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**Article**

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<sup>11</sup> R. Kaestner, S. Korenman, and J. O'Neill, "Has Welfare Reform Changed Teenage Behaviors?" NBER Working Paper No. 8932, May 2002, published in *Journal of Policy Analysis and Management*, Spring 2003, 22(2): pp. 225–48.

<sup>12</sup> R. Kaestner and N. Kaushal, "The Effect of Welfare Reform on Health

*Insurance Coverage of Low-income Women and Children.*" NBER Working Paper No. 10033, October 2003, published in *Journal of Health Economics*, November 2003, 22(6): pp. 959–81.

<sup>13</sup> R. Kaestner and W. Lee, "The Effect of Welfare Reform on Prenatal Care and Birth Weight," NBER Working Paper No. 9769, June 2003, published in *Health*

*Economics*, 2005, 14(5): pp. 497–511.

<sup>14</sup> R. Kaestner and E. Tarlov, "Changes in the Welfare Caseload and Health of Low-educated Mothers," NBER Working Paper No. 10034, October 2003, published in *Journal of Policy Analysis and Management*, Summer 2006, 25(3): pp. 623–44.

## Insider Econometrics: Modeling Management Practices and Productivity

Kathryn L. Shaw\*

Which management practices raise the productivity of workers within firms and by how much? Why does this occur, and what types of firms benefit the most from adopting new management practices? While this line of research tests microeconomic models, the results are of interest to policymakers who wish to model economic growth, and to managers who seek evidence to support or refute their views.

### Labor Management Innovations are Ongoing

Over time, firms have changed the ways they manage people. Firms are using more incentive pay or rewards, teamwork, training, careful hiring, flexible job assignment, information sharing, and greater delegation of authority to lower levels within the firm. Figure 1 shows the increased use of teamwork, training, and incentive pay within a longitudinal sample of firms in the U.S. and U.K. valve-making industry. Among these small manufacturing firms, work-

ers now do more problem-solving in teams, they are more highly trained, and their performance-based pay replaces hourly pay. These trends seem to prevail across the U.S. economy.<sup>1</sup> According to Lemieux, MacLeod, and Parent (2008), from 1976 to 1998 the percent of workers who were classified as "working in

performance pay jobs" grew from 33 percent to 40 percent.<sup>2</sup>

While there is only limited time-series data that measure management innovations into the current decade, it appears that significant people management innovations are ongoing. Case study examples provide extensive and impressive evi-

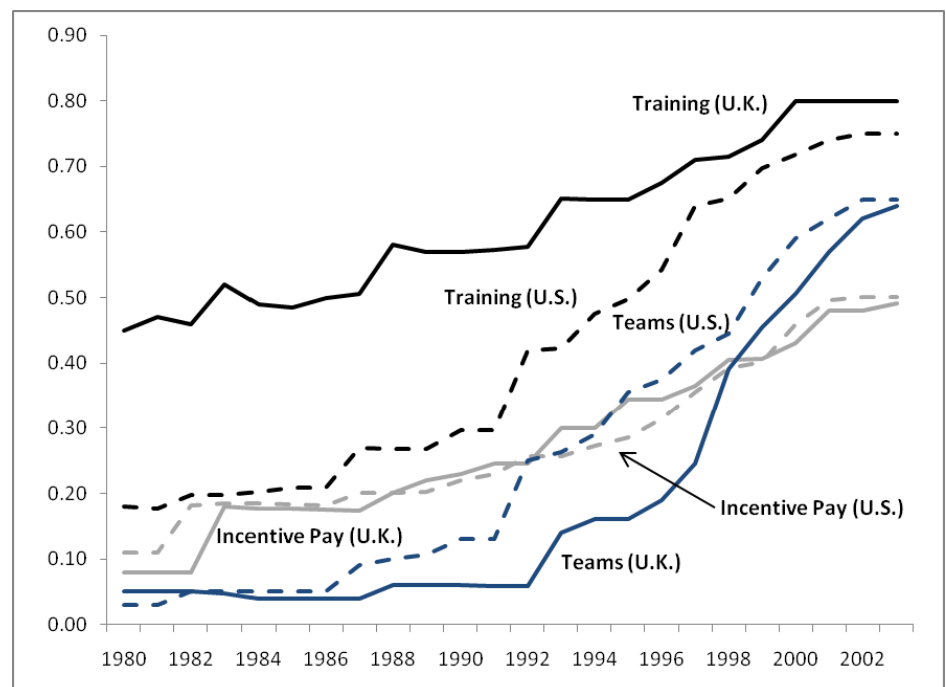


Figure 1. Management Practices Trends (U.K. and U.S.)  
(Proportion of Valve-Making Plants with Practices)

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dence that firms continue to invest in new human resource (HR) management practices, and that many of these practices are combined with information technology innovations.<sup>3</sup>

## Recent International Research on Management Practices

Over the last six years, the Alfred P. Sloan Foundation has sponsored an NBER project that delves deeply inside firms to examine the adoption and impact of innovative management practices, both within and across U.S. and European firms. Three NBER books summarize the result of this project.<sup>4</sup>

In Freeman and Shaw (2009), the authors of the seven studies of multinationals conclude that even when multinational firms make similar products in similar plants across countries, any differences in capital or in the quality of their managers will result in different productivity levels across plants. There are country-specific differences in the rules and regulations of labor practices, but they have only modest effects on workers' productivity relative to the other sources of productivity differences. Across all countries, there is evidence that "new" HR practices are being adopted widely by firms. Also, when firms put in new practices, such as incentive pay, their workers respond in comparable ways across countries.

In Lazear and Shaw (2009), eleven teams of researchers from Europe and the United States examine the distributions of wages within and across firms, revealing international differences and similarities in the structure of wages.

## Insider Econometrics is Used to Model the Impact of Management Practices on Performance

Researchers increasingly are using "insider econometrics" — that is, combining insights from "insiders" within firms and econometric modeling with microeconomic data — to estimate the impact of management practices on productivity, or to estimate why some firms adopt

practices while others do not. The micro data describe the productivity of people, teams, and various units within firms (such as stores); increasingly, that data is available to economists, but not all of it lends itself to insider econometric analysis. What should researchers aim for in conducting such insider studies?

One set of key features of insider econometric research is described in Ichniowski and Shaw (2009).<sup>5</sup> In particular, the researcher must find a treatment — that is, a management practice that has either changed within the firm or changed across very similar firms. Researchers must then model why the management practice is effective, and why some firms or workers benefit more than others. The researcher also will aim to model fundamental economic behavior, so that the results of an insider study can be generalized to other firms or industries. And, the micro data gathered should balance homogeneity and heterogeneity. That is, the more homogeneous the units — such as the people or the stores — the more persuasively the researcher can argue about modeling the production function. Yet there must be heterogeneity, or variance, in the HR practice across people or stores, to enable an estimate of the effect of the HR practice on productivity.

## How much do HR practices raise productivity, and why?

New HR management practices, like incentive pay, have the potential to substantially raise productivity. Consider the evidence from several insider studies; many more are reviewed in Ichniowski and Shaw (2009).<sup>6</sup> Using data from integrated steel mills, we find that productivity rises by 10 percent when incentive pay and a set of complementary HR practices are introduced. Using data on workers installing windshield in cars, Lazear (2000) shows that productivity increases by 44 percent when piece-rate pay is introduced. Using data on workers picking fruit, Bandiera, Barankay, and Rasul (2005) show that productivity rises by 58 percent when piece-rate pay is introduced.

These studies, and other similar insider studies, show not just how much productivity rises because of management innovations, but also *why* productivity rises. The reason for the change in productivity is often more important than the size of the gain. Consider the integrated steel industry: Figures 2 and 3 display the communications patterns among workers in that industry.<sup>7</sup> The steel mills with systems of innovative management practices (like teamwork and incentive pay) had workers who communicated daily with each other to solve problems (Figure 2).

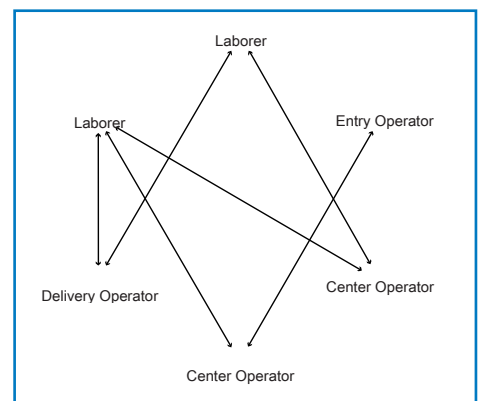


Figure 2. Communications problem-solving network for steel mills with innovative management practices.

The steel mills that had none of these innovative practices had little communication among their operators (Figure 3).

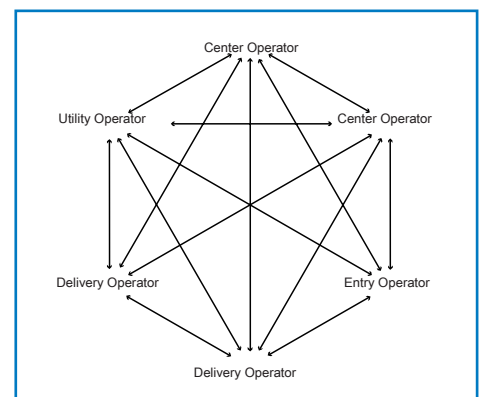


Figure 3. Communications problem-solving network for steel mills with traditional management practices.

While steel is not a big segment of our economy, the communications networks portrayed in these figures are likely repre-

sentative of the variety of social networks in many different types of firms. Firms don't just invest in the human capital of individual employees but also in the "connective capital" in which employees form communication links that support their problem-solving activities and teamwork.<sup>8</sup>

These studies identify three basic reasons why productivity rises. First, management practices induce workers to work harder or smarter. Incentive pay raises effort. Problem-solving through teamwork raises the quality and quantity of the output. Second, the firm's adoption of a management practice, like incentive pay, induces optimal sorting. Firms and workers are matched: the firms that have the biggest gains to incentive pay, in their production environment, will develop incentive pay plans that attract the workers who are most productive. Third, the firm can package together different HR practices to form a complementary systems of HR practices that together raise productivity. Adopting incentive pay is more effective when the firm also adds more on-the-job training or team problem solving.

## Modeling "HR Technology Shocks"

If human resource management practices can raise performance, why haven't all firms found their optimal practices? It seems that there are three sources of disequilibrium. First, there are time-series "HR technology shocks" to optimal best practices. Knowledge of how to use HR practices evolves and improves over time.<sup>9</sup> Thirty years ago, hourly pay or promotions based on seniority were common HR practices; today, variable pay and promotions based on performance are increasingly standard practices. Second, there are cross-sectional shocks that cause firms to adjust their HR practices. Firms enter the market with new products or processes that cause existing firms to change product market strategies or processes. Third, firms may decide to experiment with new HR practices, because some have

not yet found their optimal practices, or because their internal conditions are changing.

## Which firms adopt innovative management practices?

If HR practices can significantly improve productivity, why do some firms adopt incentive pay while others do not? The firm's choice of its optimal HR practices depends on its choice of product market strategy. Therefore, optimal HR practices vary across firms, because of differences in firms' product markets, production processes, and labor markets. Consider the airline industry: Southwest Airlines offers low-cost service on short flights and uses team-based HR practices with high levels of incentive pay. United offers premium services and uses HR practices to complement those high-level services. There are common trends in the "best practices" in the industry—both of these airlines now pay for performance—but the set of HR practices that support Southwest Airlines are different from those that support United.

Because HR practices depend on the firm's product market strategy or production process, researchers must look within industries to understand the optimal use of HR practices and the productivity gains. We have considered in some depth, for example, the software industry (Andersson, Freedman, Haltiwanger, Lane and Shaw, 2008).<sup>10</sup> In most software companies, the employees are working on new-product innovations. But software companies differ markedly. In firms that produce products like video games, there are huge potential upside gains to producing a new big-selling game. In companies that produce software for large firms, like mainframe software, the potential upside gains are small. Software firms' HR practices reflect their product market strategy. The video game firms with the high potential upside gains use higher levels of pay and higher incentive pay to all employees, whether the firm actually succeeds or not.

Another example from within the valve-making industry, which I discussed

earlier, shows that investments in management practices follow strategy. Figure 1 displayed the HR practices within this industry. Using data on 212 firms within the industry, Bartel, Ichniowski and Shaw (2007) show that new information technologies have raised productivity. However, new information technology (IT) is adopted most often by the firms that produce customized products, instead of commodities. And, when new IT is adopted, new HR practices are also more likely to be adopted.

In these cases, best practices for people management indeed have changed over time. However, but there remains tremendous variance in the adoption of practices across firms as product market strategy determines optimal practices. Insider econometric analysis models this variation in adoption across firms, uncovering results that would not be possible using aggregate industry-level or aggregate firm-level data.

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<sup>1</sup> E. P. Lazear and K.L. Shaw "Personnel Economics: The Economist's View of Human Resources," NBER Working Paper No. 13653, November 2007, and *Journal of Economic Perspectives*, 21 (4), (Fall 2007), pp. 91–114; K. L. Shaw, "The Human Resources Revolution: Is it a Productivity Driver?" in *Innovation Policy and the Economy*, A. Jaffe, J. Lerner, and S. Stern, eds. Chicago, IL: University of Chicago Press for NBER, 2003, pp. 69–114.

<sup>2</sup> K. L. Shaw, "People Management Practices and Productivity," Briefing for the Federal Reserve Board, forthcoming as an NBER Working Paper.

<sup>3</sup> The Analysis of Firms and Employees: Quantitative and Qualitative Approaches, S. Bender, J. Lane, K. L. Shaw, F. Andersson, and T. Von Wachter, eds., Chicago, IL: University of Chicago Press for NBER, 2008. The Structure of Wages: An International Comparison, E.P. Lazear and K. L. Shaw, eds., Chicago, IL: University of Chicago Press for NBER, 2009. (This book was listed as one of the Noteworthy Books in *Industrial Relations and Labor Economics* for

2009, by the Industrial Relations Section, Princeton University.) International Differences in the Business Practices and Productivity of Firms, R.B. Freeman and K.L. Shaw, eds., Chicago, IL: University of Chicago Press for NBER, 2009.

<sup>4</sup> C. Ichniowski and K.L. Shaw, "Insider Econometrics: A Roadmap for Estimating Empirical Models of Organizational Design and Performance," forthcoming as an NBER Working Paper.

<sup>5</sup> The three studies are: C. Ichniowski, K.L. Shaw and G. Prennushi, "The Effects of Human Resource Management Practices on Productivity," NBER Working Paper No. 5333, and American Economic Review, 86 (June 1997), pp. 291–313; E.P.Lazear, "Performance Pay and Productivity," American Economic

Review, 90 (5) (2000), pp.1346–61; and O. Bandiera, I. Barankay, and I. Rasul, "Social Preferences and the Response to Incentives: Evidence from Personnel Data," Quarterly Journal of Economics, 120 (3) (2005), pp. 917–62.

<sup>6</sup> J. Gant, C. Ichniowski, and K. L. Shaw, "Social Capital and Organizational Change in High-Involvement and Traditional Work Organizations," Journal of Economics and Management Strategy, 11 (2) (Summer 2002), pp. 289–328.

<sup>7</sup> N. Bloom and J. Van Reenen, "Measuring and Explaining Management Practices Across Firms and Countries," NBER Working Paper No. 12216, May 2006, and Quarterly Journal of Economics, 122 (4) (November 2007), pp. 1351–1408.

<sup>8</sup> C. Ichniowski, and K.L. Shaw, "Connective Capital: Building Problem-Solving Networks within Firms," forthcoming as an NBER Working Paper.

<sup>9</sup> Bloom and Van Reenen (2007) strikingly make this point — that best practices have evolved over time in manufacturing — for the U.S. and Europe, and for the rest of the world. See Shaw (2003) and Lazear and Shaw (2007) for a discussion of HR technology shocks.

<sup>10</sup> F. Andersson, M. Freedman, J.C. Haltiwanger, J.Lane, and K.L. Shaw, "Reaching for the Stars: Who pays for Talent in Innovative Industries?" NBER Working Paper No.12435, August 2006, and Economic Journal, Royal Economic Society, 119, (538) (2006), pp. F308–F332.

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## NBER Profile: Mark Aguiar

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Mark Aguiar is a Research Associate in the NBER's Program on Economic Fluctuations and Growth and the Program on International Finance and Macroeconomics. He is also a professor of economics at the University of Rochester.

Aguiar received his Ph.D. in economics from MIT in 1999. He began his academic career at the University of Chicago's Graduate School of Business before moving to the Federal Reserve Bank of Boston in 2004 and then to the University of Rochester in 2006.

Aguiar's research addresses issues in open- and closed-economy macroeconomics. He has studied emerging mar-

ket business cycles, sovereign debt, the political economy of capital taxation, and growth. His recent research considers the implications of "sovereign debt overhang" for volatility and growth in developing economies.

Aguiar has also investigated life-cycle consumption, time allocation, and trends in labor supply. He is currently exploring recent trends in consumption and leisure inequality.

Aguiar is an associate editor at the *Review of Economic Dynamics* and is on the board of editors of the *AEJ: Macroeconomics*. He lives in Pittsford, NY with his wife, two daughters, and his dog.