1950s. In more recent periods of relatively high unemployment, some German companies have reduced these benefits. Moreover, changes in German pension law in 1974, which allowed workers to transfer their pensions from one company to another, have reduced the effectiveness of this device for retaining workers. Nevertheless, these pensions still represent a significant accumulation of pension liabilities in the German economy; in 1993 the total pension obligations of companies amounted to about DM 460.6 billion (Queisser, 1996, p. 12).

In the early 1990s, as Table 9.2 shows, about one-fifth of employer pension assets were in private pension funds (*Pensionskassen*). Employers and employees generally make contributions to these funds and the investment behavior of these funds is regulated by the life insurance laws (Turner and Watanabe, 1995). Some employer pensions are funded by direct insurance (*Direktversicherungen*) through life insurance companies. Support funds (*Unterstützungskassen*) are another significant channel for employer pensions. These funds are legal entities that are financed by allocations of resources from the employer company but are legally separate from it. The funds are generally lent back to the employer company as an interest-bearing loan (Turner and Watanabe, 1995, p. 97). As Table 9.2 shows, these three channels together comprise just over 40 percent of employer pension assets in Germany.

The remainder, nearly 60 percent of the funds earmarked for the payment of company pensions, remain in the company as book reserves. As a company builds up its pension reserves (*Pensionrückstellung*), the increases in its pension liabilities are tax-deductible. Since enterprises are permitted to invest the funds allocated to pension obligations in the normal course of their businesses, this system in effect affords them a tax-effective means of borrowing from their employees; company pension funds were used to finance almost 5 percent of the net investment of German producing enterprises in

Table 9.2 Allocation of employer pension assets in Germany (% of total, 1996; total volume, DM 515 bn)

Type of plan	*% of total pension assets*
Book reserves	57
Private fund	22
Direct insurance	13
Support fund	8
Total	100

Source: Deutsche Bank, *Research Bulletin*, No. 2, 1998, p. 35.

the period from 1980 to 1989 and thus represented a more important source of finance for industrial enterprises than equity issues (Edwards and Fischer, 1994, p. 54). For large manufacturing AGs, provisions for pensions were even more significant, accounting for nearly 15 percent of their net investment in the period 1970–85 (Edwards and Fischer, 1994, p. 128). Major German AGs have enormous pension reserves on their balance sheets; as Hauck put it, 'Siemens has over DM 14 bn of pension reserves and can be compared in this respect with a good medium-sized life insurance company' (Hauck, 1994, p. 557). Although the importance of book reserves has fallen since 1981 from 67 percent of all occupational pension assets and, correspondingly, direct insurance has increased its share from under 5 percent in 1981 (Queisser, 1996, p. 14), the accumulation of book reserves nevertheless remains the prevalent practice with regard to German employer pensions.

There are some signs that employer pensions may be moved out of company financing into market-based instruments. In early 1996 Deutsche Bank purchased equities to the value of $330 million – nearly 15 percent of its pension book reserves – and allocated them to a pension fund managed by an asset-management subsidiary. In late 1997 Deutsche Shell AG announced that it would create a DM2 billion fund in an attempt to generate higher returns from its pension assets. The company expects to earn an average annual return of 7 percent on investments in stocks and bonds compared with the current rate of 3 percent that it is generating from holding the funds in cash.

The implications of any major move by the state or employers towards market financing of pensions would have profound implications for the German financial system. According to Josef Wertschulte, a director of Bayerische Hypotheken- und Wechsel-Bank, '[p]ension funds could total between DM1,600 bn and DM2,000 bn in 10 years if the right legal and tax conditions were created. This would double the size of the present equity market' (*Financial Times*, 17 February 1997, p. 20). Not surprisingly the German financial community can hardly contain their excitement at the prospect! Deutsche Bank, for example, has been leading the campaign to induce reserves off company balance sheets into pension funds controlled by professional asset managers. In 1996, Deutsche Bank Research published a report that called for a shift 'From Pension Reserves to Pension Funds' that provoked much discussion and controversy in Germany. At the end of 1997, the German banking association submitted draft legislation on employer pension funds that called for the management of pension funds by external money managers as well as favorable tax treatment for externally funded pension provision.

It is by no means assured that there will be a major shift to the funding of pensions through the equity markets. The political opposition in Germany to such a move would likely be enormous. The issue is not, however, solely dependent on domestic politics. What happens to pension provision in Germany will also depend on policy initiatives by the European Union. In its attempts to promote the mobility of capital and labor across European borders, the European Commission has for some time identified retirement provision as one of the key barriers to achieving this objective. With a view to removing this obstacle, the European Commission developed a draft pension funds directive in the early 1990s that was designed to allow the cross-border sale of pension products and to remove restrictions on cross-border investments by these funds, but it was forced to withdraw the proposed directive in the face of opposition from some of the member states. In 1995 the debate was reopened, however, when Mario Monti, the European Commissioner in charge of financial services, issued a Green Paper on 'Supplementary Pensions in the Single Market.' The objectives laid out in this document were very similar to the withdrawn draft directive. In May 1999 the Commission issued a blueprint for pension reform, 'Towards a Single Market for Supplementary Pensions,' which called for the liberalization of the EU pension fund market and reported that substantial progress had been made in gaining consensus among member states about the regulatory changes that such a development would require. Major companies, especially in the financial sector, have been exerting pressure on the European Commission to develop a directive along these lines for pension funds, but they have also been threatening to take the issue to the European Court of Justice if the Commission does not comply with their demands. However it comes about, change along these lines seems likely in the current political climate in Europe.

The conventional wisdom among economists is that a funded system is preferable to a pay-as-you-go system because it adds to the pool of funds currently available through the financial markets for productive investment today. From what we know about patterns of corporate financing, however, there is little empirical basis for the belief that funneling pension money through the financial markets will increase the financial resources available for productive investment. Notwithstanding the prevalence of the assumption that portfolio investors – especially public shareholders – finance investments in productive assets, the evidence, both historical and comparative, on patterns of corporate financing consistently reveals the minor importance of the stock market as a source of finance in productive assets. Internal sources of finance – undistributed profits and capital consumption allowances – have always provided, and continue to provide, the financial resources that are the foundations of investments in productive capabilities.[6]

Indeed, rather than enhancing the availability of finance for investments in productive capabilities, a move toward a pension system that is funded on the basis of investments in financial assets is likely to undermine the financial commitment necessary to support the returns to these financial investments on a sustainable basis. When pensions are financed through a pay-as-you-go system, retirees have a direct interest in a system of corporate governance that maintains the employment base today and in the future. Funding pensions by investing in publicly traded securities breaks the direct link between employment and retirement and gives those with accumulated financial assets substantial incentives to support policies that enhance financial returns even at the expense of employment. It may be that, for the system as a whole, pension payments, however they are financed, can only be sustained if investments are made in the present that enhance productivity in the future. There is, however, no disciplining mechanism on the demands of individual retirees for financial liquidity once the explicit link between employment and retirement is broken.

Conclusion: whither German corporate governance?

If the trend toward financial liquidity continues, and particularly if it gains a major boost from reforms of the pension system, it is plausible that German financial enterprises may find willing allies in the country's corporate managers attracted by the possibilities to enrich themselves. The new managerial rhetoric of shareholder value at leading German companies such as Daimler-Benz, Hoechst and Siemens is certainly striking in historical context but, at this point, it is difficult to assess its likely implications for the German system of corporate governance as a whole. Many Germans, and Continental Europeans in general, are sanguine about the possibilities of these types of behavior taking hold among German managers. Nevertheless, it is dangerous to dismiss such rhetoric as grandstanding or faddish. The analysis that I have presented here suggests that the confluence of structural changes in the productive and financial spheres poses a formidable challenge to the extant system of German corporate governance.

Moreover, the US experience of corporate governance in recent decades is an instructive one. Today the United States is regarded as a bastion of liquid financial markets. Yet market control over the allocation of corporate resources is a relatively new phenomenon in US history. Until the 1980s, organizational control dominated, ensuring committed finance to American corporate enterprises. One of the most important lessons that the history of American corporate governance teaches us is that, in the face of unprecedented productive and financial challenges to an extant system of corporate governance, 'organization men' can be induced to be, at least with appropriate incentives for self-enrichment, ardent proponents of shareholder value (Lazonick and O'Sullivan, 1997a).

If it is too early to tell how the current contest for corporate control will conclude in Germany, it is apparent that in studying the evolution of the German system of corporate governance there are a number of critical relations to watch. One is the relationship between senior German managers and the rest of the corporate organization. To the extent that they are increasingly segmented from the people that they manage, managers will undoubtedly rely increasingly on share prices as an incentive either for their personal gains through stock options or for their empire building through mergers and acquisitions. The second critical relationship for shaping the evolution of German corporate governance is that between older generations, who depend on retirement income, and the rest of German society. To what extent will a social solution be found to remedy the ills of the German pension system or will there be a push to greater individualization of pension provision with the greater resort to the financial markets, and the equity markets in particular, that such a strategy would almost inevitably entail? Third, there is the relationship between labor and the rest of German society. An important difference between Germany and the US is that if German managers try to follow their American counterparts down the path to shareholder value, they will have to contend with a politically powerful labor movement. Already the German advocates of shareholder value have been attacked by workers and their representatives, at least for their more blatant attempts to introduce 'casino capitalism.'

A strong labor movement does not, however, ensure that the foundations of sustainable prosperity will be regenerated in Germany. Perhaps the biggest risk that the German system of corporate governance now faces, given the productive and financial challenges that it confronts, is that German labor and financial interests will insist on pursuing their own independent strategies to extract returns from industrial enterprises without any consideration of whether those returns will be forthcoming in the future. If this were to happen, German corporate governance would dissipate into a 'stakeholder economy' in which different interest groups fight for their claims to corporate returns without any concern for whether these returns are sustainable. Alternatively, the existing system of governance may provide the possibility for the coordination of financial, labor and managerial interests to develop a new system of organizational control that allows a regeneration of the basis for sustainable prosperity in the German economy.

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Notes

* This chapter is adapted from material in O'Sullivan (2000a), chs 7 and 8. An earlier version of this chapter appeared as O'Sullivan (1998).

1. Unless otherwise expressly indicated, 'Germany' is used herein to refer to the former Federal Republic of Germany (FRG).
2. The neglect of innovation by neoclassical economists was long ago pointed out by Joseph Schumpeter, 1996 (1911).
3. The institutions of intercompany shareholding and bank-industry relations have been discussed at length elsewhere (Esser, 1990; Edwards and Fischer, 1994; d'Alessio and Oberbeck, 1997; Lazonick and O'Sullivan, 1997b; O'Sullivan, 2000a, chs. 7 and 8).
4. These 'foreigners' may well have been born on German soil but denied German citizenship because they are not ethnic Germans.

5. For a discussion of cross-functional integration in Japan, see Lazonick, this volume.
6. The contribution of internal funds to net sources of finance of non-financial enterprises during the period 1970–1989 has recently been estimated as 80.6% for Germany, 69.3% for Japan, 97.3% for the UK, and 91.3% for the USA (Corbett and Jenkinson, 1996).

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