The Roaring Nineties

Can Full Employment Be Sustained?

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Chapter 5

Have New Human-Resource Management Practices Lowered the Sustainable Unemployment Rate?

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The way in which work is organized in the United States has undergone a radical change in the last twenty years. Job stability has declined for long-tenured workers, there has been a large increase in the use of contract and temporary workers, especially on the manufacturing shop floor, and there has been widespread adoption of new forms of workplace organization.[1] The business press and industrial-relations experts who have traced and documented these trends often associate them with an increasingly competitive environment for U.S. business, driven by international trade and technological change.

The effects of these transformations on income distribution and productivity have been studied, but almost no attention has been paid to the effect that they may be having on the ability of the economy to maintain low unemployment. This is surprising considering the coincidence of these changes with an extended decline in unemployment that seems to have produced little inflation and with evidence of a striking improvement in the efficiency with which workers are matched with jobs. The combination of low unemployment and inflation suggests a decline in the nonaccelerating inflation rate of unemployment (NAIRU).[2] Several authors have argued that such a change has taken place over the last five to fifteen years. The most popular explanations suggested for such a decline ignore the changes in the organization of work and focus instead on developments on the supply side of the labor market. The possibility that there is a link between the decline in the NAIRU and the adoption of these new practices has not been developed.

In this paper, we discuss recent changes in how U.S. firms hire, train, fire, compensate, and manage workers. We then develop explanations for the motivations behind these changes using interviews with human-resource executives from U.S. manufacturing.[3] Finally, we use these components to suggest how the major changes in American corporations' human-resource management (HRM) practices could have led to a drop in the NAIRU.[4] A decline in labor rents that has made queuing for high-wage jobs less attractive is an important part of our story. This decline in rents occurred even as returns to skill (and, therefore, wages) rose for some workers. In fact, we show that interindustry wage differ-

ences, a measure of rents, declined in a two-step sequence with a pattern and timing similar to movements in the Beveridge curve—a measure of matching efficiency. These comovements also match in some important ways the spotty data on the adoption of innovative work practices.

This last point—parallel timing—is a key criterion of explanatory success. Any full account of the decline in the U.S. NAIRU should explain the timing and cause of the discrete inward shifts in the Beveridge curve that took place in the period 1985 to 1989 and in the period since 1994.[5] Explanations for the decline in the NAIRU that rely on unbroken long-term trends (for example, the decline in the fraction of the workforce organized by unions, the aging of the workforce) or on factors evident only in the 1990s (for example, the explosion of the Internet) must be viewed as partial at best. Our explanation, emphasizing how changes in the practices of firms have affected labor demand and matching efficiency not only takes into account important facts overlooked in most studies of matching, but also allows us to generate such a time path for changes in the NAIRU.

It is possible that some slow-moving long-term forces, such as demographics, could build over time but have only abrupt observable effects once some threshold is reached. Such effects, however, usually require an observable institutional shift and/or a centralized (policy) decision following the threshold being reached, which is difficult to reconcile with recent developments. It is also hard to reconcile a threshold explanation with the two discrete periods of improvement that the data show. This is not to say that we believe that the decline in the NAIRU has a single cause—there are a few strong candidate explanations for developments in the 1990s that may be complementary to ours. The idea that workers' perceptions of productivity gains and, therefore, their real-wage demands, lagged behind actual gains seems plausible to us (Ball and Moffitt, chapter 2 in this volume). The positive supply shocks of declining health-care costs, lower import and oil prices, and the productivity effects of information and communications technology each had a turn in the 1990s.[6] Nevertheless, the evidence that the improvements in the Beveridge and Phillips curves predate the 1990s suggests that these are only partial explanations for the changes.

Our story links the radical restructuring in firms' management and hiring of labor and the two-step decline in the NAIRU. Starting in the early to mid-1980s, the wave of international competition and technical change resulted in greater competitive pressures for customer specialization, cost reduction, and quality improvement. One effect of this change in product-market structure was a move by firms to more frequent switching between and turnover of products—the so-called flexible specialization. Responding to the demands of their product markets, many companies began experimenting with a wide range of practices known collectively as *high-performance work organization* (HPWO). Examples of these practices include job rotation, pay for knowledge, autonomous teams, total-quality management (TQM), and quality circles. A key characteristic of nearly all these HPWO systems is that core production workers' jobs are broadened and that those workers are more interchangeable among tasks. This in-

creasing ability to move workers between jobs or production lines within firms and the easier matching of hires that accompanies such substitutability may be part of the explanation for improved labor-market efficiency.

At the same time, a more flexible production process means that workers must learn new task-specific skills more frequently. If workers with greater endowments of general human capital (or learning skills) can learn new skills more quickly and cheaply, the increased depreciation rate of task-specific human capital associated with the more rapid turnover of skills should increase the demand for general human capital. With implicit or explicit wage bargaining, increasing the level of general human capital may increase the firm's relative wage. But increasing demand for general skills and the falling value of specific skills reduces worker rents since bargaining leads firms and workers to share the returns on capital that either bring to the job. As these changes take place, the return on the capital that workers bring to the table becomes a larger fraction of the wage, and the return to the firm's capital becomes a smaller portion. When rents are reduced, workers become less willing to wait unemployed for these jobs and instead apply to lower-wage jobs, where the vacancy rate is higher. This reduces both the unemployment rate and the vacancy rate, shifting the Beveridge curve in.

The process just described affects mainly the more-skilled blue-collar workers—the firm's "core" workforce. However, firms also employ a large number of less-skilled workers who do not invest as extensively in specific human capital and whose jobs are not affected as much by the demands for flexibility. An equity constraint links the pay of these workers to the pay of the more-skilled core workers. As the firm demands more general skills from its core workforce but not from these other workers, the equity constraint becomes more costly. Eventually, the cost of maintaining pay parity between these different types of workers exceeds the costs of reorganizing and coordinating with outside contractors, and the less-skilled workers are moved outside the firm through contracting and the use of workers provided by temporary-help firms. A wave of consolidation and downsizing in U.S. business in the early 1990s left in its wake a greatly revised view of what tasks should be done inside the firm and what should be contracted out.[7] Although the use of outsourcing, contracting, and temporary workers has been increasing over the entire period in which we are interested, there appears to have been a concentration of restructuring activity during the "mean leaning" of the early 1990s. During this time in particular, an increasing number of firms pursuing such practices created economies of scale in contracting and temporary services, increased the acceptability of the practices, and increased the competitive pressures on those who had not adopted the practices. Thus, growing use of these practices produced pressure for them to spread further and faster.

Several factors are probably responsible for the apparent halt in the progress toward increasing labor-market efficiency between 1990 and 1994. The poor performance of the Japanese economy during this period may have taken away some of the motivation to copy Japanese practices, while the U.S. recession left

firms with fewer resources to experiment with new ways of organizing. Data presented in the next section suggest a slowdown, and possibly even a reduction, in the use of HPWO during this period. The recession of the early 1990s probably also gave firms both the motive and the opportunity to pursue restructuring of their workforce. The transitory rise in turnover and churning associated with the restructuring process and the slow adjustment of some workers' wage expectations to their reduced opportunities may help explain the relative stability of the Beveridge curve during this period.

By the mid-1990s, however, the transition to what we will term *confident deployment* of the new high-performance work techniques began. No longer were these practices viewed as experimental. HPWO, utilizing worker flexibility, and jobs requiring a broader set of tasks had become widespread in manufacturing. Firms that had not adopted them viewed themselves as having fallen behind the norm. During this period, firms continued to upgrade general human capital for their core workforces and to outsource for lower-skilled labor. Temporary-help workers have grown from less than ½ percent of employment in the early 1980s to over 2 ½ percent today, with a large share of this increase coming in manufacturing temps. Since most temporary workers are looking for permanent employment while temping, and since they seldom count as unemployed, the growth in their numbers reduces measured vacancies and unemployment.

Recapping, we see three important routes by which the changes in the way firms use labor have improved the efficiency of the labor market. First, the increasing demand for general skills has made workers more interchangeable, and this may have improved matching efficiency. Second, the falling number of good high-wage jobs (caused by restructuring), and the increasing extent to which the wages in the remaining good jobs reflect workers' skills instead of job-specific rents, means that fewer people are willing to wait unemployed to get one of these jobs. Instead, people apply for lower-wage jobs, for which the vacancy rates are higher. The slight increase in the vacancy rate for the remaining high-wage jobs is more than outweighed by the decline in the vacancy rate for low-wage jobs. Similarly, the large decline in the number of people waiting unemployed for good jobs is considerably greater than the small increase in the number of people waiting unemployed for the low-wage jobs. Thus, the Beveridge curve shifts in. Third, the increased use of temporary workers, who search for jobs just like the unemployed while not counting as unemployed, also leads to a decline in vacancies and unemployment.

The chapter proceeds in five parts. The first section surveys the literature, drawing together facts that our story will synthesize. The second section describes the results of our interviews with human-resource managers at several manufacturing firms and executives at a contracting and temporary-help firm. The third section presents our analysis of interindustry wage differences, showing that, despite increasing wage inequality in general, interindustry wage differences have fallen at the same time that the new work practices have been adopted and the Beveridge curve has been inwardly shifting. This combination of stylized facts, interviews, and data analysis motivates the model described in

the fourth section. The fifth section recaps our argument, with a look at areas for future research and some policy implications.

WHAT HAS BEEN CHANGING IN AMERICAN LABOR MARKETS?

Since 1980, facing increasing competitive pressure from abroad, pressure from financial markets to cut costs, and significant technological change, American firms have done a great deal to adapt their human-resource practices.[8] Most notably, firms have changed how they hire and pay workers of different skill levels and how they use firm-specific and general skills. These adaptations have arguably had a marked effect on the nature of both labor demand and compensation, which could have caused shifts in the Phillips curve. This section reviews the literature on these changes. It first establishes that an inward shift in the Beveridge curve occurred in two distinct periods, separated by intervening years of corporate restructuring. It is much harder to discern the timing of changes in the Phillips curve, but it appears to have begun to shift about the same time as the Beveridge curve did (see Staiger, Stock, and Watson, chapter 1 in this volume).

This coincidence of the changing Phillips and Beveridge curves with the introduction of the new HRM practices points us toward demand-side explanations for the change in the NAIRU. The remaining subsections discuss the changes in various aspects of employers'—particularly manufacturing employers'—hiring, compensation, and management of workers. These include the changes in job turnover, layoffs, and insecurity; the rising reliance on temporary workers and contracting of business services; the development of compensation flexibility and wage decompression; and the adoption of HPWO practices. These stylized facts are then summarized as the basis for a story that can explain the drop in the NAIRU.

The Beveridge Curve's Inward Shifts

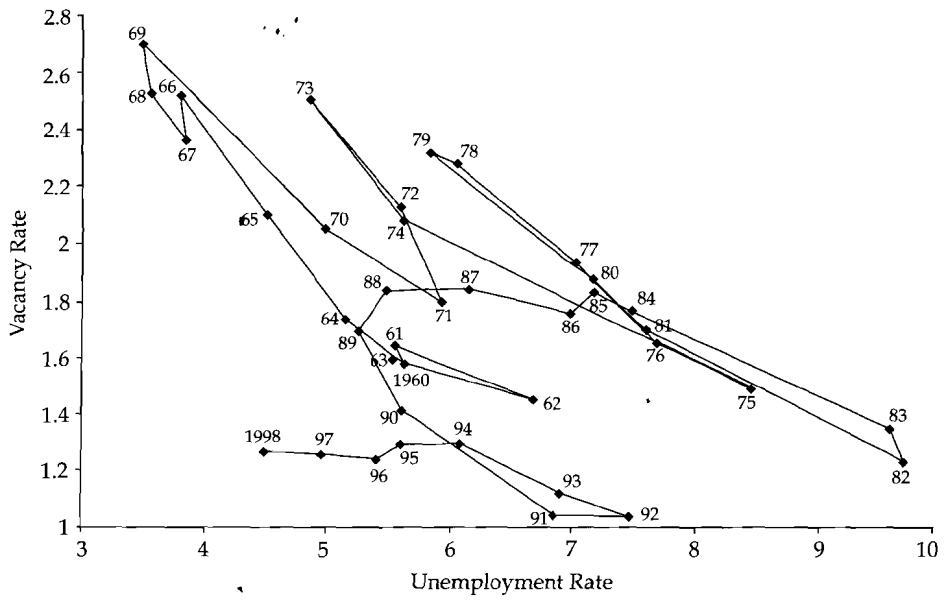
In the past, unemployment rates below 5 to 6 percent have been associated with increasing rates of inflation. In the last several years, however, we have seen unemployment rates consistently below those rates with almost no increase in core inflation. Adding to the phenomenon to be explained, a measure of job vacancies computed from the index of help-wanted advertising was near its all-time low in 1998—even before Internet job search and advertising became widespread—despite the low unemployment. That we have maintained a low level of unemployment while keeping a large fraction of jobs filled and inflationary pressures in check suggests a vast improvement in the efficiency of the labor market.[9]

It is useful to think of the Beveridge curve—a convex relation between vacancies and unemployment—as representing the efficiency of the labor market in

pairing workers and jobs. The closer the curve to the origin, the more efficiently workers and jobs are being matched.[10] For the United States, where no official government vacancy data exist, the vacancy rate has been proxied by the ratio of the Conference Board's help-wanted index of classified newspaper advertising to nonfarm-payroll employment. The ratio is adjusted using a method developed by Katherine Abraham (1987) to account for shifts in newspaper circulation and for the influence of affirmative action and anti-discrimination laws on job advertising.[11] This measure has done rather well at matching up with fluctuations seen in micro (for example, state-level) data on actual vacancies.

Figure 5.1 shows the U.S. Beveridge curve for 1960 to 1998.[12] Abraham (1987) documents an outward shift of the U.S. Beveridge curve in the 1970s, attributing it largely to the growing disparity of regional economic conditions. Olivier Blanchard and Peter Diamond (1989, 1990) focus on incidence of unemployment when a recession occurs, arguing that the shift in the United States happened because workers, including women and nonwhites, experienced long-term unemployment, which made them less likely to be rehired. But it is clear from examination of the scatterplot that, while there was a stable Beveridge curve from 1975 to 1985, the curve shifted inward markedly from 1986 to 1989, then drew a new stable curve from 1990 to 1994, and has shifted significantly inward

FIGURE 5.1 / Annual Vacancy and Unemployment Rates, 1960 to 1998



Sources: Vacancy data from Katz and Krueger (personal communication); unemployment from BLS CPS.

again since 1995. In short, there were two distinct episodes of considerable improvement in labor-market efficiency.[13]

The gaps in research to date on the employers' role in the labor market become even more important as we tackle the question of why the U.S. Beveridge curve has now shifted in. In line with the standard explanations of the Beveridge curve's outward shift in the 1970s, if there was a wholesale sectoral shift of worker demand by firms in the U.S. "new economy," say because of the expansion of an information-technology (IT) sector requiring new skills and/or new locations, this should have increased churning and turnover. Given even a positive technological shock, we would expect the Beveridge curve to have shifted *out* again by the mid-1990s, but there is no evidence of that. A straightforward IT explanation would also have difficulty with the first shift occurring in the period 1986 to 1989, given the vanishingly small ratios of IT per worker or IT as a share of total business equipment at the time. As Daniel Sichel (1997) and, more recently, Jacob Mincer and Stephan Danninger (2000) document, the most important increases in IT investment did not begin until 1993—and then from a very low base.[14]

Other prominent explanations suggest that the Beveridge curve changes should have been considerably more gradual than what we observe. Demographic changes, emphasized by Robert Shimer (1998) and Lawrence Katz and Alan Krueger (1999), seem too gradual to account for the Beveridge curve shift. Furthermore, as Gary Burtless (1999) points out, most of the aging of the American workforce took place between 1979 and 1989, beginning before the first shift that we identify here and preceding several years the other. The fraction of the workforce that is unionized has been declining since about 1950. The rate of decline accelerated in the 1970s and again after the PATCO strike, but most of the decline in unionization rates was complete before the beginning of the period in which the Beveridge curve is shifting.

Rising Job Turnover, Layoffs, and Insecurity

Even without taking the precise timing of the shifts in the Beveridge curve into account, making sense of the apparent increasing efficiency of the U.S. labor market is all the more difficult because of one of the most-discussed recent developments in American labor markets: the slight but clear downward shift in job stability for at least some workers in the 1980s and 1990s. Greater job turnover would normally be expected to lead to higher frictional unemployment, especially if much of the turnover was involuntary. Although it is clear that press reports from the early 1990s bemoaning downsizing and the end of lifetime employment were exaggerated, extensive subsequent research on trends in job stability has finally converged on a broad picture.[15] The main finding in this literature of interest here is the decreasing job stability and security in the 1990s for men who are older and have longer job tenures. This fits with case evidence of a long period from the mid-1980s to the mid-1990s of corporate downsizing,

especially in the manufacturing sector. For example, David Neumark (2000) comes to the conclusion that four- and eight-year retention rates fell for longer-tenured older men in the 1990s and that there has been some general "weakening of worker-firm bonds" in the decade. His findings are significant given his earlier skeptical views on these changes.

Accompanying this general decline in job stability for longer-tenured workers in the 1990s have been some adjustments in the experience and use of layoffs in manufacturing. As shown by Lawrence Katz and Bruce Meyer (1990), the number of unemployed workers expecting recall was always higher than the number who actually were recalled. The perceived likelihood of recall had a significant effect on the unemployed workers' search behavior. On the occasion of redesigning the Current Population Survey (CPS), Anne Polivka and Stephen Miller (1995) pointed out that perceived likelihood of recall had dropped across the board following the periods of restructuring in the 1980s and early 1990s. Survey questions had to be changed because the word *layoff* was now associated in the public's mind with permanent job loss. This change in perception was coincident with an increase in actual layoffs found by the survey (even after accounting for a change in the counting of reentrants). Todd Idson and Robert Valletta (1996) document that, through the early 1990s, the positive influence of job tenure on recall probability from layoff was declining.

The Explosive Growth of Contracting Out and Blue-Collar Temporary Employment

At the time that these shifts in job stability and security occurred in the 1980s and 1990s, American firms also changed their hiring behavior in another way. They massively increased their hiring of temporary workers and expanded their use of outside contractors to replace in-house staff. Outsourcing of business support services, and the accompanying changes in employment and firm compensation, is an understudied phenomenon. Our interviews with human-resource and strategic-planning managers in large corporations indicate that the move to outsourcing is an important part of their workplace reorganization (see the next section), and we will argue that it plays a critical role in the chain of events linking changes in the firms' management and compensation of labor to the decline in the NAIRU.

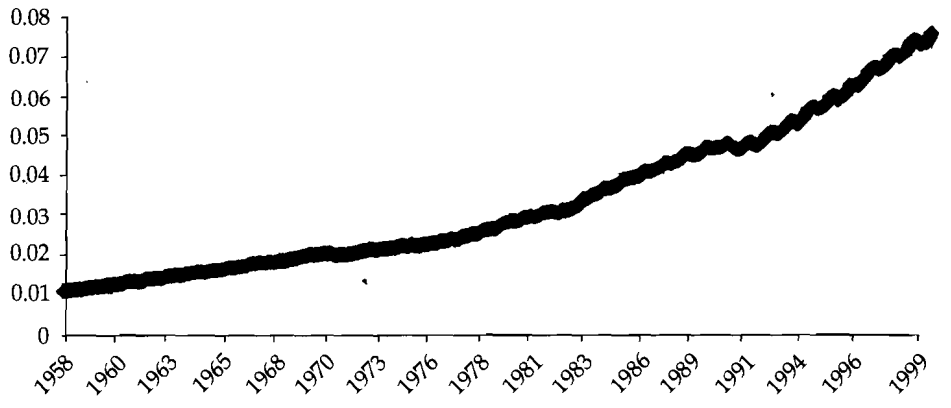
One study directly discussing firms' use of outside contractors is Katherine Abraham and Susan Taylor (1993). Using industry wage surveys from 1986 and 1987, these authors document that the share of establishments contracting out services in their sample rose in several areas after 1979.[16] The motivations for contracting out appear to have been a combination of savings on wages and benefits for lower-skilled workers, accommodating fluctuations in demand, and taking advantage of economies of scale or specialized management techniques (for example, food-service inventory management). One effect has been to reduce the access of lower-skilled workers to employment with industrial (as op-

posed to business-service) companies. As Burtless (1999) conjectures, "Unskilled workers become less numerous on big company payrolls, but they still find jobs. The jobs are in smaller companies and offer worse pay and fewer fringe benefits" (72). As one would expect, this also applies to temporary workers.

Figures 5.2 to 5.5 show the growth of employment in sectors, and a few specific industries, that we have identified with the contracting of business services. The pattern of growth in the fraction of contractor employees in total business employment shows significant accelerations in the mid- to late 1980s and again in the 1990s after the recession. The rapid growth in the 1990s precedes the second shift in the Beveridge curve but coincides with the wave of downsizing that may have temporarily increased equilibrium unemployment. On our rough accounting, the gains in employment over the relevant period are considerable, amounting to several million workers.

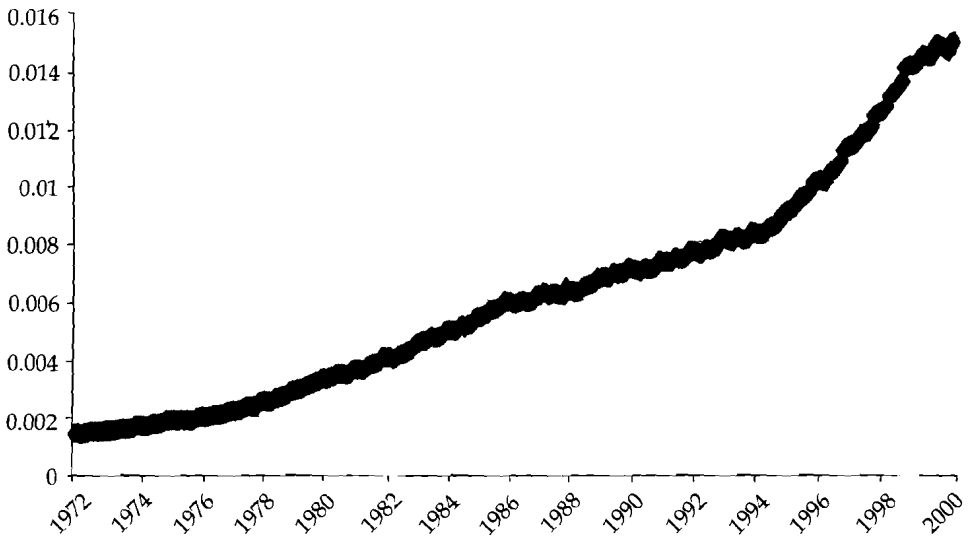
The similar expansion of temporary employment has recently received a great deal of academic attention. Maria Ward Otoo (1999) calculates that temporary employment tripled from around 0.7 percent of total nonfarm-payroll employment in the mid-1980s to 2.3 percent of total employment by the end of 1998 (see fig. 5.5). In theory, businesses using temporary-help service companies to find permanent employees could directly improve the matching process if these temporary agencies help overcome information difficulties or achieve economies of scale in job search and/or hiring. Otoo (1999) attributes 0.25 percent of the decline in the NAIRU to improvements in matching efficiency due to the growth of the temporary-help industry. Katz and Krueger (1999), offering similar intuition for benefits to matching from temporary-help services through provision of screening and training as well as lowering hiring costs and alleviating bottle-

FIGURE 5.2 / Total Employment in Business Services as a Fraction of Total Nonfarm Employment



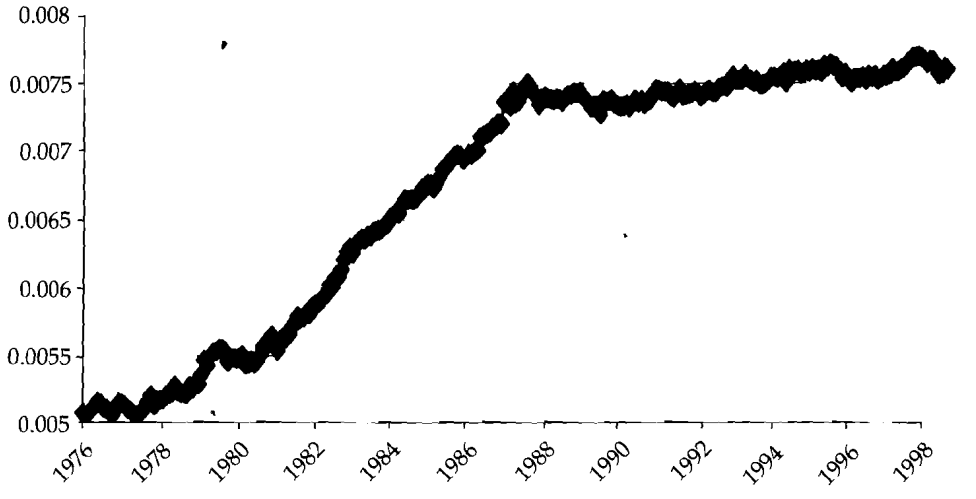
Source: BLS Current Employment Survey.

FIGURE 5.3 / Employment in Computer and Data-Processing Services as a Fraction of Total Nonfarm Employment



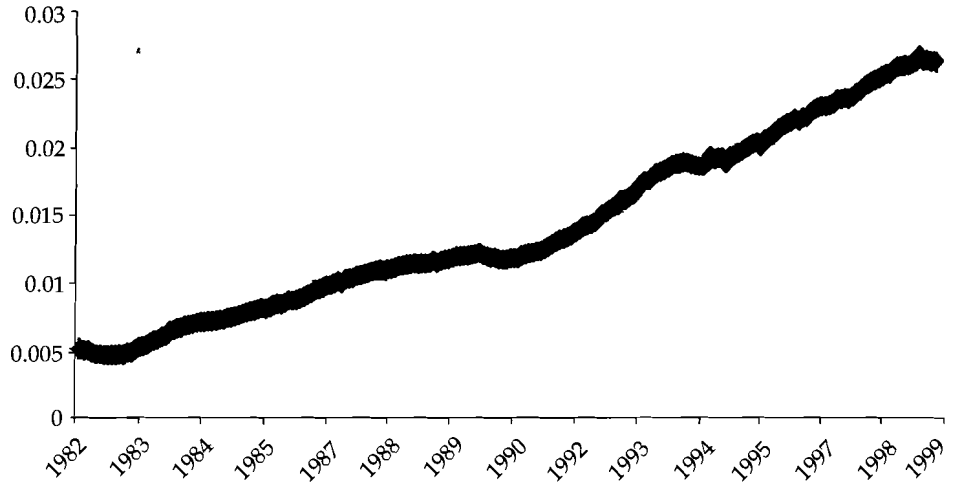
Source: BLS Current Employment Survey.

FIGURE 5.4 / Employment in Services to Buildings as a Fraction of Total Nonfarm Employment



Source: BLS Current Employment Survey.

FIGURE 5.5 / Employment in Temporary-Help Services as a Fraction of Total Nonfarm Employment



Source: BLS Current Employment Survey.

necks, estimate that the growth of temporary-help services has taken 0.39 percent off the NAIRU in the 1990s.

We believe that the increasing use of temporary-help services has improved labor-market efficiency, but not primarily because firms are using them to screen new hires. Permanent hiring of temps is rare except for clerical workers, and even then it is not all that frequent (Houseman and Polivka 1999). The hiring firms seem to benefit less from screening than from the flexibility that temps offer both staffing levels and compensation programs.[17] Lewis Segal and Daniel Sullivan (1995, 1997) establish that these workers experience very high cyclical variability of employment, as one might expect if part of firms' motivation is to deal with excess demand without hiring permanent staff. Otherwise, why would temporary employment fluctuate so much, and why would temporary employees be more likely than permanent employees to change employment, become unemployed, and even leave the labor force, as Susan Houseman and Anne Polivka (1999) demonstrate they do?[18] As with the decline in job stability discussed earlier, under normal conditions the direct effect of a greater number of workers in temporary jobs, moving in and out of active employment, should be to *raise* the NAIRU. Houseman and Polivka (1999), for example, estimate that the rise in flexible staffing arrangements from 1986 to 1996 raised the average rate of unemployment by 0.3 percent through increasing turnover and friction, an effect equal and opposite to those hypothesized earlier.

Of most interest to us in explaining the inward shifts of both the Beveridge

and the Phillips curves is that the growth in temporary employment in the 1990s was concentrated in blue-collar manufacturing jobs. While every nonagricultural sector showed a rise in the use of temporary workers from 1977 to 1997, Marcello Estevao and Saul Lach (1999b) estimate that, up to 1997, growth in the use of temps in the manufacturing and service sectors made up 85 percent of the growth in total temps in U.S. employment in the 1990s. In fact, the manufacturing-sector use of temps rose from 1 percent of sectoral employment in 1992 to 4 percent in 1997, catching up with the level in services. Blue-collar employees went from 6 percent of temporary-help services in 1985 to 25 percent in 1995, according to Estevao and Lach (1999b). Similarly, in Autor's (2000b) 1994 survey of a large sample of temporary-help-services firms, blue-collar workers made up 45 percent of the temp population. Segal and Sullivan (1997) date the increase in the proportion of male and blue-collar temporary workers to the end of the 1980s and the beginning of the 1990s.

That dating puts the sharp increase in manufacturing reliance on temporary employees coincident with the decline in direct hiring by manufacturing from peak employment in 1989.[19] Estevao and Lach (1999a) go so far as to put bounds on their estimates of the increase in temporary-labor outsourcing in U.S. manufacturing 1992 to 1997 at 340,000 minimum and 510,000 maximum; in other words, the entire decline in manufacturing employment over the period is essentially matched by their estimate of the rise in temporary-help-services blue-collar employment. This is consistent with the popular view that not all the hires into temporary services came out of unemployment, or even short-tenure employment, but that some came out of "good" jobs. A similar replacement phenomenon came up during our interview with an executive from a contracting firm who volunteered that, in many cases, the contracting firm will hire the workers let go by a company when they sign a contract to replace an in-house service.

It is worth emphasizing how different these manufacturing temporaries are from the lingering stereotypical image of the temp as a "Kelly Girl" or some other young pink-collared female clerical worker. In Estevao and Lach's (1999a) assessment, the typical manufacturing temp is male, thirty-five to fifty years old, with some college, working full-time in the Midwest. This happens also to be the type of worker who traditionally has the largest within-occupation wage differentials, meaning in all likelihood rents from a "good job" in a high-wage firm and/or firm-specific skills. In David Autor's (2000a) sample, 62 percent of blue-collar temps were classified as "handlers/equipment cleaners/labor," and 24 percent were "operators/assemblers/inspectors."

Autor (2000b) explores the phenomenon of "free general skills training" by temporary-help firms, but, in his sample from a 1994 survey, the 45 percent of temp workers classified as blue collar were markedly less likely to get that training: while 81 percent of clerical temps received some training, only 59 percent of blue-collar temps did; 74 percent of clerical temps, but only 14 percent of blue-collar temps, were given computer training. Only on the soft skill of "business conduct" did a comparable proportion of clerical (68 percent) and manufactur-

ing (60 percent) temps receive training. It is not a surprise, therefore, that, in Autor's (2000a) wage regressions showing the positive effects of training for white- and pink-collar temps, the blue-collar category shows no significant positive effects of training. In fact, the wage equations have a notably poor fit for those workers.

While it may be unusual for temporary workers to be hired permanently by the firms that employ them, most temporary workers are looking for permanent work and are temping only because it is the best opportunity available to them. Katz and Krueger (1999) note that 70 percent of temporary-help-service employees in the February 1997 CPS supplement said that they were temping for "economic" reasons rather than by choice.

To get to a story where these major shifts in corporate personnel practices could be associated with the declining NAIRU, we have to take seriously the motivations for the rise in temporary hiring and in contracting—and, as we have seen, these are not primarily screening workers for permanent employment or benefiting from someone else's worker training. The efficiency gains pursued by firms must be those that arise for the other widely recognized reasons: the possibility of decompressing wages between higher- and lower-skilled workers; the advantages of scale economies and specialized skills in outsourcing some noncore tasks; and the flexible adjustment of company labor forces to swings in demand.[20] Secular growth in temporary-help-services employment could thus account for some of the shifts in the Beveridge curve, if hiring temps substitutes for what would previously have been listed as vacancies, and in the Phillips curve, if some of those who became temps previously would have been unemployed.

The Efforts to Decompress Wages Within Firms

Unionization and internal equity constraints have generally led to the compression of wages within firms. This is inefficient for firms, which have little choice but to pay the going rate for needed highly skilled workers and then find themselves constrained to reward other employees in relation to that wage rather than to the individual worker's productivity. In recent years, there have been a number of developments in compensation practices that have the potential to increase within-firm wage dispersion (see Lebow et al. 1999, which is based on surveys done for the Federal Reserve "Beige Books"): increased use of lump-sum payments; profit sharing and stock options extending below top management; merit-pay raises (outside seniority); wider bands within wage levels for large corporations; pay for skills and outsourcing. Of course, the broader shift to temporary and contract workers, to whom the establishment need not pay usual wages and benefits, increases the wage dispersion of the firm's effective labor force even as the internal payroll gets more concentrated.[21]

Widespread Adoption of HPWO

Workplace organization—that is, the definition, organization, and supervision of workers' tasks—has also undergone considerable change in the last twenty years. Worker involvement in quality control, the design of products and production processes, job rotation, and team production have become widespread in manufacturing and beyond.[22] Eileen Appelbaum and Rosemary Batt (1994) set out a view of an American economy beset by international competition and deregulation as well as worker frustration and fear, a situation that compelled businesses to produce higher-value-added, higher-quality, more-customized products on a faster product cycle. These non- or less-standardized goods erode the benefits of mass production and standardized (or Taylorite) job descriptions. Instead, the workplace is shifted to HPWO, seen in American forms of lean production and team production.[23] In the early 1980s, such practices were essentially nonexistent in U.S. firms. As of 1992, however, when Appelbaum and Batt completed their research, HPWO practices had already been adopted by a growing minority of American manufacturers.

Paul Osterman (1994) presents the results of a 1992 survey for the spread of four such practices sampled from nonagricultural establishments with more than fifty employees. He finds that there is team production for half or more of core workers at 40.5 percent of firms surveyed, job rotation at 26.6 percent, TQM at 24.5 percent, and quality circles at 27.4 percent.[24] Reprising the survey in 1997, Osterman (2000) finds that the share of establishments with 50 percent penetration of self-managed teams has largely stagnated (38.4 percent) but that the incidence of the other three practices has risen: 55.5 percent have job rotation; 57.2 percent have TQM; and 57.7 percent have quality circles. Table 5.1 presents the results of several surveys of such practices, including Osterman's. In longitudinal data on firms in both of Osterman's surveys, 81.5 percent of those establish-

TABLE 5.1 / Percentage of Firms Adopting New Methods of Labor Organization

	Teams	TQM	Quality Circles	Job Rotation	Source
1987			28	15	Lawler et al. (1992)[a]
1990			32	16	Lawler et al. (1992)
1992	40.5	24.5	27.4	26.6	Osterman (1994)[b]
1993	32	46	15.8	24.2	BLS[c]
1994	29			21	Census[d]
1997	38.4	57.2	57.7	55.5	Osterman (2000)

[a]Companies reporting some use or more (excludes those reporting no or almost no use). Job-rotation numbers are fraction of companies reporting that they use pay-for-skill compensation systems for at least "some" of their workers.

[b]Greater than 50 percent of core employees involved.

[c]Presence measure only—no cutoff for percentage of employees involved. From BLS Survey of Employer Provided Training as cited in Osterman (2000).

[d]Approximation to Osterman's definition from census, National Employer Survey as cited in Osterman (2000).

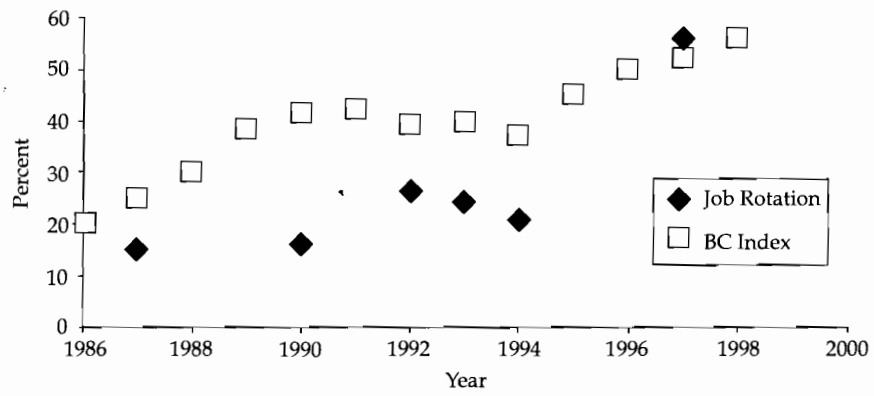
ments that had at least two HPWO practices in 1992 still had two or more in 1997, while 53.5 percent of those establishments with one or none of the HPWO practices in 1992 had two or more in 1997.

Figure 5.6 plots the change over time in the percentage of firms using job rotation (the practice for which we have the most observations) and an index of the position of the Beveridge curve.[25] As can be seen in the admittedly spotty data, the adoption of job rotation in Osterman's surveys and others displays the same two-step shift as the Beveridge curve, increasing in the late 1980s, plateauing or going back slightly from 1990 to 1994, and rising again in the late 1990s.[26] This coincidence in the development of HPWO and the shifts in the Beveridge curve is of great interest because none of the other explanatory variables for changes in matching efficiency show this rise-flat-rise sequence.

These practices, particularly those involving teamwork and job rotation, usually require some stability of the relevant workforce—a fact that would seem to be at odds with the evidence on job instability. What appears to have happened is that employers have identified "core employees" who are retained and are expected to be the ongoing participants in these practices. This does not deny that some of the firms adopting HPWO are also the same firms laying off workers and restructuring in the last two decades. In fact, Osterman (1994, 2000) finds that firms facing international competition that engaged in layoffs are more likely to have adopted HPWO.

In short, despite layoffs, employers have retained their core employees, who are presumably those who embody the most-firm-specific human capital and who, in the new structure, are required to have the most-general skills as well. This would be consistent with the desire for increased within-enterprise wage dispersion and for the employment of temps and outside contractors. In a recent study, Simon Burgess, Julia Lane, and David Stevens (2000) establish that churn-

FIGURE 5.6 / The Fraction of Firms Using Job Rotation and Beveridge Curve Index



Source: See text.

ing (firms hiring and firing workers at the same time) takes place in all phases of demand-driven cycles, consistent with the empirical literature on job flows documenting that even shrinking firms hire and growing firms fire. Using firm-level data from Maryland, they show that, for most firms, there exists a stable core of workers that does not change, even when churning takes place. Interestingly, they find evidence of a declining churn rate overall and a steady decline in the churn rate of the highest quintile of churn establishments over their 1985 to 1994 sample—which would be consistent with firms shedding without replacing non-core workers over this period.

Finally, it is in the adoption of HPWO that IT makes an appearance in our discussion of changes in how U.S. firms have hired, fired, and compensated employees in the last two decades.[27] In a thought-provoking case study of a bank adopting the image processing of deposited checks in 1994, David Autor, Frank Levy, and Richard Murnane (2000) describe how the adoption of the particular IT advancement of optical character recognition led to substitution for the (low-skilled) check-clearing labor but increasing demands for integrated and/or flexible work and self-management from the (higher-skilled) "Exceptions Department." While this is consistent with the usually invoked trend toward skill-biased technological change, there is more to the story: as IT investment occurs, lower-skill jobs are moved out of the firm, while higher-skill jobs are switched to HPWO and, presumably, greater stability.

Assar Lindbeck and Dennis Snower (1996, 2000) assert that such an interaction between what they perceive as advances in technology, worker preferences for jobs with variety requiring versatility (meaning HPWO), and a steady rise in human capital and training constitutes a general OECD-wide shift from "Taylorite" to "holistic" organization of production. In such a world, workers' initially unobservable abilities to work flexibly and in teams are revealed in tandem with wage decompression to reward those increasingly valuable general skills. Lindbeck and Snower (1996, 2000) suggest that this shift explains the increasing dispersion of wages within worker types in the United States and of job opportunities (given nominal-wage rigidities) in Europe. This dynamic is supported by evidence from firm-level panel-data studies, including Timothy Bresnahan, Erik Brynjolfsson, and Lorin Hitt (1999), Sandra Black and Lisa Lynch (2000), Timothy Dunne et al. (2000), and Paul Osterman (2000), that find a positive correlation between IT, HPWO practices across firms, and human capital.

Yet, for all the appeal of this explanation, and particularly its potential as a description for a force likely to increase as adoption of IT moves forward, the empirical evidence for its being central in American, or even European, wage developments to date cannot be deemed entirely convincing. Bresnahan, Brynjolfsson, and Hitt's (1999) model and data emphasize white-collar industries, not manufacturing, where the shifts in employment practices have been greatest, and where IT adoption was not yet widespread by the time of their survey (1995 to 1996); Dunne et al. (2000) find only weak statistical support for the direct link between IT investment and wage dispersion across firms, given the very small

quantities of and variation in IT investment by the time of their sample (the mid-1990s).

Many of Lindbeck and Snower's (1996, 2000) claims do not fit well with the facts more broadly. Their claim that production capital, like machine tools, has become more flexible is, while plausible, at odds with the ongoing occurrence of layoffs when firms change production lines.[28] The claim that IT induces HPWO is difficult to reconcile with, albeit not strictly contradicted by, the fact that many of the countries that preceded the United States in such practices, such as Germany and Japan, have remained behind the United States in IT investment. The claim that workers' previously imperfectly observed ability to work flexibly and in teams has become a source of widening pay differentials would seem to imply that churning and mismatch should have gone *up* for the firm's core workforce until the firm learns to screen and train for those skills, but the opposite has been observed. On this last point linking IT and matching, Mincer and Danninger (2000) provide a useful caution that usually turnover and unemployment duration rise for several years after a technological shift, as workers with the skills required to use the new technology are rewarded with higher wages, while others have to train and catch up. In Mincer and Danniger's estimation, this cycle is likely to be just beginning in the United States, where computer equipment per worker started rising markedly (from a very low base) only in 1992 or 1993 and computer equipment as a share of total equipment accelerates (again from a very low base) only after after 1994 (see also Oliner and Sichel 1994, 2000).

So, although we share some objects of concern with Lindbeck and Snower (1996, 2000), we have a different view of the role that technology plays in leading to the widespread use of HPWO. In our view, the effect has been much less direct as only one of several factors—along with international competition, financial-market pressures, and growing customer sophistication—leading to an increased turnover of products and, as a result, both a faster depreciation rate of specific human capital and a higher value placed on general skills. We believe that this change in the structure of product markets may have led firms to organize their production so that core workers invest less deeply and more broadly in task- or firm-specific skills. We see this as being the primary salient characteristic of the new modes of work organization for our approach to explaining the decline in the NAIRU.

Summary of the Changing American Workplace, 1980 to 1998

The significant changes in American business's HRM practices in the 1980s and 1990s are promising candidates to explain the decline in the NAIRU, although the macroeconomic implications of these developments have remained largely unexamined as yet. The remainder of this paper builds on these changes to tell a story synthesizing the major developments in U.S. firms' hiring, firing, and com-

pensation of workers of different skills and the aggregate trends in labor-market efficiency and wage dispersion. This effort is much in the spirit of Lindbeck and Snower's attempt, but it fits the sequence of developments better, including the aspects of firms' contracting out and increasing use of temps as well as the accumulation of IT investment to meaningful levels. As set out in this review, the elements of such a story should be the following:

- an explanation for why the changes should have taken place at the same time as the two abrupt changes in the Beveridge curve and the adoption of HPWO;[29]
- the decline in job stability and security for older and long-tenured male workers in the 1990s;
- a relatively constant use of layoffs by manufacturing employers, controlling for cyclical conditions, but a greater perception on the part of workers that layoffs, when used, constitute permanent dismissals;
- increased insecurity in the early 1990s, which declines but remains abnormally high even as employment increases in the middle of the decade;
- a mounting use of temporary workers and outside contractors by employers, who generally do not bring these temporary workers into permanent employment, with an explosive growth in blue-collar-temp employment in manufacturing in the 1990s;
- significant changes in corporate compensation practices designed to increase wage dispersion and flexibility within firms' workforces (not just firms' employees alone, once temps and contractors are included) and some evidence of such an increase;
- the spread of HPWO, especially of job rotation and TQM, for core employees in the mid-1980s and mid-1990s; and
- the expectation that, owing to the eroding value of firm-specific investments and internal equity constraints as well as lower-skilled workers' diminished access to "good" jobs, worker rents will shrink.

We believe that greater product-market competition—due to increasing trade, deregulation, and technology—has led to a speeding up of the product cycle and to an increase in the demand for customization. In our view, these changes drove changing employer behavior.[30] Analyzing the often-overlooked effect of changes in employer behavior on the demand side of the labor market should contribute to an understanding of the decline in the U.S. NAIRU.

INTERVIEWS WITH HUMAN-RESOURCE MANAGERS

We undertook nine interviews with senior executives in private corporations in order to get additional insight into trends in the way in which firms have organized labor in the 1980s and 1990s. All but two of our interviews were conducted with executives in either human resources or strategic planning. Seven of

the interviews were with representatives of multinational manufacturing firms, ranging from low- to relatively high-tech, although none in the IT sector—our focus on "old-economy" manufacturing firms was in line with our hypotheses. If the labor market gained in matching efficiency in the 1990s sufficiently to explain part of the drop in the NAIRU, that gain must have taken place in those sectors most subject to worker separations and delays in rehiring. The other two interviews were with executives from a multinational contracting firm and from a small temporary-employment agency. We undertook these interviews to gain some insight into whether the developments in the demand for their firms' services matched up with our understanding of the changes that have been taking place in their client establishments.[31]

Some clear patterns emerged across the interviews with manufacturing executives about the general trends in how their companies have used labor. Five of the seven stressed a shift to team production and the use of HPWOs as well as a trend toward increased contracting out of tasks not considered core competencies:[32] "The most significant change in the way that the company uses manufacturing labor has been in the transition to team production"; "the manufacturing that is left in the United States does take a team approach"; "many of the tasks which are not core competencies of the company are outsourced"; "the company now outsources or has sold off many areas that are not core to the business." One of the remaining two interview subjects is with a firm that has been a trendsetter in teamwork practices since the early 1980s, but he/she did not volunteer any discussion of contracting out. The lowest-tech and most-unionized firm of the seven was an exception to both trends—"the company is about ten years behind in innovative work-organization practices such as team production"—although even this company had begun experimenting with new production practices in its newer plants and expressed an intent to "catch up."

Increases in worker flexibility, including the broadening of tasks that were previously quite narrow, were mentioned by five of the seven executives often, but not always, as part of the move toward worker teams:[33] "The highly specialized-segregated individual is gone; team production and job broadening happened after several rounds of layoffs"; "the idea is to be as flexible as possible in what jobs are done, in moving people from one product line to another." Significantly, none of the executives attributed the increase in flexibility to improvements in technology (neither technology generally nor IT specifically) that made workers more substitutable. Instead, those who commented on the reason for the change attributed it to demand factors, such as the need to keep up with just-in-time inventory and customer expectations.

While only four of the executives interviewed mentioned that their firms now screened for "broader" or "more-general" skills—and two explicitly denied that their firms' screening processes had changed at all—there was certainly a general thrust toward demanding more from the workers already employed by the firms. Only one of the seven manufacturing-company executives interviewed said that his/her firm gives its workers greater training opportunities now, and another volunteered that his/her firm offers fewer. Discussion of IT skills or of

machines that relied on a more common set of controls and processes did not arise.

Most of the executives indicated that there had been a significant, single wave of workforce reductions within the last fifteen to twenty years: "Automation and technological changes have reduced the number of manufacturing jobs overall"; "first, the company employs far fewer employees than in the past because of layoffs, technology, and downsizing." All but one (again the executive with the lowest-tech, most-unionized firm) did indicate that their firms rely less—sometimes significantly less—on temporary layoffs among their remaining core workforce than they did in the past: "The permanent employees are left with much more employment stability"; "the company still uses temporary layoffs when dealing with low demand (although they [plant managers] try to avoid them)"; "they no longer lay off manufacturing workers as frequently as they used to." But only one of the seven manufacturing executives indicated that his/her firm had not used layoffs at all in recent years and did not expect to do so when demand slowed again.

The reduction in (but not the elimination of) layoffs was, according to our interviewees, accompanied by an increase in the use of temporary workers. Many temps are production workers, hired on during times of high demand, and let go during slack periods. These are lower-skilled workers whom the company can pay less than it does its permanent employees: "The use of temps has increased dramatically in the last fifteen years . . . ; temporary workers are useful during periods of rapid growth because they fill in and the company does not have to pay them benefits"; "the company has become more disciplined in using temporary help when it is needed and then letting the workers go"; "much more use of contingent workers than in the past, less rehiring of those laid off." According to the temporary-employment-agency executive interviewed, demand has been increasing for the last twenty years, but the answer to the question, "Why now and not twenty years ago?" is, "Nobody thought of it. There are no obvious changes in the ways that temp firms organize themselves to explain the increase in demand for their services."

These temporary workers constitute from 5 to 20 percent of the high-demand workforce at the companies whose executives we interviewed. Even the contracting-services firm relies on temps for 20 percent of its workforce, laying them off during slow seasons (the summer for university jobs, winter for groundskeeping jobs). None of the executives indicated that more than a tiny fraction of temps are considered for permanent hiring. In fact, none of the executives interviewed mentioned their companies' use of temporary workers as a screening device for hiring, except for a couple of instances of clerical hires.

Contracting out has become the norm. Almost all the executives we interviewed mentioned outsourcing cafeteria and janitorial services, but four mentioned IT services as well, while three mentioned each of medical and child care, real estate (both selling buildings and maintaining them), and some administrative tasks. The now-familiar phrases about "competitive pressures" and the need

to narrow production to "core competencies" were invoked repeatedly as explanations for the shedding of labor: "All of the tasks which are not core competencies of the company are outsourced—if it is not a task which it is desirable to be good at, it is not worth investing in the task;" "so, if they cannot make a particular area of their business more productive and it is not a core competency, they contract out." The contracting-firm executive with whom we spoke stated that the trend toward outsourcing has shown particularly strong growth in the last three years in the United States; while his/her firm has expanded hiring to meet rising corporate demand, none of the factors influencing its costs or production structure have changed recently.

The contracting-firm executive lists three main benefits that, in his/her own estimation, the firm provides to client firms: expertise in managing specific services; willingness to invest in upgraded facilities (in return for a long-term contract); and cost savings from economies of scale (materials purchasing and, more important, investment in systems of administration). While our corporate interviewees generally attributed the trend in contracting out to reductions in labor costs, two went further and articulated a more complicated motivation:

> "Part of the reason is that benefits no longer have to be spread across occupations. Instead, certain occupation areas can be contracted out or outsourced so that lower-skilled workers will no longer reap the benefits of being in the 'right industry.'"

> "When cost reductions are required and labor is a fixed cost, there has been a shift to contracting out (not just in this industry). The primary factor has been that internal equity constraints made the company pay some low-skill jobs more than they are worth, and it was difficult to cut compensation because of those constraints, which leads to contracting out the positions."

This process did not result in wage increases (beyond the secular trend) for the remaining higher-skilled workers employed by these companies. Three of the executives interviewed specifically stated that their companies' pay remained roughly at the industry median. However, since the comparisons being made are between high-wage firms, it is difficult to tell whether these companies' pay has remained unchanged relative to the pay of comparable workers in the economy as a whole. In fact, over the period during which the firms in question were restructuring, the real wages of male workers with high school degrees were declining.

Unions would normally be expected to play a role in decisions regarding the breadth of job descriptions and work rules, the use of temps and layoffs, and the effect of contracting out on wage differentials in American manufacturing industries. Of all the topics covered in our interviews, however, the role of unions elicited the widest range of views. Three executives did not mention them at all, having little unionization in their plants, while the remainder split over whether

unions supported or opposed tight job descriptions: "The company was responsible for the proliferation of job titles in union plants . . . because laying off by seniority was within job class . . . ; then the union would respond by insisting on people doing only what their job description said they should do"; "the unions and the company had always agreed to broad job descriptions, so rotating workers within plants was never a problem." Only one executive, in the most unionized industry in our sample, made a direct connection between contracting out and union disapproval. Clearly, much of what went on in the 1980s and 1990s could not have taken place without these firms being only partially or completely nonunionized. Equally clear, however, was that the executives we interviewed considered the role of unions, and even their decline, as having already been established by the time these trends began, not as causing the trends.

The causal factors behind the joint movement toward HPWO, contracting out, the reduced use of layoffs, and the increased use of temporary workers in production that our interviewees did cite were threefold: First, as already discussed, the cost pressures on these manufacturing firms—felt in just-in-time inventory and the pressure to respond to customer demands for immediate shipping—forced changes in work practices (cited in one form or another in five of the seven interviews with manufacturing executives). Second, four of the interviewees mentioned a "speeding up of the product cycle," usually attributed to increased competition (including that due to globalization) and/or the demands of customers. Third, it was clear that, especially with regard to the adoption of HPWO and the contracting out of noncore services, there was a tendency to follow the intellectual fashion: "The change was due to an effort to follow the Japanese model, with increased flexibility and team production."

Strikingly, two interviewees explicitly denied that advances in IT were an independent motivating force, and all but one of the others either did not mention IT or downplayed its effect, characterizing it as limited to administrative matters: "The transition to team production was not significantly driven by technological changes . . . ; technology could be more productive even in a more traditional work environment." The one remaining subject did draw the connection that "E-commerce has been important in speeding up the business cycle." None of the executives interviewed mentioned direct links between the adoption of IT and the increase in the flexibility of workers and/or the use of temps and contracting out. Both the temporary-agency executive and the contracting-firm executive also denied that IT had played a major role in the past changes in their operations, instead attributing their (and their industries') success to their cost advantages from economies of scale and their expertise in relevant practices.

HAVE LABOR RENTS ERODED?

The erosion of labor rents in high-wage jobs and the disappearance of worker rents in low-wage jobs played a key role in the connection made in the previous two sections between changes in the organization of work and improved labor-

market efficiency. If our story is correct, we would expect changes in rents to parallel shifts in the Beveridge curve and in the adoption of HPWO. Moreover, if the motivations for adopting HPWO and increasing the use of contractors and temps do, indeed, include the desire to loosen the equity constraint, as our interviewees indicated, then rents should have eroded in step with these developments.

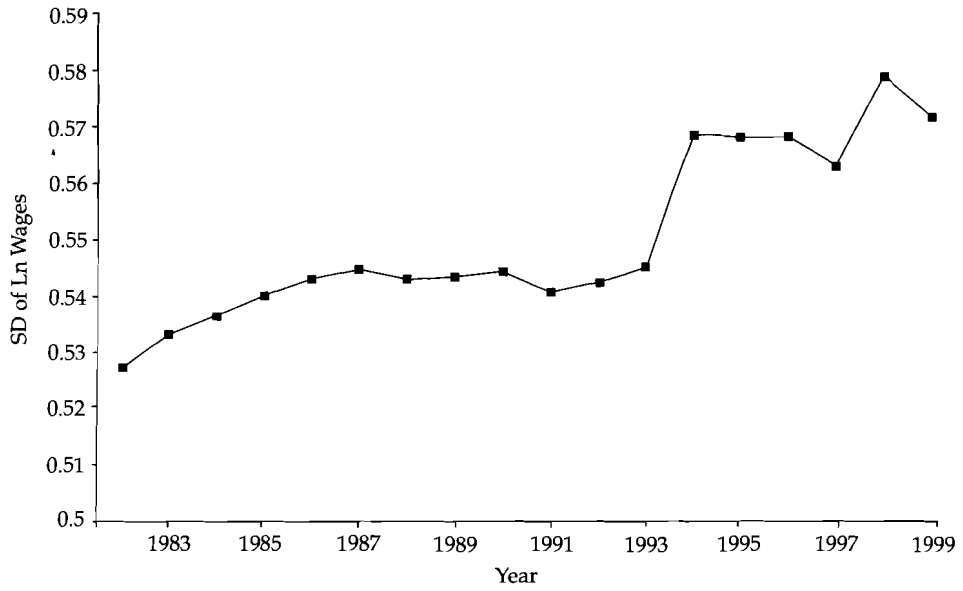
The identification of labor rents is less than straightforward. For one thing, their very existence is controversial among some economists. While few would question that unions are able to obtain a share of company rents for themselves through bargaining, the notion that nonunion workers should be able to secure higher wages for themselves, either through bargaining or through the implicit threat of collective action, has not been fully accepted. William Dickens (1986) argues that even nonunion workers with the potential to bargain collectively should benefit from that threat, but Alan Krueger and Lawrence Summers (1987) question whether this in fact happens.

If rents do differ among workers, one might consider using the extent of wage dispersion to measure rents. However, the growth in overall wage inequality in the United States during this period—widely attributed to growing returns to human capital—would confound this method. Given that residual inequality has been growing along with overall inequality, even using the dispersion of wages net of observable human capital to measure rents would not work.[34] A feasible indicator of the magnitude worker rents is the dispersion of interindustry wage differences. Dickens and Katz (1987a, 1987b) and Katz and Summers (1989) have proposed that interindustry wage differences primarily measure worker rents.[35] Subsequently, we examine changes in the dispersion of interindustry wage differences for evidence that changing rents may be driving the observed changes in the efficiency of the economy.

To measure interindustry wage dispersion, we analyze the outgoing rotation groups of the monthly CPS from 1982 through 1999. We group together all workers surveyed in each calendar year. We use as our measure of wages the hourly wage, if workers are paid hourly, or normal weekly earnings divided by normal weekly hours, if they are not. We include in our analysis all workers for whom wage data are available. Figure 5.7 presents the time series of the standard deviation of the natural log of wages. It shows the familiar pattern of rising inequality, conforming with prior work.

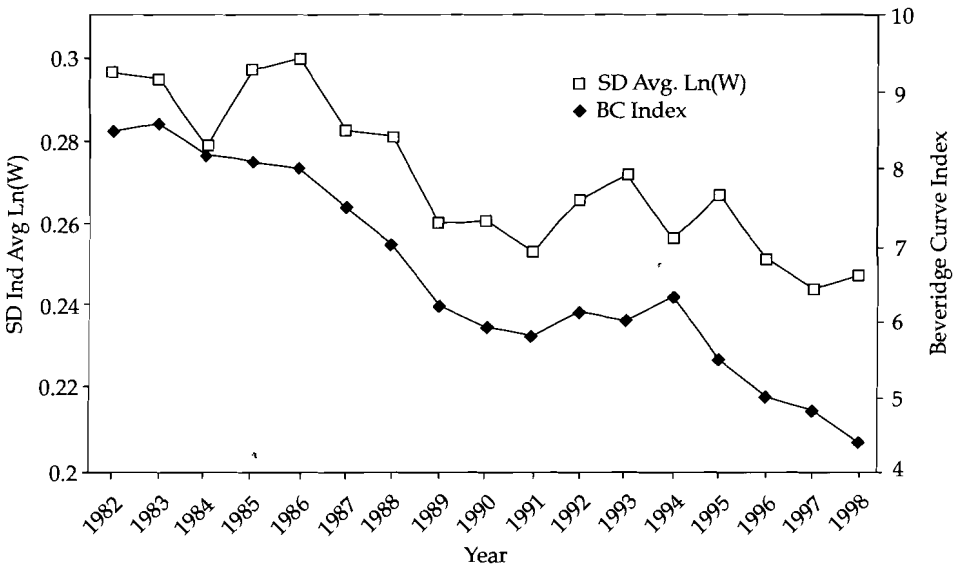
Figure 5.8 presents our first measure of interindustry wage differences along with our index of the shifting Beveridge curve.[36] Interindustry wage differences are measured as the standard deviation of the average log wage within three-digit industries. Given the extent of increasing inequality, the significant decline in raw interindustry wage differences is remarkable.[37] Even more remarkable is the timing of these changes. Like the movements in the Beveridge curve, the declines in the raw interindustry wage differences are concentrated in the same two periods—the late 1980s and the late 1990s—with a flat period in between. The correlation of the levels of the two series is 0.93 (statistically significant at the .01 level). Figure 5.9 shows that nearly the same pattern can be seen in the

FIGURE 5.7 / Standard Deviation of ln (wages)



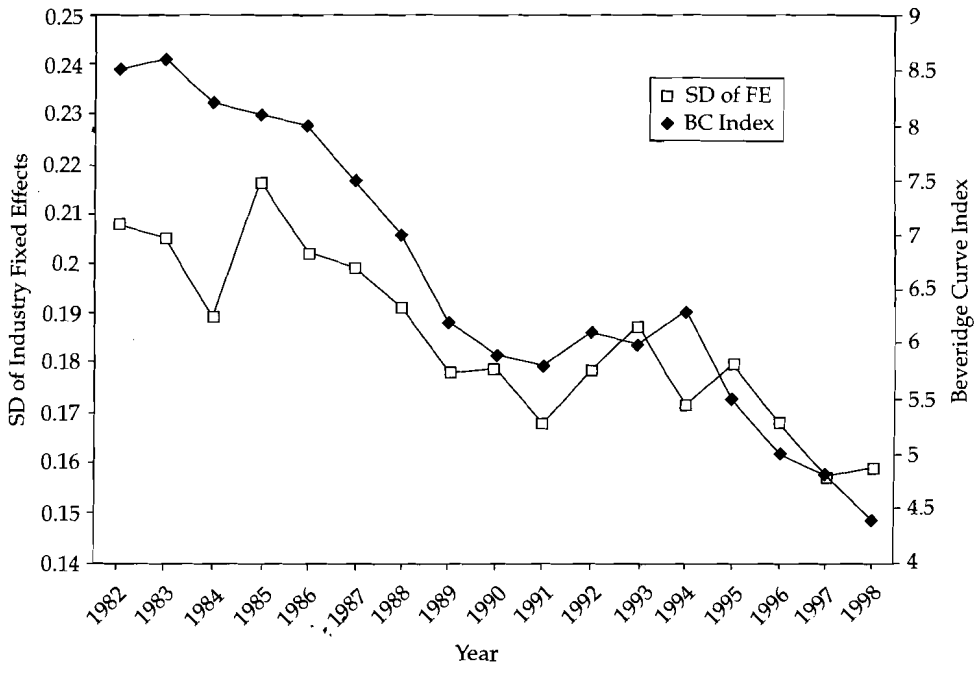
Source: Authors' calculations from CPS.

FIGURE 5.8 / Standard Deviation of Average Log Wages in Three Digit Industries



Source: Authors' computation, see text.

FIGURE 5.9 / Beveridge Curve Index and Standard Deviation of Industry Fixed-Effects



Source: Authors' computation, see text.

dispersion of what is usually considered the preferred measure of rents—the industry fixed effects from an elaborate human-capital regression including controls for a wide range of personal characteristics and workers' occupations. The pattern is nearly identical to that of the raw interindustry wage differences seen in figure 5.8. The correlation with the index of the Beveridge curve is 0.91 (statistically significant at the .01 level).[38]

These results tell us two things, which provide surprisingly strong support of the story presented so far. First, there is a near-perfect coincidence of the two periods of decline in both interindustry wage difference series with the shifts in the Beveridge curve and in HPWO adoption. This lockstep motion is not easily attributed to artifacts such as coincidence with the business cycle. The 1990 recession was officially over by 1992, and a robust recovery was under way by the end of 1993—the first year that unemployment fell. Yet the changes in the Beveridge curve and in the dispersion of interindustry wage differences did not commence again until 1995 and 1996, respectively. Second, as described previously, this hiatus corresponds as well to the period of retrenchment in the deployment of HPWO apparent in figure 5.6.

CONNECTING THE COINCIDENT CHANGES INTO A COHERENT STORY

This section first summarizes our theory of the changes that have been taking place within high-wage manufacturing firms. We describe how a speeding up of the rate of introduction of new products can lead to an increase in demand for general skills, to an erosion of worker rents, and, ultimately, to the decision to hire contracted and temporary workers for a substantial fraction of jobs within the firm. Second, we present our explanation of how these changes have led to improved labor-market efficiency and provide some illustrative calculations of potential gains. The firm and market models discussed are described in greater detail in Jessica Cohen and William Dickens (2001). At this point, the purpose of the model is simply to demonstrate our ability to tell a consistent story about how changes in the way in which firms use labor have affected the NAIRU. In future work, we hope to develop a model we can estimate that will allow us to test our hypotheses directly.

Inside the Firm

In order to analyze the effect of shortened product cycles and greater flexibility on the increased demand for general skills and the use of contracted and temporary workers, we consider a representative primary-sector firm's behavior when the possibility of contracting out some of its workforce exists. The firm earns a fixed revenue for a fixed output, so profit maximization requires the minimization of the present value of expected total costs. This minimization problem involves two decisions: the firm must choose the level of general skills that it requires of its workforce, and it must decide whether to operate with all tasks performed in-house or to contract out and use temporary workers for some of those tasks. As illustrated in what follows, the firm's decision to outsource some fraction of its jobs rather than to have all jobs performed in-house is a discrete choice by the following logic. We assume that there are a fraction of workers in whom specific human-capital investments are profitable and that the firm will not replace these workers with contracted or temporary labor. The firm must then, however, decide whether to keep the jobs of the remaining workers in-house or to outsource them and/or fill them with temporary workers. The firm's choice is discrete rather than continuous because the difference between the marginal cost of a noncontracted, unskilled worker and the marginal cost of a contracted worker is unaffected by the total number of these types of workers employed. Thus, the firm either uses contracted and temporary workers for all the jobs that must be filled by unskilled workers, or it operates these jobs in-house.

The firm faces two expected-total-cost functions, one for the no-contracting state ("*nc*") and another for the state ("*c*") in which the firm contracts out and/or uses temporary workers for some fraction of its jobs:

$$E(\text{PVTC})_{nc} = \frac{w_{nc}}{\delta} + \frac{\phi c(g)(d + \delta)}{\delta}, \tag{5.1}$$

$$E(\text{PVTC})_c = \frac{\phi w_c}{\delta} + \frac{\phi c(g)(d + \delta)}{\delta} + \frac{(1 - \phi)}{\delta}[\mu w_s + (1 - \mu)w_T] + Q. \tag{5.2}$$

In equation 5.1—the expectation of the present value of the firm's total costs if it does no contracting—the firm incurs costs from the wage bill (w_{nc}) and from training its workers. The function c represents the cost per unit of labor of investing in firm-specific human capital and is assumed to be declining in g, the level of general training possessed by the worker. The d parameter is the rate of depreciation of task-specific human capital, which can also be thought of as the speed of the product cycle. The parameter ϕ is the fraction of required efficiency units of labor in which the firm can profitably invest in specific human capital. We assume that the firm discounts future earnings over an infinite future at the rate δ.

We assume that w_{nc} is a collectively bargained wage that satisfies the Nash bargaining solution with bargaining power. The wage satisfying the Nash bargaining solution is a weighted average of the reservation wage and the rents due to the firm's investment in specific human capital (with weights determined by relative bargaining power). Note that the firm pays the wage w_{nc} to each of its workers. There is strong evidence of wage compression within firms, due both to unionization and to equity constraints. This latter source of wage compression was commonly cited in our interviews as a motivating factor in firms' decisions to outsource. We simplify the representation of this phenomena by assuming that all workers receive w_{nc}.

Equation 5.2 represents the expectation of the present value of total costs when the firm contracts out. The bargained wage w_c (derived in a manner similar to that in which w_{nc} is derived) is paid to the core workforce in the firm—that is, to ϕ workers. Of the remaining jobs (performed by the $1 - \phi$ workers), μ of them are contracted out and $1 - \mu$ filled with temporary workers, to whom the firm must pay w_T. The distinction between temporary and contract workers is not important for our analysis of the firm's decisions, but it will become important when we examine the causes of the declining unemployment in our market-equilibrium model. The contracted workers are compensated with wage w_s, the wage paid in the secondary sector, which the firm takes as given. We assume that, when the firm decides to contract out some of its jobs, it must pay a fixed, one-time coordination and restructuring cost, Q. The fixed cost of contracting can result from, for instance, the potentially substantial cost of reorganizing production so that some jobs can be kept in-house and others contracted and the cost of negotiating the complex contracts required to specify job requirements to the contracting firm.

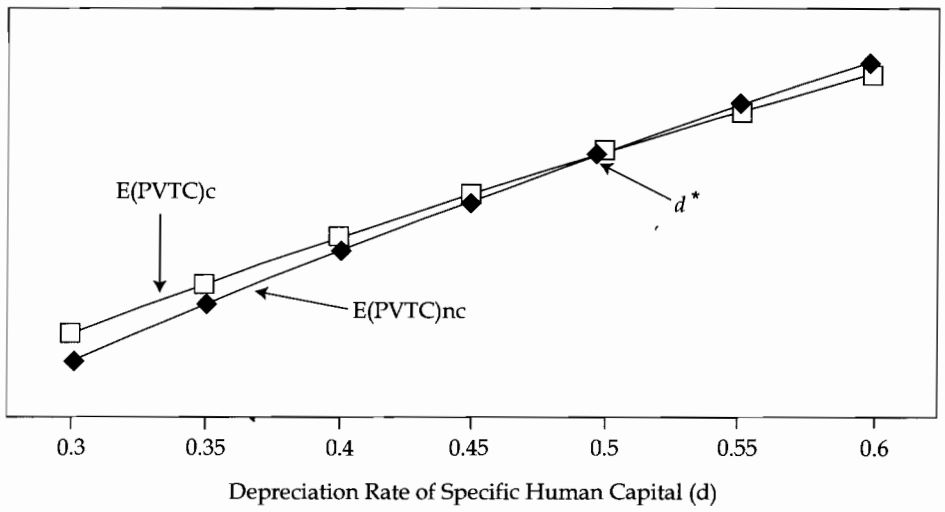
Assuming a functional form for $c(g)$—the cost function for investing in specific human capital—which is declining at an increasing rate in g, and assuming a functional form for the reservation wage, which is increasing in the flow cost

of g, we can derive the optimal level of general human capital that the firm will desire of its workforce (g^*). As demonstrated in Cohen and Dickens (2001), the optimal value of g for both regimes is increasing in the depreciation rate of specific skills (d). As the length of time over which the firm can amortize its investment in specific skills decreases (that is, as the firm is required to invest in specific skills more frequently), the firm is induced to reduce the cost of this investment by increasing g.

For sufficiently large values of the coordination cost Q, at low levels of d a firm will prefer to operate all its jobs in-house (that is, $E[\text{PVTC}]_{nc} < E[\text{PVTC}]_c$). When the product cycle is relatively lengthy, the firm's investment in the specific skills of its ϕ core workers depreciates less quickly. Less-general human capital is needed by core workers, and the equity constraint is less costly. Thus, the firm will prefer the cost of the equity constraint (paying the less-productive workers the same wage as the skilled workers) to the cost of coordination and restructuring.

Figure 5.10 plots the present value of expected total costs for the contracting and noncontracting regimes (equations 5.1 and 5.2) for a particular set of parameter values with the depreciation rate of specific human capital (d) ranging from 0.3 to 0.6.[39] We assume the following: (1) the firm invests in specific human capital for 75 percent of its workforce and divides the remaining 25 percent evenly between contractors and temps; (2) only half as many workers with specific training are required as workers without specific training to produce the same output; (3) workers and firms have equal bargaining power; (4) w_T and w_s are both 3 percent higher than the reservation wage (which is normalized to 1);

FIGURE 5.10 / Expected Total Costs for Contracting and Noncontracting Regimes



Source: Authors' computations.

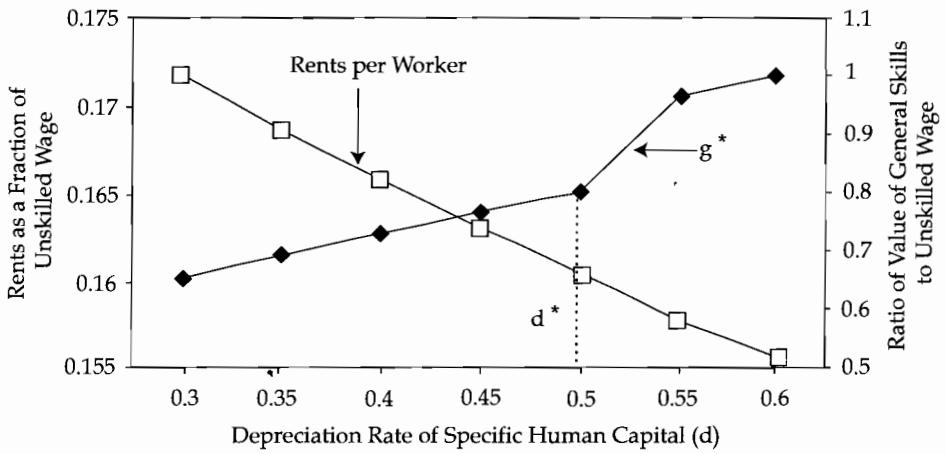
(5) the coordination cost is 15 percent of annual earnings; and (6) the discount rate is 5 percent.

At very low levels of d, the expected total costs of contracting and using temps for the noncore jobs are higher than the costs of operating the noncore jobs in-house. As d increases, the equity constraint becomes more costly. This is because, as the product cycle quickens, the firm demands a more generally skilled core workforce that will learn new tasks quickly as it is moved between production activities. This increase in the demand for g leads to an increase in the bargained wage paid to all workers (both skilled and unskilled). Note, however, that, although wages are increasing with g, since the wage is bargained, both the firm and the worker share the return on the increased value of the worker's general skills. Thus, workers' wages rise less than their reservation wages, and rents decline.[40] Figure 5.11 plots the increase in g^* and the decrease in rents per worker as the depreciation rate of specific human capital (d) increases. Note that there is a discrete jump up in g^* and a jump down in rents per worker when the firm shifts from the no-contracting to the contracting regime at d^*. When the firm begins to contract and use temporary workers for the tasks that do not require specific skills, the level of general skills required of its remaining core workers will increase sharply, and, thus, the portion of core workers' wages that can be attributed to their general training increases, decreasing rents.

From Firm to Market

Cohen and Dickens (2001) describes the market-equilibrium model in which the firm model is embedded in order to calibrate the potential effects of the changes

FIGURE 5.11 / Rents per Worker and General Human Capital (g^*)



Source: Authors' computations.

that we describe on the efficiency of the labor market. Here, we describe the essence of how the firm-level changes translate into changes in overall labor-market efficiency.

Think of the American economy as starting out in the early 1980s with a high-wage primary sector where decisions about demand for general human capital and whether to contract are made as described earlier. We imagine at this time that there is little use of temporary help or contracting. There is also a low-wage secondary sector that pays a fixed minimum or an efficiency wage.

Unemployed workers choose to apply for jobs in either the primary or the secondary sector and allocate themselves between search in the two sectors so as to equate the expected income from searching in both sectors with the reservation wage. Secondary-sector workers can search for primary-sector employment while employed, but with a reduced efficiency compared to unemployed workers.

Once primary-sector firms make the move to contracting out on a large scale, a temporary-help sector is added to the economy. We can assume that all workers—including the unemployed—who want to temp can and that they will never count as unemployed while in that sector. Nonetheless, we assume that temps will search for primary-sector employment with efficiency between that of a secondary-sector worker and that of an unemployed worker.

Our model describes the improved efficiency of the labor market as deriving mainly from the decline in rents in the primary sector and the increased use of temporary workers. Prior to the rise of contracting out and temporary-help services, an increase in the depreciation rate of human capital increases the demand for general human capital in the primary sector and causes the rents in primary-sector jobs to fall (see the earlier discussion), making them less attractive. Unless primary-sector job vacancies are filled only by workers searching for jobs while employed in the secondary sector, this decline in the attractiveness of the primary sector will lead some unemployed workers to shift their search efforts from the primary to the secondary sector. In that sector, the vacancy rate is higher and equilibrium unemployment lower, with the result that these workers will spend a larger fraction of their time employed. They will also contribute to lowering the vacancy rate in the secondary sector, with the result that both the overall unemployment rate and the vacancy rate will decline.

When the depreciation rate of specific human capital rises high enough, primary-sector firms switch to outsourcing noncore jobs, as described earlier. When they do, there is a further abrupt decline in rents as well as a decline in the number of jobs available in the primary sector. These factors combine to make primary-sector jobs relatively less attractive, even if their wages remain high relative to the secondary sector. This causes the unemployment rate in the primary sector to drop further and more workers to search for the relatively easier to find jobs in the secondary sector. Further, the increased number of secondary-sector workers searching for a smaller number of primary-sector jobs—combined with the even more effective search of the temporary workers—displaces still more unemployed workers from the queue for primary-sector jobs. This

further lowers unemployment and vacancies. Any ongoing increase in the speed of the product cycle and/or the value of flexibility in the primary sector will also increase the rate of depreciation of specific human capital and will continue to cause a decline in rents—translating into a decline in the NAIRU.

The parameters chosen yielded an unemployment rate of 6.9 percent when the vacancy rate was 1.5 percent. Unemployment resulted mainly from workers queuing for primary-sector jobs, which were assumed to make up about two-thirds of the jobs in the economy. The unemployment in the primary sector is created by rents equal to about 15 percent of the reservation wage of an unskilled worker. The job-destruction rate in both the primary and the secondary sectors is assumed to be 10 percent a year and the rate of depreciation of task-specific skills three times that.

Starting from this point, a 50 percent increase in the rate of depreciation of task-specific skills in primary-sector jobs investing heavily in such skills results in a reduction of labor rents in the primary-sector wage of about 30 percent. At a vacancy rate of 1.5 percent, it also leads to a reduction in the rate of unemployment to 4.7 percent, if no temporary workers are added to the labor force, or to 4.0 percent, if there is an increased use of temps amounting to 2.5 percent of the workforce. Thus, in this scenario, the reduction in rents reduces the unemployment rate associated with 1.5 percent vacancies by over 2 percentage points, while the increased use of temporary workers accounts for another 0.7 percentage points of decline.

An increase of 50 percent in the rate of depreciation of specific skills may seem large, but it may not be, given the dimension of the changes in work practices described in the literature and evident at the firms whose executives we interviewed. Further, it is the decline in labor rents that is the crucial intermediate variable between the increased depreciation rate and the decline in unemployment, and the change produced by the model is commensurate with the changes in interindustry wage differences documented in the previous section.

There seems to be considerable sensitivity of the results to parameters that are not known with precision. Thus, the actual effects could easily be much larger or much smaller. However, the results do show that we are able to tell a story that is consistent with the facts.

CONCLUSION

There is considerable agreement that the lowest sustainable rate of unemployment has declined in the United States in the last fifteen years. Examination of data on unemployment and vacancies suggests that the improvements in market efficiency were concentrated in two discrete periods. The first runs from 1985 to 1989. The second, which began in 1995, may still be continuing. These abrupt changes in the vacancy-unemployment relation, or the Beveridge curve, contrast starkly with the time path of changes that have been proposed by past researchers to explain the improvement in the inflation-unemployment relation,

but they seem to mirror the time pattern of adoption of a host of new HRM methods—particularly in manufacturing, where a disproportionate share of unemployment is concentrated. The changes in efficiency also parallel declines in workers' rents as measured by interindustry wage differences.

We propose an explanation for improved overall efficiency of matching in the U.S. labor market since 1985 that links these synchronized changes in a sensible fashion. This approach has six steps, drawing on important developments in HRM by U.S. manufacturing firms that altered the demand side of the labor-matching function:

1. Technological innovation and increased competitive pressures (including those coming from abroad) have led to a speeding up of the rate at which product lines are switched and production (levels and lines) adjusted in primary-sector firms.

2. This speeding up of the product cycle causes investments in firm-specific human capital to have a higher rate of depreciation. We view this as the main cause of the adoption of the new HRM policies. These policies emphasize generality of skills and the ability to move between jobs over deep investment in a narrow set of skills. These policies also make more demands on workers' general skills and flexibility since they require more substituting between tasks by workers.

3. Higher demand for general skills means higher wages for those core workers who remain, but, because bargained wages do not increase one-for-one with reservation wages, the increased demand for general skills also lowers rents to workers. Internal equity constraints force firms to pay higher wages, not just to core employees utilizing flexibility, but also to those lower-skilled workers who have narrowly defined jobs. This creates a tension that mounts as demands for general human capital rise along with cost pressures.

4. Eventually the tensions between the rising demand for skills and the equity constraint lead primary-sector firms to adopt new forms of organization in which they contract out all jobs for which investments in specific human capital are not important (that is, jobs that are not part of the firm's core competency). This relaxing of the equity constraint leads to a further decline in rents for all workers, both those who now seek employment outside the primary sector and those in good jobs.

5. Falling rents make high-wage jobs relatively less desirable and reduce worker willingness to wait unemployed to get such jobs. Vacancies in the primary sector decline as well. More workers then apply for jobs in lower-wage sectors, where jobs are easier to find owing to the presence of more vacancies. This lowers both the unemployment rate and the vacancy rate.

6. The growth in the market for temporary-help services leads to the development of a large temporary-help sector in which workers have considerable freedom to search for jobs while still being employed most of the time (and almost never counting as being unemployed). These workers displace still more unemployed workers from the queue for high-wage jobs, the displaced workers again

switching their search to lower-wage jobs. This too reduces both the unemployment and the vacancy rates.

Our story is, admittedly, at present more an intriguing linkage of hypotheses with stylized facts than a directly tested model. Our two-step alignment of shifts in interindustry wage differentials, the Beveridge curve, and the adoption of HPWO, combined with complementary developments in American labor markets, requires supplementation with additional empirical analysis to be fully convincing. And, while we offer our story in opposition to certain classes of explanations for the decline in the NAIRU, such as those relying on gradual forces without clear institutional-transmission mechanisms, we do not claim that this breakdown of firms' internal equity constraints is the only cause of that decline.

Nevertheless, we believe that our approach to explaining the decline in the NAIRU offers promising aspects, in addition to being able to match with the specific time-series sequence of relevant shifts in the 1980s and 1990s:

First, we are able to synthesize several of the most notable developments in firms' use of workers into a coherent story—the widening use of HPWO and the increasing demand for more *generally* skilled employees in firms' core workforces; the rise in the share of temporary workers in blue-collar manufacturing employment; the sudden expansion of contracting out of noncore activities despite no apparent change in the supply curve of those services; the "mean leaning" downsizing movement of the early 1990s; the growing sense of the permanency of layoffs among workers in good jobs; the increased competitive pressures on American firms, starting in the 1980s, for production to be flexible and high quality; the increasing flexibility of compensation; and the decline in interindustry wage differentials. To date, all these developments have been largely ignored in considerations of the NAIRU.

Second, we are relying on what we believe to be a more realistic view of the importance of technological improvement, and IT specifically, than some of the more vague new-economy hypotheses do. In our view, technological change, international competition, financial pressure to cut costs, and increased customer demands result in a speeding up of the rate at which firms switch between products and a general increase in the demand for workforce flexibility. Workers must now make shallower investments in specific human capital more frequently, and this can be accomplished more quickly and at less cost if the workers possess more general skills. Thus, it is the change in work organization, and not the need to operate IT equipment, that drives the increased demand for general human capital.

Finally, we should note that, although we believe that the process of restructuring and the increase in temporary and contract workers may have facilitated today's low unemployment and low inflation, we do not claim that these changes have been without cost. There is no doubt that at least part of the widening of the income distribution can be attributed to the changes that we describe and that many individuals have had their lives severely disrupted by

displacement from good-paying jobs at which they had worked for many years. But our work does suggest that there may have been some overlooked benefits, accruing both in the aggregate and to individual workers, from these changes beyond the improvements in productivity (and profitability) that others have already argued occurred.

A full cost-benefit analysis is well beyond the scope of this paper, but, if one were conducted, it would at a minimum have to balance the falling wages of less-skilled workers and the lost rents of workers displaced from good jobs with the gains of increased employment. If our story is right, the United States did get something beyond a redistribution of income for the changes that have occurred.

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NOTES

1. The adoption of these methods of production has been remarkably widespread within U.S. firms. For instance, Osterman (2000) finds that, by 1997, 57.2 percent of the firms in his survey had adopted total-quality-management practices involving more than 50 percent of their core workforce.
2. We use the term *NAIRU* in this paper for conformity with the rest of the papers in this volume and common usage. As we use that term here we mean it to be synonymous with the term *LSRU*, or lowest sustainable rate of unemployment, which encompasses the NAIRU/natural-unemployment-rate concept of a unique unemployment rate consistent with constant inflation as well as the concepts described by George Akerlof, William Dickens, and George Perry (1996, 2000), concepts that allow a range of unemployment rates to be consistent with constant inflation.
3. Although we have interviewed only human-resource management executives from manufacturing, we believe that our theory of the restructuring that has taken place within these firms is applicable to other sectors as well. Manufacturing was the trendsetter, although the changes have spread widely. In future work, we plan to interview executives from service industries as well.
4. The formal model, which is only described here, is presented and analyzed in Cohen and Dickens (2001).
5. Dickens's (1999) comments on Katz and Krueger (1999) first raise this challenge.

6. Allowing for all these positive shocks and the effects for which we argue here would seem to explain all the change in the NAIRU and then some. However, we will also argue that some causes that have been cited by others are not likely to have made important contributions to reducing the NAIRU.
7. Where companies may have run their own cafeterias in the past, today over 90 percent of corporate food service is provided by contractors (with half that 90 percent provided by the three biggest contracting companies). And food service is only the tip of the iceberg. While it is very common for firms to outsource such services as security, groundskeeping, and payroll, some firms have outsourced everything from their computer services to their mail rooms. See the more detailed discussions that follow.
8. This sense of greater competitive pressure is commonly expressed by American business managers and the financial press. We note that this sense is difficult to reconcile with the rapid growth in corporate profits in the 1990s and the rise in consensual mergers without antitrust intervention since 1980. Looking for the sources of both this sensibility and the actual HRM changes is a primary topic for future research.
9. Katz and Krueger (1999) also suggest that the auspiciously timed movements in the U.S. Beveridge curve point toward a matching efficiency explanation for these improvements.
10. Blanchard and Diamond (1989) develop a theoretical model to support such a link.
11. For a discussion of the validity of this proxy, see also Zagorsky (1998). Note that the development of Internet advertising, search, and placement services may presently be transforming this process as well as decreasing the reliability of newspaper ads as a measure, as argued by Autor (2000c).
12. We do not attempt to plot the Beveridge curve after 1998 because of the widespread use of the Internet after this date, which makes us suspicious of the help-wanted index as a measure of vacancies. Were we to do so, the plot would show *both* unemployment and vacancies declining in 1999 and 2000.
13. Note that it is unlikely that any measurement problems with the help-wanted index could have caused such a pattern.
14. This does not rule out productivity-enhancing effects of IT in the last few years or even going forward. It simply points out that the labor-market developments that we believe are the main motivating force behind the decline in the NAIRU predate the growth in IT investment.
15. Including the Current Population Survey Displaced Worker Surveys (Farber 1997, 1998) and tenure supplements (Neumark, Polsky, and Hansen 1997; Neumark 2000), the Panel Study of Income Dynamics (Jaeger and Stevens 1999), the National Longitudinal Survey of Youth (Monks and Pizer 1998; Bernhardt et al. 1998), and the Survey of Income and Program Participation (Bansak and Raphael 1998).
16. The number of companies in their survey contracting out janitorial services increased by 18 percent between 1979 and 1987, and contracting out of machine maintenance increased by 6 percent, drafting services by 12 percent, accounting by 11 percent, and computers and technical support by 12 percent.
17. As another source for rising temp demand, Autor (2000a) argues that the new "unjust dismissal doctrine" adopted in the majority of American states has induced part (20

percent) of the growth in temps because firms wish to retain their discretion to fire workers with the fewest firm specific skills.

18. Houseman and Polivka (1999) explicitly downplay the role of screening for permanent hires as a major motivation for the move to flexible staffing arrangements. In their words, "Only a small minority of employers stated that they often move workers in flexible arrangements into regular positions" (8).

19. As Estevao and Lach (1999b) point out, this implies that the growth in temporary-help services was due to a change in the hiring behavior of firms, not to a rise in employment in those sectors that were disproportionate users of temps at the start of the 1990s. The finance, insurance, and real estate and the transportation, communications, and utilities sectors have shown a slow, although steady, rise in temporary-help services use since the early 1980s, and, in construction, the use of temporary-help services has been stable since 1987.

20. Abraham and Taylor (1993), Estevao and Lach (1999a), and Houseman and Polivka (1999) all come up with essentially this same list of three reasons, plus training and/or screening, as potential motivations. As will be seen in the next section, those of our corporate interviewees who discussed the motivations for moving to flexible staffing volunteer the same three reasons (but not training), while the one (clerical) temporary-agency executive interviewed largely denies there being migration from his agency to permanent employment by client firms.

21. While, to an economist, compensation is compensation, be it wages or benefits, there is reason to think that, in practice, the divide between wages and benefits and the absence of benefits in many temp jobs are significant in workers' minds. On the one hand, from an internal moral or equity point of view it is even harder to justify giving different workers different health coverage than it is to justify different wage premiums for seniority. There are also important tax considerations mandating that benefits being offered to some workers be widely shared within the firm for them to qualify as deductions from pretax earnings.

22. Whether these practices significantly increase worker productivity and production efficiency net of labor costs is subject to dispute (although no responsible observer appears to claim to have evidence that they harm productivity). See Casey Ichniowsky, Kathryn Snow, and Giovanna Prennushi (1997), Lynch and Black (1997), Cappelli and Neumark (1999), and Black and Lynch (2000).

23. American forms because, as Appelbaum and Batt (1994), along with others, note, many of these other practices were already implemented in different forms or combinations in Germany, Japan, Sweden, and elsewhere and the American firms and workers were very conscious of the international examples.

24. Osterman (1994) distinguishes between those establishments that have had these practices penetrate at least 50 percent of their core workforces and those at which these practices were merely adopted somewhere within the (sometimes large) organization. The figures for those merely adopting somewhere within the organization were 54.5 percent for teams, 43.4 percent for job rotation, 33.5 percent for TQM, and 40.8 percent for quality circles.

25. The Beveridge curve index is computed as the unemployment rate at a 1.5 percent vacancy rate in a given year (assuming that the Beveridge curve had a constant

slope), subtracted from 10, and then multiplied by 10 to put it on the same scale as the fraction of firms using job rotation.

26. We have reasonable confidence in the 1992 and 1997 data points since, as noted, Osterman (2000) used a genuine panel, resurveying previous respondents, to get the results, which were consistent with his new full survey.

27. In the future, there is likely to be a direct effect of IT on employers' and employees' job-search efficiency and perhaps even on outsourcing via telecommuting, as described in Autor (2000c), but these effects were felt in 1997 to 1998 at earliest, about the time the apparent new level of the NAIRU was reached (when employment pushed up wage inflation), and long after the Beveridge curve shifted. Thus, to repeat an earlier point, IT cannot be held responsible for the improvement in matching already evident by 1995.

28. A practice attested to by many whom we interviewed (see the next section).

29. We have empirical work under way to test whether the changes that appear obvious from visual inspection of the Beveridge curve can also account for the shifts in the Phillips curve. We are estimating a multiple-indicator model of the error processes in the two curves in a way that will allow us to test whether a common error component shares the time pattern evident in the Beveridge curve shifts and completely accounts for the movement of both curves. Developments in HPWO and interindustry wage differentials (discussed in the third section) also feed into this multiple-indicator model.

30. Eileen Appelbaum and Rosemary Batt (1994), John Duca (1998), and Assar Lindbeck and Dennis Snower (1996, 2000), along with many others, point to these forces of competition and pressures for high-value-added production as one of the major factors behind the shift to HPWO and to contracting out and/or wage decompression. A strict interpretation of these changes as being driven by a shortening of the narrowly defined product cycle is not supported by the one source of data that we could find. Brent Moulton and Karin Moses (1997) do not find any significant change in the fraction of items leaving the CPI product survey between 1983 to 1984 and 1995. However, these are the only dates for which data are available, and the years are not at comparable points in the business cycle.

31. These interviews were conducted with a guarantee of complete anonymity, and all quotations given here have been cleared with the interview subjects.

32. Lisa Lynch has pointed out to us that HRM managers are more likely to be excited about HPWO practices than average management is and may overstate their actual implementation. In future research, we intend to interview shop managers to document the extent of HPWO usage.

33. Interestingly, the lower-tech and/or higher-unionization firm was part of the majority here: "The significant increase in the variety of products produced has led to increased demand for workers with a broader skill base. In the older plants, workers always rotated between machines. . . . In the newer plants, workers are reassigned almost on a daily basis."

34. Measured by the dispersion of the residuals of a human-capital wage equation, with controls for individual characteristics such as age, gender, education, location, and occupation.

35. Krueger and Summers (1987) interpret interindustry wage differences as indicating the presence of efficiency wages, while Kevin Murphy and Robert Topel (1987) argue that interindustry wage differences may reflect compensating wage differences or unobservable human capital. For a review of the evidence, see William Dickens and Kevin Lang (1993).
36. The latter being the predicted unemployment rate at a 1.5 percent vacancy rate in a given year, subtracted from 10, then multiplied by 10.
37. Preliminary analysis of annual earnings data from the CPS does not show declining interindustry wage differences. We are investigating this discrepancy.
38. In contrast to these results, very recent work with survey and firm data by David Levine et al. (forthcoming) finds that the variance and persistence of employer wage effects appear to be fairly stable in the 1990s. We have not yet had the opportunity to examine, and perhaps thereby reconcile, these results in light of the clear (and opposing) ones that emerge from our use of a standard methodology on wage data. But we would note that, to the extent that firms are specializing in employing either low- or high-wage workers, there would be a tendency for firm differences to grow at the same time that industry differences might decline.
39. If the time period of analysis is assumed to be one year, one can interpret a value of $d = 0.3$ to mean that workers must be retrained to learn a new task roughly once every three years.
40. Rents are defined as wages minus reservation wages.

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