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The Human Resources Revolution: Is It a Productivity Driver?

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Executive Summary

This paper assesses the empirical evidence and policy issues associated with the human resources revolution. While managers and practitioners have long emphasized the role of human resource practices, economists and policy makers have only recently begun to evaluate the impact of human resource policies on overall productivity growth. This paper suggests that advanced human resource practices (ranging from team-based problem solving, to incentive pay, to training) have facilitated the strong productivity record experienced in the 1990s, both directly and as a complement to the intensive adoption of information technology. Two implications emerge from the analysis. First, the advantages of innovative human resource practices can be realized only when the U.S. workforce possesses a strong human capital foundation. Second, although the private sector has invested intensively in advanced human resource practices, many of these investments have not been measured consistently or expensed correctly as an accounting matter. The lack of standards by which to measure workplace organization implies that society finds it difficult to identify and diffuse productive practices as quickly as possible.

I. Introduction

For many years now, businesspeople have suggested that the primary competitive advantage of firms lies in the quality and optimal use of their workforce. The United States cannot compete internationally on the basis of low-cost labor and must compete instead by having the highest quality labor to make high-quality products more productively.

There are three possible routes for improving productivity from the optimal use of labor resources. One is to increase the quantity of capital that labor can work with, another is to increase the quality of labor, and the third is to improve the management of labor resources to increase their output. There is no doubt that over the long run, increased

labor quality and rising amounts of capital in the United States have contributed to rising labor productivity (Jorgensen, Ho, and Stiroh forthcoming). However, the unknown question is, To what degree has the improved management of labor resources contributed to greater productivity or overall performance? That is the primary question addressed in this paper.

I begin by arguing that there has been a major technology shock in the form of the use of more innovative human resource management (HRM) practices in the developed countries in the last twenty-five years. Specifically, firms have moved toward the use of practices such as teamwork, problem-solving teams, information sharing, job rotation, and incentive pay—all aimed at eliciting greater effort and effort focused on problem solving on the job. Thus, we have the following key questions: Has there been an evolution toward more innovative HRM practices worldwide? What theoretical impact might these practices have on worker performance levels? Have these practices increased productivity or performance, and if so, how?

I ask, finally, what role might policy play in fostering productivity gains arising from the adoption of innovative HRM practices? Two options are emphasized. First, the government should continue to expand its commitment to elementary education and the development of basic skills. Firms in the United States today want workers who are capable of solving problems on the job. Thus, even at the fairly low-skilled level of production workers, firms want employees who can read, write, do math, and communicate with others. Firms can build on these basic skills with the investment in more firm-specific skills. The basic skills are best taught in the primary grades, not in later government-sponsored training programs. Second, firms have begun to emphasize their investments in their knowledge workers, or human capital. While this often refers to the more highly educated worker, it can and should also refer to the less-educated production worker. Unlike investments in physical capital or R&D, however, the investment in workers is typically not measured or expensed. Many have suggested that the government should facilitate better accounting systems that acknowledge, and thus encourage, the investment in people.

II. The Macroeconomic Evidence on Productivity Gains

An important question in recent years is, To what degree did labor resources contribute to the new economy of the 1990s? The last half of

the 1990s was labeled the "new economy" by economists because the trend growth rate of labor productivity rose from an average of 1.44 percent in 1973–1995 to 2.43 percent from 1995–2001, and many believe that higher trend productivity growth continues into this century. Thus, I turn first to the industry growth accounting models to ascertain the sources of that growth.

A consistent picture emerges—the use of information technologies (IT) contributed significantly to the growth of productivity during the 1990s. The IT-producing industries experienced rapid productivity growth but, in addition, the non-IT-producing industries also contributed to the growth of productivity (Jorgenson, Ho, and Stiroh 2002; Oliner and Sichel 2002). Of the 0.9 percentage point gain in labor productivity (from 1.5 to 2.4) in the late 1990s relative to the early 1990s, .56 percentage point was due to capital deepening through the purchase of IT capital (either hardware, software, or communications IT in line 3 of table 3.1). Looking within the non-IT industries, those industries that were heavy purchasers of IT equipment had the highest rates of productivity growth (Baily 2002). At the same time, performance gains within the IT-producing sector resulted in a .36 percentage point gain in productivity for the overall economy (lines 10–14 of table 3.1). Thus, overall, gains arising from the IT sector account for all of the gains in labor productivity.

Turning to the impact of labor resources, human resources might play two possible roles in the productivity gains. First, increases in labor quality over time could contribute to the gains in productivity. However, the data show this is not likely to be the case. Using industry-specific national accounts data, Jorgensen, Ho, and Stiroh (forth-coming) calculate a measure of labor input that incorporates the heterogeneity in labor inputs across industries by using industry-specific values for gender, age, job class, and educational attainment to produce 168 different types of workers for each of their forty-four industries. Using these measures, they create a labor quality index for each industry and then weight it by hours worked in that industry. Given these data, they then show that labor quality did not contribute to the productivity gains over this period. In fact, just as other research has shown (Jorgensen, Ho, and Stiroh 2002; Oliner and Sichel 2002), labor quality fell, and thus it alone would have produced a decline in labor productivity.

The second possible role of human resources arises from the improved use of human capital within firms. Specifically, if firms learned how to manage their workforces better through the use of innovative human resource practices, then this improved management should

Table 3.1
Contributions to growth in labor productivity, using data as of March 2002

		1974–1990 (1)	1991–1995 (2)	1996–2001 (3)	Post–1995 change (3) minus (2)
1.	Growth of labor productivity[a]	1.36	1.54	2.43	.89
	Contributions from[b]				
2.	Capital deepening	0.77	0.52	1.19	0.67
3.	Information technology capital	0.41	0.46	1.02	0.56
4.	Computer hardware	0.23	0.19	0.54	0.35
5.	Software	0.09	0.21	0.35	0.14
6.	Communication equipment	0.09	0.05	0.13	0.08
7.	Other capital	0.37	0.06	0.17	0.11
8.	Labor quality	0.22	0.45	0.25	−0.20
9.	Multifactor productivity	0.37	0.58	0.99	0.41
10.	Semiconductors	0.08	0.13	0.42	0.29
11.	Computer hardware	0.11	0.13	0.19	0.06
12.	Software	0.04	0.09	0.11	0.02
13.	Communication equipment	0.04	0.06	0.05	−0.01
14.	Other sectors	0.11	0.17	0.23	0.06
15.	Total IT contribution[c]	0.68	0.87	1.79	0.92

[a]In the nonfarm business sector, measured as the average annual log difference for the years shown multiplied by 100.
[b]Percentage points per year.
[c]Equals the sum of lines 3 and 10–13.
Note: Detail may not sum to totals because of rounding.
Source: Oliner and Sichel (2002).

result in an increase in total factor productivity. Numerous researchers have speculated that improved HRM practices have contributed to productivity gains (Jorgenson, Ho, and Stiroh forthcoming; Oliner and Sichel 2002). They have also speculated that a portion of the gain from the investment in information technologies is due to the changes in the use of human resources to complement the investments in information technologies (see also Bresnahan, Brynjolfsson, and Hitt 2002). For the purposes of an aggregate industry-level growth accounting framework, however, there are no data on changes in HRM practices by industry over time with which to test that hypothesis.

Thus, I turn next to an examination of the evidence of the effectiveness of HRM practices. The evidence comes from firm-level data or produc-

tion line data. Before turning to that evidence, however, I ask the question, Why did firms start adopting innovative HRM practices in the 1980s and at what rates did they adopt new practices?

III. Technology Shocks

The evidence below will show that firms began utilizing innovative HRM practices in the 1980s and beyond. The following question naturally arises, If firms knew of the value of HRM practices, why weren't these practices adopted earlier? I argue that the value of these innovative practices was discovered in the United States in the 1980s, and that this discovery represents a technology shock, just like the discovery of information technology innovations represents a technology shock.

The Information Technology Shock

The information technology shock is evident in the size of the productivity gains in the IT-producing sector, in the falling prices of their products (per quality unit of computing), and in the higher investments by firms that have resulted from these falling prices. Since 1980, the speed of microprocessers used in personal computers (PCs) has increased more than a hundredfold, so that the cost of performing 1 million instructions per second has fallen from $100 to less than 20 cents. The cost of a megabyte of hard disk storage has fallen from $100 in 1980 to less than 1 cent today. Data transmission also skyrocketed because fiber optics lowered the costs of sending 1 trillion bits of information from $120,000 in 1980 to 12 cents in 1999 (see Council of Economic Advisers 2001, for these data).

The net effect of these performance gains per dollar of expenditure is that prices of computers and equipment fell 71 percent between 1995 and 2000. Investments by firms followed. Use of the personal computer began in the early 1980s, but its extensive power and widespread use developed in the 1990s. More recently, in the mid- to late 1990s, very extensive developments in networking developed—with intranets and the Internet for business to business (B2B) and business to consumer (B2C) communications. As a result of the acceleration of technological improvements in computing, investment in computers and software grew at a 19 percent annual rate during the 1990s and accelerated to a 28 percent annual rate after 1995. Complementary investment in

software also doubled in those years (rising from $10 billion in 1980 to $50 billion in 1990, to $225 billion in 1999), although the price of software fell by only 2 percent a year.

The Human Resource Management Technology Shock

Just as innovations in information technology have produced productivity gains arising from investments in IT, innovations in HRM practices may also have produced productivity gains arising from investments in HRM. These innovations in HRM can also be considered a technology shock over the last twenty-five years, although it is more difficult to measure the size of the shock. Cole (2000) describes potential innovations in HRM practices as a shock to managers: twenty-five years ago, the traditional U.S. system of HRM practices gave production workers very little problem-solving involvement; at the same time, the Japanese demonstrated that participatory practices could raise performance. Cole documents the huge gap in product quality in the United States relative to Japan in the 1970s and early 1980s, and U.S. managers' eventual discovery that the technology of production had changed. Some innovative firms took up the challenge and adopted innovative HRM, others moved more slowly, and some of the early changers were among Japanese transplants to the United States.

The investment in innovative HRM practices varies across firms, both in the extent of use of these practices and in the definition of what constitutes innovative practices. In previous research, innovative HRM practices are defined as the seven sets of practices that combine to raise employee involvement (Ichniowski, Shaw, and Prennushi 1997):

- The careful screening and selection of workers is required to obtain those employees who are more skilled in job-related skills, as well as in the team skills or people skills to work together to solve problems.
- Formal problem-solving teams, with procedures for their development and use, are introduced to provide production workers with direct input into improving the production process.
- Workers are rotated across jobs to provide training and worker flexibility and to increase teamwork.
- Incentive pay, such as pay for performance in piece rates or in group incentive plans, is introduced to offer the incentive for greater employee involvement and to increase production performance.[1]

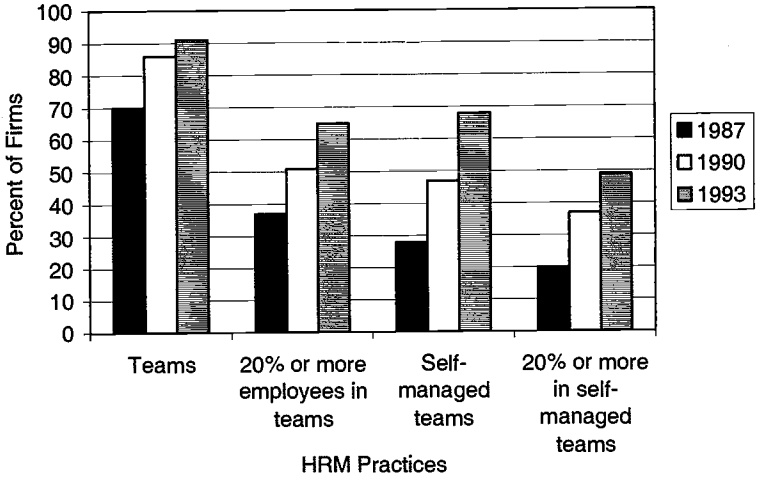

Figure 3.1
HRM practices in large U.S. firms.
Source: Lawler, Mohrman, and Ledford (1995).

- Information sharing, in formal meetings or through informal networks, provides the information and motivation for greater involvement and decision making.
- More extensive training increases worker performance, enhances problem-solving success, and increases skills for day-to-day decision making.
- Job security is used to assure workers that suggestions for improvements in production performance will not result in the direct loss of jobs.

While firms choose different sets of HRM practices to develop, the overall adoption of these individual innovative practices appears to have increased over the last twenty-five years. Lawler, Mohrman, and Ledford (1995) show that Fortune 500 firms substantially increased their use of teams (or work groups) and of self-managed work teams (see figure 3.1). In these firms, these practices became more pervasive: the percentage of large firms having more than 20 percent of workers participating in work groups rose from 37 percent to 65 percent from 1987 to 1993, and the percentage of firms having more than 20 percent of workers participating in self-managed teams rose from 20 percent to 49 percent. While the survey does not go back to the early 1980s,

earlier questions on total quality management (which is the precursor to teams) suggests that the practices began to be adopted in the 1980s.

Across all types of establishments, including small and nonmanufacturing, there has been significant growth in the use of multiple HRM practices in the 1990s. Using survey data of all types of establishments, Osterman (2000) finds that, from 1992 to 1997, the percentage of establishments with two or more practices in use by at least half the workforce rose from 25 percent to 38 percent when he followed the same establishments over time. These practices were sustained within establishments: an "overwhelming majority of establishments in place in 1992 maintained that status in 1997" (Osterman 2000, p. 186). And while team use did not increase in his survey from 1992 to 1997, the use of other practices did: the percentage of establishments that used job rotation rose from 24 percent to 47 percent.

The HRM technology shock is also present in European countries from the 1980s onward. While the levels of HRM in Europe cannot be compared to those in the United States because no data sets contain these cross-continent data, we can compare practices within Europe. Using data from three different sources, Bauer (2002) shows that the adoption of innovative HRM practices that raise teamwork is most prevalent in the Scandinavian countries and the United Kingdom, and the lowest dissemination is in the southern European countries (Greece, Portugal, Spain, and Italy). Figure 3.2 shows the European Union (EU) data. Overall, Germany ranks slightly below average and France slightly above average in the use of teamwork.

The key question is, How has the use of innovative HRM practices changed over time in Europe? Data from Denmark, a country with high current rates of adoption, displays the increases over time (see figure 3.3). The most remarkable increases have come in the use of teamwork, rising from 27 percent of companies prior to 1990 to 42 percent in 1996–1999, and the levels of use are also high. As in all studies, in the United States and Europe, large firms are most likely to adopt new innovative HRM practices, and firms with a more highly skilled workforce are more likely to adopt innovative practices.

In sum, a conservative assessment suggests that, prior to the 1980s, almost no firms in the United States or Europe had HRM practices emphasizing employee involvement, but their use grew fairly steadily over the 1980s and into the 1990s. The introduction of employee involvement occurred in the early 1980s; by 1990, approximately half of all firms had some innovations; and since 1990, there has been vari-

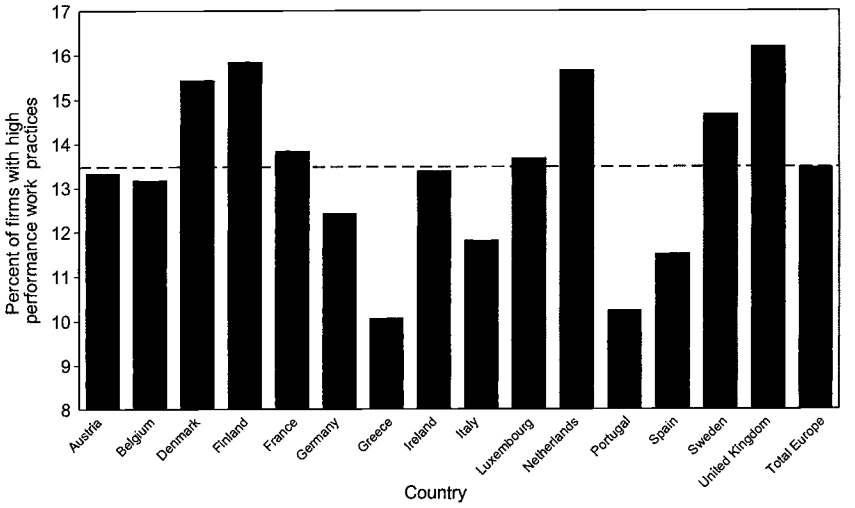

Figure 3.2
HRM practices in Europe.
Source: Bauer (2002).

able but continued progress. Thus, to the extent that HRM represents a technology shock, this shock occurred and adjustments were made in the 1980s and early 1990s, and perhaps to a lesser extent in the mid- to late 1990s. Thus, the introduction of innovative HRM practices cannot directly explain the growth of labor productivity in the late 1990s. However, as with most new technology, it takes time for new investments to pay off and diffuse (Bresnahan, Brynjolfsson, and Hitt 2002; Bresnahan and Greenstein 2000), and this is likely to be true of HRM practices as well as technological innovations. Moreover, HRM practices are likely to augment the returns to information technology (discussed below). Overall, as described below, HRM practices are likely to have contributed to productivity gains in the 1990s.

IV. The Effects of HRM Technology Shocks: Building Problem-Solving Capacity

The Combined Effects of the IT and HRM Technology Shocks: Changes in Decision Rights to Build Problem-Solving Capacity

The advent of innovations in HRM practices and in information technologies is likely to have increased the value of locating decision mak-

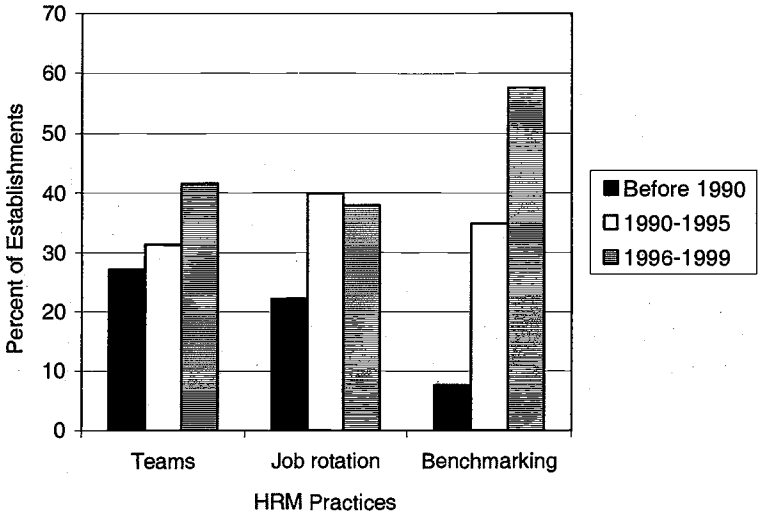

Figure 3.3
HRM practices in Denmark.
Source: Eriksson (2002).

ing at lower levels in the organization. The typical goal of innovative HRM practices is to move decision rights from managers to workers at lower levels in the organization. For example, Jensen and Meckling (1992) posit that firms should "co-locate" decision-making authority with employees who have the most relevant information. In this section, I describe the investments that firms make to push decision making down the hierarchy and thus increase performance.

The movement toward greater degrees of worker participation in decision making is likely to have grown over the last twenty-five years as a result of three changes:

1. Firms began to recognize that production workers possess valuable information—information that engineers and supervisors often lack—about the operation of production lines. This discovery of the value of workers' insights is part of the "Japanese technology" shock or HRM shock.

2. The IT revolution resulted in two changes: all individuals now have more information available to them at all levels, and communications are much more rapid and information intensive. These communications links and decentralized information have increased progressively

over time, with the latest improvements arising from networking and extensive developments in intranets and the Internet for B2B and B2C communications.

3. In today's competitive environment, the competitive advantage of U.S. firms is often in the domain of producing niche products, or products that are R&D or knowledge intensive. In this environment, employees at all levels are required to undertake problem-solving activities; the days of producing commodities with cheap labor are gone.

Thus, there is a movement toward greater authority for production workers to make operating decisions, and firms typically must make other changes in the HRM environment to enhance this change in authority. For example, production workers must also be given the incentives that motivate good decisions (Jensen and Meckling 1992, Baker 1992).[1] Prior to the Japanese technology revolution, most U.S. firms managed through the use of the "hierarchical control" model of management (Aoki 1988). Employees were managed through "control"—close supervision rather than involvement and personal incentives or rewards. Today, use of problem-solving teams, or of greater day-to-day decision making at lower levels, tends to be combined with some form of incentive pay that induces workers to want to make more decisions and to be more accountable for those decisions. The complementarity of incentive pay and other HRM practices with problem-solving teams is discussed further below.

As a result of these changes, firms are making new investments in practices to enhance workers' performance. Firms are investing in workers' problem-solving capacity or connective capital (Ichniowski, Shaw, and Gant 2002). An example helps to clarify the concept of problem-solving capacity. In the traditional steel mill, if a production worker recognizes a quality problem on the line, such as a surface defect in the new steel, he will call the supervisor and report the problem (or he will do nothing and let the line continue running). If the mill introduces innovative HRM practices, however, the production worker will know of more options for correcting the problem (due to his higher training level), and he will have up-to-date information about whether the current customer would reject such steel (given increased day-to-day information sharing). And perhaps most important, he will have easy access to other production workers and staff so that he can gather the necessary knowledge to solve the problem. For example, he

may organize a group of people to help him solve the problem on the spot. In the organizational literature, the worker makes use of his "social network" of contacts to solve a specific problem.

Thus, problem-solving capacity is the capacity each individual worker has to solve problems by tapping into his co-workers' knowledge base (or into his social network). More specifically, problem-solving capacity is reflected in the worker's connective capital, CC_i, for worker i, which is equal to the sum of the communications between worker i and all other workers j, weighted by the human capital knowledge, HC_j, possessed by the worker with whom he communicates (Ichniowski, Shaw, and Gant 2002):

$$CC_i = \sum_i \sum_{i \neq j} cc_{ij} HC_j = \phi(\text{HRM})$$

where $cc_{ij} = 1$ if worker i communicates with worker j (and $cc_{ij} = 0$ if he doesn't) and HC_j is the human capital of worker j.

Thus, when worker i has high connective capital, he communicates with others extensively. Note that to build connective capital or problem-solving capacity, the firm must implement innovative HRM practices, such as problem-solving teams, training, and incentive pay, that induce the communications and problem solving by worker i. Connective capital is a function of the innovative HRM environment, or ϕ(HRM) above.

Data on the individual communications patterns from the steel industry suggest that plants with more innovative HRM practices are raising their problem-solving capacity by increasing the communications network of their production employees. Gant, Ichniowski, and Shaw (2003) measured each worker's communications links with all other workers as they work on the job. On those steel-making lines with innovative HRM systems, workers interact with a majority of other line workers, both within shifts and across shifts. On those steel-making lines with traditional HRM practices, workers interact with a much smaller number of their peers or managers.

Building Problem-Solving Capacity: The Complementarity of Innovative HRM Practices and IT

Given the definition of connective capital, the ways in which innovative HRM practices affect performance are twofold:

1. Innovative HRM practices raise the level of each individual's intellectual capital *by providing employees with the information, training, and opportunity to raise their level of intellectual capital.*

2. Innovative HRM practices raise the level of each individual's problem-solving capital *by providing employees with access to their peers' or manager's assistance, and by providing the incentive to utilize that access.*

The innovative HRM practices of teamwork, information sharing, job rotation, and careful selection are aimed at reshaping a production worker from one who merely operates a machine to one who makes day-to-day and long-run decisions regarding the use of the machinery and the strategic capabilities of the machinery and the firm. Innovative HRM practices give workers the opportunity and the incentive to invest in problem-solving capacity, and then to make day-to-day and long-run decisions regarding the use of the machinery and the strategic capabilities of the machinery and the firm. Firms reward the employee for these investments and higher effort levels. The rewards could be in the form of either incentive pay or enhanced recognition and job satisfaction.

As this discussion implies, the various HRM practices tend to be complements—greater use of one HRM practice tends to increase use of the others. In research on the steel industry, Ichniowski, Shaw, and Prennushi (1997) conclude first that the preponderance of evidence suggests that a full set of innovative HRM practices raises workers' performance levels more than does the adoption of individual practices. Then, using data from the survey of workers' communications patterns in a subset of these mills, Ichniowski, Shaw, and Gant (2002) conclude that connective capital rises with innovative HRM practices. While that data cannot show definitively that sets of complementary practices raise communications more than do individual practices, the overall body of research suggests that systems of HRM practices are more effective than individual practices.

Other researchers have pointed out that IT and organizational changes or innovative HRM practices are complements (Bresnahan, Brynjolfsson, and Hitt 2002; Black and Lynch 2001). The likely reasons for the complementary nature of HRM and IT were given above—IT provides the information needed for better or faster problem solving. In addition, the introduction of more innovative HRM practices make better use of IT innovations.

In sum, firms today are likely to have a much greater incentive to invest in problem-solving capacity, and innovative HRM practices and IT investments are likely to contribute to their ability to invest. One key HRM practice to support building problem-solving capacity is the change in job design. Broader job definitions (so workers do a greater range of tasks) and a flatter, less hierarchical job structure provide workers with access to the information that builds problem-solving capacity. In recent studies, economists have emphasized either the importance of job design (Holmstrom and Milgrom 1991) or the importance of the information network (Aoki 1986; Bolton and Dewatripont 1994; Appelbaum, Bailey, Berg, and Kalleberg 2000; and Greenan and Mairesse 1999) but have not combined these in the development of problem-solving capacity.

Overall, innovative HRM practices are aimed at raising the level and the incentive to develop knowledge capital by all employees. Most important, the uniqueness of my focus on building *problem-solving capacity* is that it emphasizes the value of the knowledge capital of production workers or other similar employees who would not be considered the star performers in a firm.

V. The Effects of the IT and HRM Technology Shocks: Changes in Performance

There are two sources of econometric evidence: industry specific studies and broad surveys of firms across industries. The steel industry study is described first to provide an in-depth account of the impact of HRM practices.

Has Increased Use of New HRM Practices Improved Business Performance in the Steel Industry?

Two primary studies, one based on data from finishing lines in integrated steel mills (mills that use basic oxygen blast furnaces; Ichniowski, Shaw, and Prennushi 1997) and one based on data from rolling lines in steel minimills (mills that use electric arc furnaces; Boning, Ichniowski, and Shaw 2001) provide evidence on performance effects. The first study uses panel data from thirty-six finishing lines that coat and treat very large coils of flat-rolled steel. The second study uses panel data from thirty-four minimill production lines that reheat very large

steel beams and thin and shape the steel into thinner rods or bars for use in construction or manufacturing applications. Both studies include almost all the production lines of these types in the United States and develop large panels with well over 2,000 monthly observations in each study's sample.

The first study, of integrated steel finishing lines, concludes that systems of innovative HRM practices are more effective in raising productivity than are the more traditional HRM practices (Ichniowski, Shaw, and Prennushi 1997). Regression results suggest that productivity is 6.7 percent higher under the most innovative HRM system, 3.2 percent higher under the high teamwork system, and 1.4 percent higher under the communications system. Lines that adopt a full bundle of innovative work practices therefore achieve the highest levels of productivity, and the traditional system produces the lowest performance.

The second study, of minimill production lines, reinforces the finding that innovative HRM practices improve productivity but also highlights the complementarity between problem-solving teams and incentive pay (Boning, Ichniowski, and Shaw 2001). Problem-solving teams are adopted only when incentive pay is already in place, and teams raise the return to incentive pay.

Intra-Industry and Cross-Industry Analyses of HRM Effectiveness

The research method utilized in the steel industry studies has been labeled insider econometrics (Ichniowski and Shaw 2003), and to some degree this methodology has been utilized in other intra-industry studies of the effects of HRM practices on business performance. The insider econometrics methodology is an approach in which economists go inside firms within one industry and gather data on performance and practices so that they can best model the production function within that industry and measure HRM practices without error. As described in table 3.2, in the apparel, auto, and machine tool industries and in call centers, there is evidence within and across plants that innovative HRM practices raise performance. Corroborating this intra-industry evidence is survey evidence from plants or firms. For the most part, the regression results based on cross-industry survey data also show that innovative practices raise performance when adopted (see table 3.2 and Becker and Huselid 1998).

Researchers in several European countries have had access to firm or establishment level data concerning HRM practices and perfor-

Table 3.2
Performance effects of HRM practices

Authors and their studies using survey data across establishments	Sample data	Dependent variable	HR measures	Results	Methods
Sandra E. Black and Lisa M. Lynch (2000)	A panel of 766 establishments (drawn from both manufacturing and nonmanufacturing and with more than 20 employees) was constructed from the Educational Quality of the Workforce National Employers Survey administered by the U.S. Bureau of Census in 1994 and 1997.	Value added per person.	Use of high-performance work systems like re-engineering, benchmarking, and self-managed teams; number of managerial levels; worker characteristics; technology; employee voice and recruitment strategies.	• High performance workplace practices lead to higher productivity and higher wages. • There is a positive and significant relationship between the use of computers by nonmanagers, undergoing re-engineering and increasing employee voice and productivity. • Increasing profit sharing results in lower regular pay for technical and clerical/sales workers.	Regression equation for the cross-sectional data and for establishment fixed effect.

Table 3.2
(continued)

Authors and their studies using survey data across establishments	Sample data	Dependent variable	HR measures	Results	Methods
Sandra E. Black and Lisa M. Lynch (1996)	Same as above.	Log sales.	Quality of human capital; training of employees; recruitment strategies.	• Human capital is an important determinant of productivity. • The greater the time spent on formal off-the-job training, the greater is the productivity for both manufacturing and nonmanufacturing. • Recruitment strategies like focus on grades affects productivity. • Capital equipment less than one year lowers productivity while the capital stock aged 1–4 years raised current productivity.	Estimate the impact of human-capital investments on productivity using standard Cobb-Douglas production function.

Table 3.2
(continued)

Authors and their studies using survey data across establishments	Sample data	Dependent variable	HR measures	Results	Methods
Timothy F. Bresnahan, Erik Brynjolfsson, and Lorin M. Hitt (2002)	Cross-sectional survey of organizational practices and labor force characteristics conducted during 1995 and 1996 matched with panel data of IT capital levels and mix over 1987–1994. The data set covers approximately 400 large U.S. corporations. (55 percent in manufacturing, mining, or construction; 45 percent in services).	Log output.	Team-based work organization; individual decision authority; human capital levels and investment; composition of production workers.	• The empirical evidence suggests that there are three clear complementarities among human capital, workplace organization, and IT. All play different roles in the firm. • The falling prices of computers and IT services have raised demand of IT capital and led to invention of new organizational forms along with introduction of new products and services.	Use the short- and intermediate-run production function framework to explain complementarities and derive implications for labor demand. The complements that are studied are: cheaper, more powerful IT capital; organizational change; and new products, services, or quality.

Table 3.2
(continued)

Authors and their studies using survey data across establishments	Sample data	Dependent variable	HR measures	Results	Methods
				• Despite the adjustment costs and rising wages of highly skilled labor, firms will find the cluster of complements worth adopting. • Information technology is a source of increased demand for skilled labor and rising wage inequality.	
Peter Cappelli and David Neumark (1999)	1997 Census Bureau survey of more than 1,800 plant and business managers.	Sales per worker; total labor costs per worker; and a combined measure of efficiency.	Use of IT, benchmarking, self-managed teams; TQM; cross-training; profit sharing.	• Little consistent evidence of the effect of profit sharing on productivity. • High-performance work practices raise labor cost per worker. • There are gains to workers when organizations use high-performance work systems, but there is no clear cut evidence of a positive impact on organizations.	Regressions of efficiency variables on various work practice variables.

Table 3.2
(continued)

Authors and their studies using survey data across establishments	Sample data	Dependent variable	HR measures	Results	Methods
Mark A. Huselid and Brian E. Becker (1996)	Data was drawn from 10-K filings focusing on HRM systems used by the firms in calendar years 1991, 1993, and 1995. The sample consisted of all publicly held domestic firms with more than 100 employees and $5 million in sales, and surveys were sent out to the chief human resources officer of each firm.	Output.	Systems of HRM practices.	• Use of organizational High Performance Work Systems (HPWS) is linked to a variety of firm and environmental factors. • Industry complexity, capital intensity had a negative effect on the adoption of HPWS. • Union had a positive effect on the adoption of HPWS.	Cross-sectional and longitudinal regressions were run on survey data to check the conceptualization of a multidimensional HRM system.

Table 3.2
(continued)

Industry studies using "insider" data from within establishments	Sample data	Dependent variable	HR measures	Results	Methods
Eileen Appelbaum, Thomas Bailey, Peter Berg, and Arne Kalleberg (2000)	Survey data for 4,000 employees collected During 1995–1997 of 38 plants (14 in steel, 14 in apparel, and 10 in medical electronic instruments and imaging).		Horizontal coordination and communication; self-directed teams; contingent pay and participation.	• Competitive pressures are altering the relationships between managers and workers. • Adoption of practices that engage workers in decisions about production and quality improvements. • Firms are putting in place contingent pay systems. • Provide a cross-industry perspective.	Survey and interviews with a variety of managers and union officials.

Table 3.2
(continued)

Industry studies using "insider" data from within establishments	Sample data	Dependent variable	HR measures	Results	Methods
Rosemary Batt (1999)	Data consisted of questionnaires administered to 223 unionized employees in 68 workgroups in customer service centers in a large regional Bell operating company.	Sales productivity and self-reported quality.	Measures of human resources practices like skill level, coaching support, advancement opportunities, job insecurity, and annual earnings. Other measures included employment relations, service market location.	• Self-managed team participation increases sales and improves perceived quality. • Group interaction improved the use of technology, presumably through learning or problem solving. • Teams encourage individuals to assume more responsibility, though it is not the only structure. • Individual discretion may lead to a negative impact on quality. • Perceptions of declining job security increase sales but adversely affects quality.	Data were collected from observation, interviews at multiple levels of the organization, individual surveys that were also matched to performance data. The model used additive indices for work organization and multiplicative terms for the work organization and technological system.

Table 3.2
(continued)

Industry studies using "insider" data from within establishments	Sample data	Dependent variable	HR measures	Results	Methods
John T. Dunlop and David Weil (1996)	Forty-two business units in men's and women's garment product lines collected between 1988 and 1992 at the business unit level.	Lead times—standard and shortest; and operating profit.	Compensation practices, training practices as they differ from modular systems.	• Slow diffusion of innovative HRM practices in the U.S. apparel industry due to concerns of costs and labor productivity. • Firms shipping in a high percentage to mass merchants and national chains are more likely to adopt modular systems. • A strong relation between investments in IT and adoption of modular systems.	Use of logit regression models to test for the determinants of modular adoption.

Table 3.2
(continued)

Industry studies using "insider" data from within establishments	Sample data	Dependent variable	HR measures	Results	Methods
John Paul MacDuffie (1995)	International assembly plant study based on 1989–1990 survey of 62 automotive assembly plants.	Labor productivity and consumer-perceived quality.	Total automation; product design age; model mix complexity; and parts complexity. Production organization measures like use of buffers, work systems, and HRM policies.	• Three indices to capture systemic differences in organizational logic between mass production and flexible production were developed. • The assembly plants using flexible production systems outperform more traditional mass-production systems in both quality and productivity. • There is a positive relationship between innovative HRM practices and economic performance.	Survey data were collected for the sample plants and regression analysis was carried out. The regression model was based on standard Coub-Douglas production function using log of dependent and independent variables. Factor and cluster analysis was also performed on the data.

Table 3.2
(continued)

Industry studies using "insider" data from within establishments	Sample data	Dependent variable	HR measures	Results	Methods
Maryellen R. Kelley (1996)	1991 national telephone survey of size stratified random sample of manufacturing establishments from 21 industries.	Total hours required in the machining process to produce one item of a given product type.	Work organization like participative bureaucracy; wage and hiring policies; technical education.	• Number of group-based employee participation mechanisms are being combined in a new organizational form. • Large, complex and multilocation organizations rely more on formal bureaucratic control. • Group based participative structures do not necessarily have beneficial effects on productivity.	A regression model testing the impact of product quality, and complexity, work organization, and technological and operational strategy is used against a composite measure of relative efficiency.

mance. As in the U.S. studies, two main themes documented in intraindustry studies continue to gain support in these nationwide, cross-industry analyses of HRM practices and economic performance. First, firms tend to use multiple HRM innovations. Second, new work practices and, more specifically, interactions among new work practices are associated with higher business performance. Overall, these conclusions apply for research for Denmark (Eriksson 2001), Italy (Leoni, Cristini, Labory, and Gaj 2001), Great Britain (Fernie and Metcalf 1995; Michie and Sheehan 1999), France (Ballot, Fakhfakh, and Taymaz 2002; Greenan and Guellec 1998; and Greenan and Mairesse 1999); and Germany (Wolf and Zwick 2002).

Summary

In an earlier review of the effectiveness of innovative HRM practices, Ichniowski, Kochan, Levine, Olson, and Strauss (1997) conclude that the preponderance of evidence suggests that there are significant performance gains from managerial improvements in HRM, gains that outweigh the costs of these investments. Their conclusion is consistent with two studies of the productivity gains from innovative HRM practices in the steel industry. These steel studies, and the additional studies in other industries and across industries using survey data, reach the conclusion overall that innovative HRM practices are productivity enhancing. Most of these studies also reach the conclusion that sets or systems of complementary HRM practices tend to be productivity enhancing. While it is difficult to prove econometrically that these HRM practices are complements (Athey and Stern 1998), the preponderance of quantitative and qualitative evidence suggests that such complements exist (Pfeffer 1994).

In the last few years, researchers have begun to emphasize the interaction between HRM and IT, or the value that organizational changes have in enhancing the value of IT. Discussions of the complementarities among these practices are emphasized in Brynjolfsson and Hitt (2000), and Bresnahan, Brynjolfsson, and Hitt (2002) because they provide an explanation for the recently growing returns to IT investment. For these investments to pay off, firms must also invest in organizational changes. Other researchers making this point include Autor, Levy, and Murnane (2002, 2003), Black and Lynch (1996, 2000, 2001), and Dunlop and Weil (1996).

VI. Investing in Innovative HRM Practices—Should All Firms Invest?

Thus far, I have emphasized the growing importance of investing in problem-solving capacity—to compete in international markets and to utilize the U.S. comparative advantage in investing in human capital and information technologies. In reviewing the empirical results on the effectiveness of HRM practices, I conclude that these practices seem to raise worker performance levels, and thus that firms seem to be benefiting from their investments in HRM practices that produce higher levels of problem-solving capacity. But should all firms invest in innovative HRM and thus in greater problem-solving capacity?

Who Should Invest in HRM?

The average firm should find it increasingly advantageous to make problem-solving investments, for three reasons. On average, product quality has gone up over time in the United States and innovative HRM practices are aimed at producing higher quality products. Information technology use has gone up over time, and IT and problem-solving capacity or HRM practices are likely to be complements. And finally, as firms continue to discover the value of the HRM technology shock, firms should raise investments in these practices independent of changes in product quality or IT.

Like all investments, however, investments in innovative HRM practices certainly have different rates of return across firms, and not all firms should invest heavily in them. The minimill steel study provides the most "microeconomic" evidence on what types of firms ought to invest. In that study, Boning, Ichniowski, and Shaw (2001) estimate a two-equation model: one equation estimates the expected gains (or productivity gains) from investing in innovative HRM choices, and the other equation estimates the decision to invest in innovative HRM practices as a function of the characteristics of the technology. The econometric results show that the steel mills that gain the most and adopt the most innovative practices are those with more complex production lines and more complex high-quality products. This result is intuitively appealing: problem solving is more valuable when the production environment faces greater problems due to its greater complexity or when output must be of the highest quality. In other

words, firms that produce commodity products and that change their processes little over time will have the least to gain from investing in problem solving. However, another case study analysis in other industries (Bartel, Ichniowski, and Shaw 2003) shows that firms that produce commodities may find innovative practices to be valuable if the production environment is highly capital intensive and high quality, so both extensive IT and innovative HRM are valued.

This industry-specific evidence on the value of problem solving is quite consistent with the survey correlations. Osterman (1994) concludes for his establishment survey that plants that are more likely to adopt innovative team practices are those in an internationally competitive product market, that have a technology that requires high skill levels, and that follow a strategy that emphasizes product quality and service rather than low costs. Ichniowski and Shaw (1995) also find that adoption is greater in steel mills that face more competitors. These factors are likely to be correlated with the expected productivity gains, but perhaps also with transition costs, because these costs are likely to be lower for newer plants.

Other researchers have emphasized the value of adopting innovative HRM practices to complement investments in IT—implying that firms that are high IT users are also likely to invest more in innovative HRM practices. Milgrom and Roberts (1990) describe cases of HRM and IT complementarity, such as Ford's joint adoption of computerized CAD/CAM design techniques along with a team approach to design and manufacturing. Appelbaum, Bailey, Berg, and Kalleberg (2000) and Dunlop and Weil (1996) emphasize that the adoption of "modular" apparel manufacturing (which relies on a set of innovative HRM practices) was driven by the implementation of computer-aided information systems used to track sales by large retailers. Finally, several recent studies using nationwide, cross-industry business surveys find higher performance among businesses that adopt both innovative work practices and some computer technologies (Brynjolfsson and Hitt 2000; Bresnahan, Brynjolfsson, and Hitt 2002; Black and Lynch 1997; Barua and Mukhopadhyay 2000).

Thus, if IT raises the return to HRM practices, then the greater investments in IT over the last twenty-five years could contribute to the greater adoption of innovative HRM practices. Overall, these studies suggest that the use of IT and HRM may be complements because IT raises the return to HRM by providing the technology to facilitate deci-

sion making, and thus HRM adoption enables workers to make the best use of the investments in IT.

Though investments in IT may increase the value and use of innovative HRM practices, many firms may adopt HRM practices alone—without investments in IT. Several intra-industry studies summarized above (in the steel and auto assembly industries, for example) estimate significant returns to HRM practices in environments when IT investments are not growing substantially. For example, in the steel industry samples, while there is a modest, positive cross-sectional correlation between measures of computerization and the use of innovative HRM practices, there is no correlation between investments in new computer technology and the adoption of new HRM practices within mills over time. Interviews with managers also corroborate the conclusion that new HRM practices were innovations aimed at raising performance undertaken independently of technology investments.

Why Don't More Firms Invest in HRM?

While differences across firms or plants in the long-run value of innovative HRM practices may explain much of the limited adoption of these practices, there may also be transition costs that limit adoption. While 93 percent of large firms have some form of teamwork (Lawler, Mohrman, and Ledford 1998), only about 40 percent of all establishments use teams extensively for more than half of the workforce (Osterman 2000).

Transition costs associated with HRM adoption can be extensive and are examined in numerous studies. There are some obvious sources of transition costs. First, workers and managers must invest in entirely new skills—workers in decision-making skills and managers in coaching or advisory skills as opposed to supervisory skills. Workers and firms may be slow to undertake these investments, even when there are performance gains from the actual use of innovative HRM practices, if the time horizon is short for the firm or for the workers. In addition, older firms with investments in older HRM or IT technologies are earning rents on these investments. They undertook investments in old skills in the past, and as long as they can stay in the market and cover marginal costs, it may not be optimal to re-invest in new HRM. These firms can compete with new firms, because new firms have higher average costs due to the costs of new HRM or IT, while old firms have lower average costs and earn rents on old investments.

Second, complementarities between HRM practices can raise transition costs. Systems of innovative HRM practices should be adopted at once to raise performance, and in some industries, systems of innovative HRM practices must be coupled with other management policies to improve performance (such as the use of production and inventory management policies in auto assembly plants; MacDuffie 1995). Adoption of systems, rather than individual practices, makes the up-front costs more sizable. Since these costs are typically paid for out of retained earnings, investments may decline. When systems of practices are most valuable, firms will find it more difficult to search for the optimal practices. Levinthal (1997) uses simulations to show that businesses might get locked-in to an existing set of organizational policies that produce less than the highest levels of performance when complementarities exist among the organizational policies. Managers who begin with an inherited set of HRM practices may search for better policy choices by experimenting with changes in only one or two policy areas. When broader complementarities exist among numerous policies, performance will not improve and managers may then abandon their search for better practices. This kind of costly search would limit the adoption of innovative work practices.

VII. Changes in Labor Demand: Building Problem-Solving Capacity

The innovative practices listed above contain some direct and indirect evidence on the ways in which innovative HRM practices affect labor demand. Regarding the direct ways in which it affects labor demand, one of the innovative HRM practices is the more careful screening of employees to select better employees. But what kinds of employees are being selected?

The overall set of HRM practices described above can be used to infer indirectly the kind of employees the firm now demands in the problem-solving environment. Employees are expected to work in a team environment, to work smarter and to work harder, and to take greater responsibility in their day-to-day decision making. To achieve these goals, the personal traits that firms seek in hiring workers are that they have the team skills to cooperate and communicate well with others in a team setting, the personal motivation and drive to respond to reward incentives such as pay and recognition, and the desire to take on additional responsibility (perhaps in response to better rewards).

Table 3.3
Job requirements by occupation

	Occupation				
Task	Professional/managerial	Clerk/sales	Service	Craft/Operative	Laborer
Customers	80%	84%	78%	41%	31%
Read	88%	67%	58%	54%	34%
Math	76%	70%	52%	62%	53%
Computers	66%	75%	23%	23%	17%

Source: Holzer (1996).

Overall, firms want employees with a can-do attitude or the desire to make a difference.

Data from Black and Lynch (1996) and Holzer (1996) suggest that firms search for workers with these personal and interpersonal skills. Black and Lynch (1996) provide survey evidence on hiring criteria using an extensive establishment survey conducted in 1994. They asked establishments to rank, on a scale of 1 to 5 (5 being the most valuable), a list of criteria in hiring, with the following mean outcomes (1996, p. 266):

Applicant's attitude	4.6
Communication skills	4.2
Work experience	4.0
Outside recommendations	3.4
Industry credentials	3.2
Years of education	2.9
Employer tests	2.5
Applicant school grades	2.5

As you can see, the applicant's attitude, communications skills, and experience are considerably more important than education. Data from Holzer (1996) also directly summarizes skill needs. Holzer surveyed U.S. establishments in four major U.S. cities and asked about the types of workers they seek in new hires. His results by occupation for expected daily tasks to be performed are shown in table 3.3, where "customer" is dealing with customers, "read" and "math" are the uses of reading or writing and arithmetic, and "computers" is the use of computers. Holzer asked about the daily tasks on jobs to ascertain the skills required by employers of their new hires. As a result of these tasks, he found that firms demand fairly extensive skills or experience for most jobs; only

3 percent of all jobs have almost no requirements. On average, about 50 percent of all jobs require some computer use, and this finding is similar to that reported in other studies (see Krueger 1993).

The next question is, Has skill demand changed over time to emphasize the growing need for these problem-solving or people skills? There is no detailed time series data on task use, but Holzer did ask about changes over time and estimated that, on average, all the tasks above experienced an approximately 23 to 25 percentage point increase from 1980 to 1994. Thus, computer use rose, as did the importance of basic skills that are necessary in firms that require more employee involvement or more employee autonomy.[2] There is a perception that there has been an increasing need for computer skills in today's economy. In surveys of firms, however, they rarely emphasize the importance of computer skills. They state that computer skills are fairly easy to teach on the job, but basic skills are not readily taught.

Finally, Autor, Levy, and Murnane (2003) provide a comprehensive assessment of changes in skill demand over time. They use Current Population Survey data and information on required skills from the *Dictionary of Occupational Titles* to show that the demand for nonroutine cognitive skills has risen over time. This increase in cognitive skills is correlated with the use of new technologies. In a different study, which identifies the underlying skill distribution of workers, Abowd, Haltiwanger, Lane, and Sandusky 2001 and Abowd, Haltiwanger, and Lane 2002 also show that the percent of high skilled workers rose in the 1990s. Industry studies containing detailed descriptions of hiring changes in workplaces that adopt new technologies add corroborating evidence of a connection between new work practices and an increased demand for problem-solving skills (Bartel, Ichniowski, and Shaw 2003; Autor, Levy, and Murnane 2002; Appelbaum, Bailey, Berg, and Kalleberg 2000; and Holzer 1996).

VIII. Policy Implications

The description above of the changing demand for labor skills has numerous implications for public policy. First, the typical firm investing in innovative HRM practices wants workers who can think for themselves, solve problems, participate in teams, and communicate well; are responsible and reliable; and have a positive attitude toward hard work and rewards. Thus, I turn to policies that facilitate the development of such workers. Second, the typical firm utilizing innovative HRM

practices is making an investment, and thus firms making those investments and earning returns on those investments should be rewarded—through higher stock market valuations. Thus, I turn to a consideration of how firms value these investments and are rewarded for them.

The Investment in Human Capital: Education

As described in Carneiro and Heckman (2002), the rate of return from education, as measured by income gains from education, tends to fall with increases in education—the return is highest for preschool or early elementary school and falls over time (see Carneiro and Heckman 2002, Figure 6-1). This means, for example, that programs to improve the skills of high school dropouts are rarely successful on a cost-benefit basis. High school dropouts may choose to complete high school by passing a series of tests to receive their high school equivalency degree, or GED. About 15 percent of all high school degrees granted today are GED degrees, but research shows that those achieving a GED do not earn higher wages than high school dropouts who have the same basic ability. Similarly, the income gains from postschool training, such as job training programs, are lower than the gains from preschool educational investments per dollar invested. Therefore, when compared with the opportunity cost of investing, it is clear that optimal investment levels are very high for early education and fall from that point onward.

The studies reviewed in the sections above of the value of innovative HRM practices and changes in skill demand provide a ready interpretation for the Carneiro and Heckman 2002 conclusion. The skills that tend to be taught in the early years—such as reading, math, communications, interpersonal relations, and motivation—are those skills that are particularly valuable in firms with innovative HRM practices. Studies in child development emphasize that there are life-cycle patterns to effective learning, and that cognitive skills are best taught early in the educational life cycle (Carneiro and Heckman 2002, p. 27). These general skills are valuable and are very difficult to teach later in life. Thus, early childhood interventions of high quality—such as the Perry Preschool program—have permanent effects on learning and raise incomes (Carneiro and Heckman 2002, p. 46). Note also that the quote—"good families produce good children"—also implies that programs aimed at family or parental support often have indirect benefits in raising the quality of children's educational outcomes.

In addition, as emphasized in the labor demand discussion above and by educational researchers, there are also important returns to

investments in noncognitive skills, such as motivation, dependability, or interpersonal communications, that firms value. Some noncognitive skills, such as motivation, are readily taught later in life through, for example, mentoring programs (Carneiro and Heckman 2002). But many programs inadequately address the need for these noncognitive skills. The GED emphasizes cognitive testing to receive the high school diploma, but Cameron and Heckman (1993) demonstrate that high school dropouts who get their GED have poor noncognitive skills—they lack the ability to think ahead or to persist in tasks—and these skills are not developed by the GED program.

In sum, low-cost ways of increasing educational levels, such as the GED program or other forms of remedial training, are less likely to be effective than improvements in early education. The returns to investment in early education are often estimated to be in the range of 17 to 20 percent (Carneiro and Heckman 2002, p. 23), which is higher than typical returns to the investment in physical capital. When training is provided later in life, however, returns to investment in noncognitive skills are likely to be higher.

Recent patterns of investment in education have produced growing investment in higher education and less in elementary education. The investments in basic skills are declining over time in the United States and there is increasingly a bimodal distribution to investments in human capital overall.[3] Once GED degrees are subtracted from the measure of annual high school graduation rates, the number of high school graduates is trending down over time. The United States is now producing a greater fraction of low-skill dropout youth than it was thirty years ago, even though these basic skills are also necessary for the less educated workforce to obtain the higher-wage, higher-performing jobs. Studies show that the demographic groups who have increased their educational levels in recent years in response to higher wage returns on education are the groups that are predominately white middle income. Youth coming from lower-income households have been responding more slowly to the wage returns on education, and thus the income gap between middle-income and low-income households is growing (Carneiro and Heckman 2002).

The Investment in Human Capital: Firms' Investment in Training

Firms have long invested fairly significantly in the training of their workforces. However, the use of innovative HRM practices emphasizes

two things: competency levels need to be higher than previously if production workers (or other less-educated workers) are expected to do greater amounts of problem solving, and workers need to have a broader range of general skills that includes basic skills (math, reading) and communications and interpersonal skills.

Overall, firms are unlikely to teach basic skills to their employees for several reasons. First, the majority of training is of an informal nature and thus would not produce basic skills training (Lowenstein and Spletzer 1999; Dearden, Reed, and Van Reenen 2000). Second, most of the training dollars go to better educated workers, those who are learning how to do specific jobs. Even among newly hired workers, most of the formal and informal training goes to those who are more highly educated (above high school). Thus, workers with more sophisticated tasks get more training, and these are workers who are already likely to have the necessary basic skills, such as math, reading, and verbal skills. Third, these basic skills are general skills that are not specific to the firm, and thus workers have every incentive to take their skills elsewhere to firms that will pay higher wages because they did not absorb the investment costs. When firms do train in skills that are valuable to other firms (and 70 percent of all firms believe that most of their training is in largely general skills; see Barron, Berger, and Black 1999, p. 282), the skills tend to be very specific to the occupation and not basic in nature.[4]

Overall, firms are unlikely to teach basic cognitive skills like math and reading, but they do provide some training of a general nature. They do provide training in specific problem-solving methods (like "6-sigma") and communications skills. But such training is only effective if the workforce already has the basic skills in math and reading and noncognitive motivational factors. Thus, the basic skills, which are likely to have the biggest returns in the labor market, must be taught in school. The evidence on hiring and screening patterns corroborates this conclusion: firms increasingly search for workers who have the basic skills, as described above. They do not hire less-skilled workers and then train them.

The Investment in Human Capital: Government Support for Investment in Training

Government programs to facilitate the development of skills through postsecondary school training are numerous. Beginning in the 1960s, the Job Corps and the Manpower Development and Training Act

provided training for disadvantaged youth and for technologically dislocated workers. By the 1970s and 1980s, there was a shift toward helping disadvantaged workers (Comprehensive Employment and Training Act of 1973) and of involving the private sector in training (Job Training Partnership Act of 1982 and then the Workplace Investment Act in 1998). At the same time, there have been mandatory training programs for welfare recipients (the Work Incentive Program of 1967 for job search, and the JOBS program of 1988 for training and job search). In 1996, the reform of the welfare system increased the emphasis on job training assistance. In sum, by 2002, the federal government spent about $6 billion a year on training programs (Council of Economic Advisers 2001).

States also invest fairly heavily in training, and often the training programs are aimed at working with specific employers or providing vouchers to employers. Total spending is over $600 million by forty-five states. Most of the training is for incumbent workers, currently employed, and thus the programs tend to be tailored for specific companies or occupations.

Are these training programs effective in raising the incomes of those who are trained? The evidence suggests that the programs are most effective when they are aimed at disadvantaged women or at dislocated workers (Carneiro and Heckman 2002, and Council of Economic Advisers 2001). It is much harder to reach disadvantaged youth, or men, with training or search techniques aimed at increasing their incomes.

These results on the limited effectiveness of training are consistent with two arguments made above. First, early education is more effective than later training: rates of return on early education are higher than rates of return on investment in training, and early education is much more likely to help disadvantaged males. Second, the HRM studies reach these same conclusions: those individuals who did not learn basic skills in school are hard to "retrain" later in life. Firms value the basic skills on which they can build—given basic skills, investments in specific skills (both formal and informal investment in new skills) are done within firms. If individuals do not learn these basic skills early in life, it is very costly to teach them later, and without the basic skills, firms cannot train. Thus, training programs are more likely to be successful for women, who may have the basic skills but have not participated in the labor market in the past, or for dislocated workers, who clearly do have the basic skills. Welfare-to-work policies and other

training programs are aimed today at working with firms to train new workers with the specific skills that are needed by those firms. These programs are most likely to be effective when the participants in the programs have basic skills (reading, writing, communicating, and motivation) on which to build new specific investments.

Note finally that the government is also indirectly influencing training through its tax or subsidy programs. Training is an expense that reduces pretax income for companies. Thus, in years in which firms have profits, investments in formal training are subsidized. However, the form of the subsidy for training differs from that of other investments by the firm, in physical capital or in R&D. Physical capital is not expensed but is depreciated over time, and R&D receives a tax credit (rather than a deduction). Thus, R&D expenditures reduce the firm's taxes dollar for dollar. As a result, in principle, investments in training relative to these other investments may well vary with the business cycle—rising in booms to take advantage of the tax reduction—and are less heavily subsidized. However, these indirect tax subsidies for training are likely to have little effect on training expenditures for three reasons. First, because investments are made from retained earnings (not by borrowing, as is true for capital expenditures), they tend to vary with the cycle without the tax effects. Second, the tax effects refer only to investments in formal training programs, which are likely to be considerably smaller than investments in informal training on the job. And investments in informal training may rise during recessions, when the opportunity cost of time for workers falls. Finally, when looking across firms, at which firms train and which don't, the differences in training are likely to arise from differences in the production function for firms rather than tax differences—some firms get much higher basic returns on training than others. Of course, because firms can expense the costs of training, there is an underlying subsidy in favor of training investments by firms as opposed to investments by individuals (such as full-time college education) that are not subsidized, except through loan programs.

The Investment in Human Resources: Valuing the Investment

The adoption of innovative HRM practices is described repeatedly above as an "investment" in response to the technology shocks—where the shocks of innovative HRM, IT shocks (or falling IT prices), and the increasing emphasis on quality induce greater investment in HRM. The

cost side is comprised of the costs of training, carefully screening workers, sharing information, initiating and maintaining a formal team structure, structuring compensation appropriately, and maintaining a degree of employment security. The returns come over the long run, through higher performance and higher profits.

Unlike the investments in physical capital or research and development, firms typically do not measure their investments in human resources. Most firms do not know how much they spend on training—on either formal or informal training programs. In annual reports, firms include their training expenditures as a hidden part of their selling, general, and administrative expenses. Only when training exceeds a "material" amount (generally 5 percent of revenues) is it reported as a separate line item, and few firms spend that much (Bassi, Lev, Low, McMurrer, and Siesfeld 2002). Firms are even less likely to measure the more intangible investments in other human resources practices. Last, they are least likely to assess whether these investments earn returns. When corporate managers are asked whether there would be significant benefits to having better information about their investments, 70 percent say that there would be, and they also say that financial investors would value that information (Bassi, Lev, Low, McMurrer, and Siesfeld 2002).

Valuation systems are increasingly proposed, but it is difficult to develop a measurement system that would be broad based and generalizable so that data can be compared across firms. There are many suggestions for such valuations, and some have been implemented. For example, the balanced scorecard is one method of valuing intangibles like human resources within firms and is widely adopted by many firms.[5] Lev and Radhakrishnan (2002) develop a concept of structural capital that represents the organizational capital—like technologies, managerial processes, and designs—that enables firms to profit from the investments in both tangible and intangible capital (like training). But again, it is difficult to measure. They impute it for each firm from sales and expenditure data and shows that, while it is correlated with stock market returns, there also appears to be room for improvements in stock market efficiency by providing more information on intangible capital.[6] Note, however, that another study has found that firms' investment in HRM practices are correlated with stock market returns (Lev 2001; Brynjolfsson, Hitt, and Yang 2002), showing that stock market investors are, of course, taking steps to impute value to firms when they make investments in intangible assets.

Overall, firms do not have the incentive to develop a systematic accounting framework for valuing intangible capital, nor do they have the incentive to share their own information with others. Firms do have some incentive to invest in the measurement of intangibles—to allocate internal resources and to signal value to investors—but the full returns from developing systematic (across firm) reporting methods do not accrue to individual firms. Thus, the government sector must consider a role in the development and disclosure of such an information structure.

IX. Conclusion

There is now an increasingly large body of empirical research, based on data from firms or within plants, that reaches the conclusion that investments in innovative HRM practices raise workers' performance levels. These practices—such as teamwork, information sharing, training, careful screening and hiring, job rotation, employment security, and incentive pay—are often adopted jointly by firms to form complementary systems of HRM practices that enhance performance. These systems of innovative practices seem to be aimed at building the development and use of the problem-solving capacity of the workforce.

Given this microeconomic evidence, two questions remain. Which firms gain the most from investments in HRM practices? And have these practices contributed overall to the productivity gains for the macroeconomy in recent years? The empirical evidence suggests that the firms that gain the most from innovative HRM practices are either those that produce high-quality or highly complex products or firms that are also making investments in new information technologies. Firms in both environments are likely to benefit from the greater problem-solving skills and incentives that innovative HRM practices generate.

There is some indirect evidence to suggest that innovative HRM practices may well be contributing to the recent productivity gains of the economy overall. Of course, the conclusion that many firms gain, based on micro evidence, suggests that the macroeconomy gains as well. There is also indirect evidence of macroeconomic gains. Over the last twenty-five years, the distribution of wages has become more skewed—the number of people in the bottom of the wage distribution has grown, and the number in the top has grown. Most important for the analysis of HRM effectiveness, the wage distribution has become more unequal even within very narrowly defined industries and

occupations (Autor, Katz, and Krueger 1998). Thus, even among workers with homogeneous measured skills, such as blue-collar workers with high school degrees within detailed manufacturing industries, the variance of wages has increased. What could account for this increasing variance? A portion of it is due to changes in institutions—the decline of unions and the minimum wage—which caused the greatest increase in inequality in the 1980s (Card and DiNardo 2002). However, the unexplained increase in the variance over the entire 1980–1999 period may well represent rising returns from intangible skills, such as problem solving, communications, or motivation (see Autor, Levy, and Murname 2003, for evidence supporting this view). These intangible skills are supported or developed through the use of innovative HRM practices within firms. Thus, the higher wages paid to attract and retain workers with these intangible skills are likely to reflect the higher performance gains achieved by employing highly skilled workers and managing them with innovative HRM practices. These workers, and supporting HRM practices, enable firms to achieve a competitive advantage through information technologies and a focus on innovative high-quality products and processes.

Two sets of potential government policies support the sustained use of innovative HRM practices as a productivity driver. First, the investment in basic education—in reading, math, and problem solving at the elementary and secondary level—is a public good that earns long-run returns in the United States and enables firms to utilize innovative HRM practices that require these basic skills. Second, firms and markets are now placing greater value on the returns from firm-level investments in intangibles, such as innovative HRM practices, and there is certainly room for improvement in the accounting standards for valuing these investments.

Notes

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1. For more on the assignment of responsibility within firms, see Prendergast (1995) and Rosen (1982).

2. Of course, computer use alone could have caused the increases in the demand for other skills if computer users must undertake more skilled tasks.

3. Murnane and Levy (1995) make a strong case for the investment in basic skills that emphasize problem solving. See also Levine (1998).

4. For reviews of the training practices of firms, see Leuven and Oosterbeek (1999); Finegold and Mason (1999); Lowenstein and Spletzer (1999); Barron, Berger, and Black (1999); Bishop (1997); and Dearden, Reed, and Van Reenen (2000).

5. Kaplan and Norton (1996) and Huselid and Barnes (2002) emphasize its use in HRM applications.

6. See also Hall (2000), Nakamura (2000), Lev (2001), and FASB (2000) for suggestions for voluntary disclosures.

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