NBER WORKING PAPER SERIES

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Working Paper 12878
http://www.nber.org/papers/w12878

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 2007

This study was funded by a grant from the National Science Foundation. The authors want to thank Heidi Aggeler, Carrie Conaway, Hwikwon Ham, John Hauge, and Keith Vargo for their assistance with the study. We also thank Lisa Lynch and Kathryn Shaw, and the participants at the Personnel Economics Workshop at the NBER Summer Institute for their comments and suggestions. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 12878
January 2007
JEL No. J0,J53

ABSTRACT

This study uses a 10-year longitudinal database on U.S. manufacturing establishments to analyze the dynamics of the adoption and termination of employee involvement programs (EI). We show that firms' use of EI has not grown continuously, but rather introduce and terminate EI policies in ways that imply that the policies are complementary with each other and with other advanced human resource practices, seemingly moving toward an equilibrium distribution of EI policies. Using a Markov model, we estimate the long-run distribution of the number of EI programs in firms and find that adjustment to the steady-state distribution takes about 20 years.

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Employee involvement (EI) programs—the diverse set of personnel and human resource (HR) practices that increase workers' authority at workplaces and in business decision making, such as total quality management, self-directed work teams, and workplace committees—are among the most widely discussed innovations in US business. Impressed by these programs, the federal government's Commission on the Future of Worker-Management Relations recommended in its 1994 report that the government encourage EI programs to improve the quality of work life and productivity.[1]

Most analyses of EI focus both on the factors that lead firms to adopt EI policies and on the impact of EI on outcomes. Adoption of EI is more likely in competitive product markets, among firms that: respond to the market quickly and flexibly; use new technologies that require highly skilled workers; have business strategies that emphasize quality and innovation rather than low cost; and adopt complementary HR practices, such as high levels of training and incentive compensation plans.[2] Studies of the effect of EI on economic outcomes find that EI promotes higher productivity, improves quality, raises customer satisfaction and sales,[3] and reduces quits and improves worker satisfaction.[4,5] But studies also show that EI is not a universal solution to the problems faced by a firm. Some studies find that EI has modest impacts on outcomes that may not justify the cost of implementing these programs.[6] Other studies emphasize the intermediating effect of

[1] Commission on the Future of Worker-Management Relations, 1993–1994.
[2] Osterman, 1994, 2000; Arthur, 1992; Ichniowski and Shaw, 1995; Pil and MacDuffie, 1996; Dunlop and Weil, 1996; Gittleman, Horrigan, and Joyce, 1998.
[3] Arthur, 1994; Ichniowski and Shaw, 1997; MacDuffie, 1995; Huselid, 1995; Banker et al., 1996; Berg et al., 1996; Dunlop and Weil 1996; Batt, 2002; Batt, Colvin, and Keefe, 2002; Bartel, 2004; Black and Lynch, 2004a, 2005; Wood, Holman, and Stride, 2006.
[4] Freeman and Kleiner, 2000; Hunter, MacDuffie, and Doucet, 2002; Freeman and Rogers, 1999. Black and Lynch (2004b) find that EI raises wage inequality within a company and lowers employment.
[5] A survey of recent studies on EI and economic performance is contained in Godard (2004).
[6] Freeman and Kleiner, 2000; Cappelli and Neumark, 2001; Guest et al., 2003; Godard, 2001. Addison and Belfield (2001) also posit that the findings of the effect of high-performance work practices depend on the specific survey data used.

business strategy, other business characteristics, and market factors on the relationship between EI and financial performance.[7,8]

Although EI programs have been increasing, these policies are not universally successful, leading some firms to terminate their programs. The failure rate for quality of work life and quality circles has been high.[9] Eaton (1994) estimates a 20 percent failure rate for employee involvement practices in union establishments, while Kleiner, Leonard, and Pilarski (2002) provide case evidence of firms abandoning poorly performing EI programs. Black and Lynch (2004a, 2004b) document that a substantial number of firms dropped or lowered the percentage of employees participating in job rotation, profit sharing, or self-managed teams between 1993 and 1996.

This paper uses the results of detailed on-site interviews of managers in 51 manufacturing establishments on the history of their EI and related policies to examine the decision to adopt and terminate EI programs. We sampled establishments in the Midwest area, close to the University of Minnesota where the survey team was assembled, drawing the sample from the US Census Bureau's Census of Manufacturers. The 51 establishments agreed to participate in the survey and allow researchers to visit the plant and conduct interviews. From 1995 through 1997, the survey team interviewed managers, workers, and union representatives at the plants and collected documents about business environment, technology, and production of the plants. The team visited each plant several times to verify the facts and learn more about the way the EI programs operated. The result is a data set with more accurate longitudinal information than could be gained

[7] Huselid, 1995; Youndt et al., 1996; Robinson and Wilson, 2006; Godard, 2001; Pérotin and Robinson (2000).

[8] Addison et al. (2000, 2004) reviewed studies of the impact of the German works council, a particular kind of EI, on companies' performance, positing that the effect of works councils is sensitive to firm size. A significantly positive association between works councils and economic performance is observed only for large firms, whereas an insignificantly positive or negative one is found for small plants.

through large-scale surveys conducted via phone or mail. This is critical to our research design, which focuses on the timing of the introduction and termination of particular EI programs and policies in the covered establishments.

The survey asked about the plants' employee involvement policies, recruiting and selection, training, performance evaluation, and financial participation practices, and about business strategy and management style. Managers were asked whether the plant had adopted a certain program since 1986, and if yes, in which year; whether the program was still in use, and if not, the year the establishment terminated the program. The employee involvement practices covered were job rotation, suggestion system, quality of work life, quality circles, total quality management, self-managed work teams, job redesign, joint labor-management committees, and employee representation on the board of directors. In addition, the survey asked about *selection and staffing* policies—whether the company had a detailed screening process, personal interview, aptitude test, physical exam, reference check, and probationary period; *training*—whether the company offered on-the-job training, training in team building, on-site training, and tuition reimbursement; *performance appraisal* policies—whether the company used assessment centers, formal review sessions, and a standardized form to evaluate their employees periodically; and *financial participation programs*—whether the company had an individual incentive plan, employee stock ownership, cash or deferred profit sharing, gain sharing, skill-based pay, employee stock purchase plan, and group bonuses.

The survey team also asked managers about business strategies and management policies. It identified four categories of business strategy: growth of the market share of the firm, seeking to obtain a market niche, short-term profit maximization, and maximizing shareholder value of the firm. It asked the manager to rate the

[9] Goodman, 1980; Rankin, 1986; Drago, 1988; Eaton, 1994.

establishment's emphasis on these strategies on a 1 to 5 scale with 1 indicating "a little" and 5 being "a great deal." Managers were also asked whether the plant had undergone major restructuring since 1986 and, if yes, in which year, how many times; and whether the firm had changed the plant manager/production leader since 1986, and to rate each manager's style on a 1 to 5 scale with 1 representing "close monitoring" and 5 representing "gives employee autonomy." The basic information on the plants included the year the plant was built, whether the company had union representation, and the average yearly turnover rate. Slightly over half of the sample (27 of the 51 establishments) was unionized.

Trends in EI Use

Table 1 shows the proportion of firms with different numbers of EI programs in place in each year from 1986, the first year covered by the survey, to 1995. Consistent with the national increase in EI over the period, the number of EI policies in place increased from 124 in 1986 to 204 in 1995—a 65 percent change, while the percentage of establishments with at least one EI program rose from 76.5 percent in 1986 to 96.1 percent in 1995; and the number of companies using two or more programs grew from 55 percent (1986) to 90 percent (1995), while the proportion with just one program fell from 21.6 percent to 3.9 percent.

To see which programs are the most/least frequently adopted, table 2 displays the number of establishments adopting or terminating a program in a given year and gives the total number of adoptions and terminations and the number of establishments with a program in 1995. It shows that in 1995 job rotation was the most frequently used EI policy, with over 75 percent of plants in the sample adopting it. The second most popular program is a joint labor-management committee, followed by suggestion system and total quality management (TQM). Forty-eight percent of companies in the sample had adopted

TQM by 1995—just slightly higher than the 42 percent reported by Black and Lynch (2004a) based on national survey data for 1994. Worker participation on corporate boards is the least used policy among those in our analysis. At the beginning of the period, only two companies had adopted the policy of having employees on the boards of the company. In the 10-year period, one company adopted the program, but another company abandoned the policy.

Looking at the pattern of change in the introduction and termination of EI programs by year, table 2 shows relatively large numbers of terminations of programs in 1988 and 1991 when the economy was weak. This suggests greater terminations in business cycle downturns, possibly due to efforts to cut costs. The most frequently terminated programs were quality circles and TQM, suggesting that these two programs may be less effective than other policies.

Investing in EI

What leads firms to adopt or terminate EI?

Viewing the decision regarding EI as an investment designed to raise productivity or lower costs, firms will invest in EI whenever the *expected* return from a program exceeds the fixed (organizational) cost of the initial investment and the variable cost of operating the EI program. The decision to terminate a program will depend on the variable cost of operating it and the *actual* returns (taken as the best indicator of future returns). This implies an asymmetry in the effect of factors on the likelihood of adoption and termination of the program. Since the adoption decision depends on fixed as well as variable costs, it will take a larger return to induce a firm to introduce a program than to terminate it. This should produce smaller estimated impacts of a factor on decisions to introduce rather than terminate programs.

Our interviews with plant managers, first-line supervisors and production workers, along with the results of previous research, suggest that the following factors should influence the decision to introduce an EI program: the extent to which the program complements other EI programs and HR practices; the firms' business strategy; and unionization and other factors such as age of the plant and restructuring that will affect the transactions cost of introduction or termination.

Complementary Programs

Many analyses of EI indicate that a complementary bundle of practices generates greater performance than a single program.[10] Complementarity implies that more firms should have a larger number of EI practices than if they selected programs independently. To test this, we modeled the selection of EI programs on the assumption that each firm selected policies randomly from an urn that contained the actual distribution of policies in a given year, and did so without replacement. For example, in 1995 there were 204 EI policies out of a possible 459 (the 51 firms could have selected 9 EI policies each), so the hypothetical urn had 204 balls with "EI policy" on it and 255 balls with "no policy." The assumption that firms select policies from the urn without replacement yields a hypergeometric distribution[11] as the appropriate null hypothesis to complementarity. Assuming that each firm reached into an urn and selected either an EI policy or no policy, the variance of the number of firms with different numbers of programs would be 2.20.[12] The actual variance in 1995 was 4.27—twice as great. Alternative statistical models give

[10] Ichniowski and Shaw, 1995, 1997; Delery and Doty, 1996; Pérotin and Robinson, 2000.
[11] http://en.wikipedia.org/wiki/Hypergeometric_distribution.
[12] The mean number of programs is 4; The probability of getting a program from the urn P is 0.466. The variance for the hypergeometric distribution is the variance from the binomial $9(P)(1-P)$, or 2.24 times the finite correction, $(N-n) / (N-1)$, where N is the total sample size (459) and n is the number of draws by a firm (9), to obtain the variance of 2.20.

similar results.[13] Figure 1 compares the hypergeometric distribution with the actual distribution of firms by the number of policies they have in 1995. The actual distribution shows more firms with 0–2 policies than the hypergeometric distribution predicts and more firms with 8 or 9 policies. This rejects the null hypothesis that the policies are independent draws and is consistent with the notion that they are complementary.

Looking back at table 1, we note that the proportion of firms with just one practice falls over time, while the numbers with 2–5 practices grow over time. This suggests further that firms learn about complementarities over time, so that the distribution changes in the direction of adopting programs that fit together into a package.

Analyses also suggest that EI is complementary with other advanced HRM practices. Firms that have extensive training and incentive pay programs are more likely to adopt EI.[14] To see whether this is true in our data, we counted the number of advanced practices exclusive of EI programs that each firm had in 1995 and compared the number of EI practices across firms with different numbers of non-EI programs. Appendix table A gives the cross-tabulation matrix of numbers of HR practices at an establishment and the number of EI practices at an establishment in 1995. The final column in the table gives the average number of EI programs for each of six categories of other HR programs. In the three categories with the most observations, establishments with 14–16 non-EI HRM practices average 5.6 EI programs, those with 12–14 average 4.5 programs; those with 10–12 average 3.2. In the three categories with relatively few observations, the pattern is less clear, as one of the two establishments with just 4–6 other HR programs in 1995 has eight EI programs, giving an average of five for that group. But overall, the

[13] For example, we could model the process as a multinomial distribution in which a firm selects a ball labeled policy or no policy from a set of nine urns. This null would fit not only the total number of EI policies but also the number within each category. We use the hypergeometric distribution because it is consistent with our ensuing Markov chain analysis.

[14] Osterman, 1994; Pil and MacDuffie, 1996; Whitfield, 2000; Gittleman, Horrigan, and Joyce, 1998.

correlation coefficient between numbers of other HR programs in 1995 and numbers of EI programs in 1995 is 0.29, which is statistically significant at the 5 percent level.

Business Strategy

Companies emphasizing service, quality, variety, and employee commitment are more likely to adopt EI than those focusing on low costs (Arthur, 1992; Osterman, 1994). Similarly, companies that shift from a low-cost policy to emphasizing service and quality tend to adopt EI, while those that shift from service and quality to competing on low costs are more likely to terminate these policies (Youndt et al., 1996).

In our survey, the business strategy of short-term profit maximization is the closest to the low-cost strategy and should thus reduce the probability that a firm will adopt an EI program. On the other side, companies that reported that their strategy was growth of market share could be expected to adopt EI programs to the extent that employees' commitment and innovation helps attract potential new customers. Companies focusing on a niche market have loyal customers and face less cost pressure, and thus may not need to cut programs to save costs. But they may be less likely to adopt EI because their emphasis is on task specialization and greater output. Whether companies that pursue shareholder-value maximization are more or less likely to terminate EI depends on whether these interests are best served by the programs.

Transactions Cost: Unions, Age of Firm, and Restructuring

Unionization is often associated with low EI use. Since EI programs reduce workers' desire for unions (Freeman and Rogers, 1999), firms with such programs are more likely to remain nonunion than other firms. In unionized establishments, unions may see EI as a substitute for their function in the organization and may pressure companies from adopting EI practices. This occurs despite the fact that properly implemented EI programs can increase the voice of employees and give the union greater

say in the day-to-day operation of the firm. Under these conditions, unions may support EI policies (Eaton, 1994) and reduce the chance that a firm terminates a program.

Two other factors are likely to impact the transactions cost of introducing or terminating EI programs. New plants have an advantage in adopting EI because they face less transition costs and resistance from employees than plants that have existed for a long time (Ichniowski and Shaw, 1995). For older plants, a major restructuring is like resetting the age clock of the plant. During restructuring, old organizational routine, structure, and culture undergo dramatic changes. If firms introduce EI at this time, they deal with the transition cost and resistance all at once (Kleiner, Leonard, and Pilarski, 2002). Moreover, if EI is introduced after a recent restructuring, both organizational structure and culture change to fit with EI. As a consequence, EI implementation may encounter less resistance, and the performance effect of EI may be greater.

Plant size, technology, and product market conditions also may affect the adoption decision. Large firms are more able to afford the costs of implementing EI than small firms since this is a fixed cost that can be spread over a large number of workers. However, size may not affect termination because if both large and small firms have invested in EI, the investment cost is a sunk cost and should not affect the firm's decision to end the program. The introduction of new technology and the increased market competition both drive companies to adopt EI. Many of the interviewed companies cited increased competition and new technology as the reasons why the companies adopted EI.

The precise definition and descriptive statistics of the explanatory variables are reported in appendix table B.

Analyzing EI

Many studies measure the intensity of a firm's EI program with a composite index of EI calculated by forming a summated rating of specific EI programs (Ichniowski and

Shaw, 1995; Pil and MacDuffie, 1996), valuing each program the same. As an alternative to this procedure, we used the latent variable Rasch model from educational testing to form an index of employee involvement. In educational testing a Rasch model weighs more heavily a correct answer on a problem where few students answer than a correct answer on a problem that many students get right, rather than a simple count of the correct answers. Analogously, our Rasch index gives greater weight to policies that are relatively rare in forming an index of the establishment's intensity of EI.

Formally, the model posits the probability that a plant with a certain program is a function of plant and EI policy characteristics:

$$P(X_{ij} = 1) = \Phi(\theta_i, \gamma_j)\text{, } i\text{, establishment, } j\text{, EI practice,} \qquad (1)$$

where θ denotes the index of employee involvement in an establishment, and γ indicates the rarity of the particular EI program. The probability that an establishment had a certain EI policy depends on an establishment's degree of EI use (θ) and the difficulty level of an EI program (γ). The function Φ is specified to have a logistic form, giving equation (2):

$$P(X_{ij} = 1) = \frac{\exp(\theta_i - \gamma_j)}{1 - \exp(\theta_i - \gamma_j)}\text{, } i\text{, establishment, } j\text{, EI practice.} \qquad (2)$$

We use maximum likelihood estimation to estimate the establishment parameter (θ) and the EI policy parameter (γ).[15] The estimates of θ is our measure of EI use in plants. Its value ranges from –1 to 1. While conceptually preferable to a simple count of the number of EI programs that an establishment has, the Rasch measure is highly correlated with a summated rating count variable (r = 0.98).

[15] We use the Quest computer software package to estimate the Rasch measure of EI systems for each establishment, indicating the difficulty level of each EI practice in each year.

Econometric Analysis

Taking the Rasch estimates as the appropriate measure of EI intensity, we first estimated the determinants of the level of EI use in plants, by pooling observations for all establishments and years. Column 1 of table 3 records the results of regressing the Rasch measure of EI on a diverse set of explanatory factors. The estimated coefficient on union representation is large negative, consistent with the notion that nonunion firms are more likely to introduce EI programs than union firms. Older and larger plants are also less likely to have an extensive EI program. On the other hand, companies with other HR programs, such as training, selection, performance appraisal, and the group-level incentive pay, had a higher level of EI use than companies without these programs. This is evidence that EI programs are complementary with these programs. Consistent with its business strategy, managements that emphasized giving employees autonomy made greater use of EI programs than managements that emphasized other strategies. Finally, establishments that recently experienced restructuring had a lower level of EI use, whereas durable manufacturing establishments made greater use of EI.

Columns 2 and 3 in table 3 turn the extent of EI to the dynamics of adopting or terminating EI programs in a given year. The dependent variable in column 2 is a 0/1 variable that measures whether or not the firm added at least one EI program between year *t* and year *t*+1. The dependent variable in column 3 is a 0/1 variable that measures whether or not the firm dropped at least one EI program between year *t* and year *t*+1. To assess how explanatory factors affected these decisions, we estimated the following equations:

$$A_{it} = X_{it-1}\beta + X_{ij}\delta + \alpha_i + \gamma_t + \varepsilon_{it}, \qquad (3)$$

$$T_{it} = X_{it-1}\beta + X_{ij}\delta + \alpha_i + \gamma_t + \varepsilon_{it},$$

where A_{it} is the measure of EI adoption in year *t*, and T_{it} measures EI termination in year *t;* X_{it-1} are a set of time-varying explanatory variables lagged one year; and X_{ij} are time-invariant variables. Furthermore, α_i are individual plant dummy variables, which control for plant fixed effects, and γ_t are year dummy variables.

The two equations are estimated as the linear probability model so that the coefficients show how much a change in an explanatory variable affects the probability. We also estimated the adoption and termination decisions using Probit and Logit specifications and obtained similar marginal effects at the means of explanatory variables to those given in table 3.[16] The first aspect of the estimates in columns 2 and 3 is that most variables have opposite effects on adoption and termination. The estimated impact of the existing level of EI is significantly negative in the adoption equation and significantly positive in the termination equation. This suggests that the establishments are adjusting their programs, possibly through a Markovian process of the type we examine next, toward an equilibrium. If this were the case, we would expect other factors to have comparable opposite signs in the two equations. In fact, this is the case. The two other significant variables in the adoption equation relate to business strategy: establishments that emphasize market growth are more likely to adopt EI, while those seeking niches in the market are less likely to introduce EI programs. In the termination equation, growth of the market share has a negative sign, while the niche market variable has a positive but insignificant sign. Unionization also operates in opposite directions between the two types of changes: it reduces the probability of terminating a program while increasing the chance of introducing a program. Incentive pay also reduces the

[16] The results are available from the authors.

chance of terminating a program while having a negligible positive effect on the chances of introducing an EI program.

The complementarity hypothesis suggests that firms would do better to introduce or terminate EI programs[17] as a group rather than singly, and thus that the number of adoptions or terminations in a period of time ought to exceed what one might expect from a binomial model in which the firm has a fixed probability of changing programs and does so independently of what it is doing with other programs. At the same time, there is a competing possibility: that management learns slowly about which programs work together and moves incrementally toward the best combination. In this case, there is reason to expect fewer or at least no more multiple adoptions or terminations in a given time period than one might expect from a binomial model. To see which of these factors dominate the data, we tabulated the distribution of changes in programs in a year and compared them to the distribution that would result from a binomial distribution in which the changes occurred randomly among the 51 establishments. If, for example, there were 10 adoptions of EI programs in a period, the probability of having one firm adopt two programs in the period would be $10/51 \times 10/51$.

Table 4 shows the actual and expected distributions for changes in adoptions (panel A) and for changes in terminations (panel B) for all the years and firms in the data set. The first row in panel A gives the frequency with which firms adopt policies in a year. Since in most years firms do not change policies, the frequency of a change is relatively low. The remaining rows in panel A give the frequencies of adoption *conditional* on the

[17] To see whether the EI programs had any effect on the behavior of workers, we regressed employee turnover rates on EI and the other variables included in table 3. This estimated result supports studies that found reduced turnover rates as being associated with the use of EI policies (Batt, 2002; Batt, Colvin, and Keefe, 2002; Bartel, 2004). In addition, we also find that average turnover rate declines with the age of plant, and it is also lower in durable manufacturing companies. The turnover rate also decreases as companies use more individual incentive pay and performance appraisal programs.

firm having made a change. The actual distribution shows that a much smaller proportion of the changes were done with no other policy changing than predicted by the binomial and that a much larger proportion of changes involved two or more policies changing. This is the signature of complementarity. The first row of panel B gives the frequency with which firms terminate policies in a year. The rate of termination is 4.9 percent (25 observations of companies ending EI out of 510 possibilities). The remaining rows of panel B give the frequencies of termination *conditional* on the firm having terminated a program. The actual distribution shows that a much smaller proportion of terminations were done with no other termination than predicted by the binomial and that a much larger proportion of changes involved two or more terminations. The data thus support complementarity in terminations as well as in adoptions.

Markov Analysis

The pattern shown in table 2 in which establishments add new EI programs and terminate other programs suggests a dynamic adjustment process that potentially moves establishments toward an equilibrium distribution of numbers of programs. If all the establishments had identical characteristics, the result would be a single point—say four EI programs. But establishments differ in various ways, so it makes more sense to think of the equilibrium as a distribution, with firms that can make better use of EI programs having more programs and firms to which the programs add less value having few. With nine different programs, there are a large number of possible combinations ($512 = 2^9$), which is analytically non-tractable. Instead of trying to model the links between specific programs, we examine next the number of programs that a firm has, using a Markov chain analysis. We assume that in any period a firm can add or subtract programs and that the decision to change the number of programs depends solely on the number that the

firm had in the previous period. This gives us a Markov chain matrix whose elements are the probability that a firm moved, say, from three programs to four or two programs, or five programs or one program. Associated with the matrix is a stationary distribution that represents the equilibrium state to which the process is headed (Kemeny and Snell, 1976).

Table 5 gives the Markov matrix that we use to analyze the adoption and termination of EI programs. The elements of the matrix are obtained by averaging all transitions in the data, regardless of year. Say five firms had three programs in one year and none changed their number of programs, and five firms had three programs in some other year and three of the firms increased their programs to four while two firms reduced them to two, our estimated transition matrix would have a probability of staying with three programs of 0.5, of increasing to four programs of 0.3, of decreasing to two programs of 0.2, and zero probability of other transitions. The table groups the eight and nine programs together both because there are few observations in that part of the distribution and because, taken by itself, having eight policies is an absorbing state, which is highly unlikely with additional observations.

The summary statistics in the table give the steady-state or equilibrium distribution from the Markov analysis and contrast that distribution with the initial distribution in 1986 and the distribution in 1995. The initial distribution moved rapidly toward the equilibrium over the period. The sum of the absolute value in the differences between the distribution in 1986 and the equilibrium distribution was 80 percentage points.[18] By 1995, the sum of the absolute value in the differences between the distribution and the equilibrium distribution was just 16 percentage points. The model predicts that the distribution would reach the equilibrium by 2006. Thus, the adoption and

[18] This statistic simply subtracts the percentages in the two distributions element by element and takes the sum of the absolute values. It is the natural metric for comparing two distributions.

termination process takes about 20 years to equilibrate, with much of the movement toward equilibrium occurring within 10 years.

Conclusion

Using 10-year longitudinal data from on-site visits to establishments, we show that firms' use of EI has not grown continuously, but rather follows a more complex pattern, with firms adopting and terminating programs over time, seemingly moving toward an equilibrium distribution of EI policies. The distribution of firms by their number of policies indicates complementarity among the policies. Firms are more likely to adopt EI programs and less likely to terminate them when they have other advanced human resource practices and a business strategy that includes giving workers autonomy at the workplace. In addition, firms introduce and terminate EI policies as bundles that imply that the policies are complementary with each other. We model the dynamics of adjusting the number of policies over time with a Markov chain and find that the process moves reasonably rapidly to the steady-state distribution, attaining it in about 20 years.

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Table 1: Percentage of Firms with Different Numbers of Programs, 1986–1995

Percentage of plants using 0–9 programs	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	23.53	23.53	21.57	21.57	17.65	15.69	11.76	11.76	5.88	3.92
1	21.57	19.61	17.65	17.65	13.73	7.84	9.8	7.84	7.84	3.92
2	9.8	7.84	11.76	13.73	15.69	13.73	13.73	11.76	15.69	17.65
3	13.73	17.65	17.65	19.61	19.61	19.61	17.65	17.65	21.57	21.57
4	9.8	9.8	9.8	7.84	7.84	13.73	19.61	13.73	9.8	13.73
5	1.96	1.96	3.92	3.92	9.8	9.8	9.8	15.69	15.69	15.69
6	11.76	11.76	9.8	9.8	11.76	9.8	7.84	11.76	11.76	11.76
7	3.92	3.92	3.92	1.96	0	5.88	3.92	3.92	5.88	1.96
8	1.96	1.96	1.96	1.96	1.96	1.96	5.88	5.88	5.88	9.8
9	1.96	1.96	1.96	1.96	1.96	1.96	0	0	0	0
Number of plants adopting one or more EI programs	—	4	3	2	11	11	10	10	10	6
Number of plants terminating one or more EI programs	1	1	5	3	2	5	2	6	0	0

Source: Interviews at 51 manufacturing establishments.

Note: The table shows the percentage of establishments that used zero to nine EI programs in a year. These EI programs include job rotation, joint labor-management committee, suggestion system, TQM, quality circles, self-managed work team, job redesign, quality of work life, and employee representation on the board of directors.

Table 2: Number of Establishments Adopting or Terminating Program by Year

Adoption of Policy	1986 (left-censored)	1987	1988	1989	1990	1991	1992	1993	1994	1995	cumulative
Employee Representation on Board of Directors	2				1						1
Joint Committee	20				3	3	2	2	3	2	15
Job Redesign	10			1	2	2	2	2	3	1	13
Self-Managed Work Team	4			1	3	3	5	3	1	1	17
TQM	16	1			3	6	1		2	2	15
Quality Circles	16	2			1	3		1	2	1	10
Quality of Work Life	14		1		2	2	1	2	2		10
Suggestion System	19	1	2	2			3	2	1	3	14
Job Rotation	23			1	3	5	4	2	2		17
Total Number of Adoptions		**4**	**3**	**5**	**18**	**24**	**18**	**14**	**16**	**10**	**110**

Termination of Policy	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
Employee Representation on Board of Directors						1					1
Joint Committee		1	1			1					3
Job Redesign			1			1					2
Self-Managed Work Team			1			1		3			5
TQM			2	2		2	1	1			8
Quality Circles	1		3	2	2	4					12
Quality of Work Life			2			1	1				4
Suggestion System			1			2		2			5
Job Rotation						1		1			2
Total Number of Terminations	**1**	**1**	**11**	**4**	**2**	**14**	**2**	**7**			**42**

Source: Interviews at 51 manufacturing establishments.

Table 3: Regression Estimates for the Analysis of the Level of EI and Adoption and Termination of Programs

	: Rasch Level of EI (1)	Adoption of EI (2)	Termination of EI (3)
EI value $_{-t-1}$		-0.113***	0.080***
(EI t in column 5		(0.035)	(0.028)
Union	-0.840***	0.211	-0.459**
	(0.136)	(0.361)	(0.197)
Age of plant	-0.005**	0.004	0.0001
	(0.002)	(0.003)	(0.002)
Log Plant Size	-0.220*	-0.045	0.014
	(0.126)	(0.031)	(0.016)
Durable	0.276*	-0.060	0.454**
Manufacturing	(0.156)	(0.364)	(0.215)
Restructuring$_{-t-1}$	-0.225	0.087	-0.093
	(0.188)	(0.101)	(0.071)
Selection$_{-t-1}$	0.114**	0.043	0.021
	(0.051)	(0.039)	(0.018)
Appraisal$_{-t-1}$	0.174**	0.094	-0.027
	(0.073)	(0.074)	(0.031)
Training$_{-t-1}$	0.213**	-0.005	0.007
	(0.075)	(0.047)	(0.034)
Individual incentive	0.141	0.006	-0.170***
pay $_{t-1}$	(0.136)	(0.111)	(0.065)
Gain sharing or	0.725***	0.071	0.073
group bonus $_{t-1}$	(0.137)	(0.102)	(0.070)
Other firm-level $_{t-1}$	-0.337**	0.101	0.105
	(0.164)	(0.141)	(0.073)
Management	0.366***	0.041	0.005
granting	(0.068)	(0.033)	(0.030)
autonomy$_{-t-1}$			
Niche market$_{-t-1}$	-0.046	-0.080*	0.004
	(0.089)	(0.046)	(0.027)
Growth of market	0.146	0.161**	-0.067**
share$_{-t-1}$	(0.091)	(0.071)	(0.032)
Max. shareholder	0.070	-0.055	-0.052
value$_{-t-1}$	(0.059)	(0.049)	(0.037)
Short-term profit	-0.008	0.004	-0.003
maximization$_{-t-1}$	(0.077)	(0.053)	(0.043)
Constant	-0.491	-0.483	0.341
	(0.932)	(0.525)	(0.194)
Number of observations	389	344	344

Note: The level of EI is the Rasch value of EI for each year. Missing values of Plant Size, Management Granting Autonomy, Niche Market, Growth of Market Share, and Short-term Profit Maximization are replaced by their mean value; dummy indicators of missing values for these variables are included in the regression to control for the effect of imputation. The estimates of these dummy indicators are not reported for brevity. Standard errors are reported in parentheses. *, **, and *** indicate $P < 0.1$, 0.05, and 0.01.

Table 4: **The Actual and Predicted Frequency of Multiple EI Policy Adoptions and Terminations**

A-- Adoptions

	Actual (%)	Predicted from Null (%)
Frequency that a firm adopts new EI policies	13.1	13.1
Given that firm adopts EI policy, distribution of number of policy adoptions		
with no other EI policy changing	70.2	86.9
...with 1 other policy changing	13.4	11.4
...with 2 other policies changing	5.9	1.5
...with 3 other policies changing	3.0	0.2
...with 4 other policies changing	4.5	0.03
...with 5 other policies changing	3.0	0.01

Note: With all years pooled, there is a total number of 67 observations of companies adopting EI out of 510 (51 companies * 10 years).

B-- Terminations

	Actual (%)	Predicted from Null (%)
Frequency that a firm terminates existing EI policies	4.90	4.90
Given that firm terminates EI policy, distribution of number of policy terminations that the firm makes		
with no other EI policy changing	76	95.1
...with 1 other policy changing	16	4.7
...with 5 other policies changing	4	0.0
...with 8 other policies changing	4	0.0

Note: With all years pooled, there is a total number of 25 observations of companies ending EI out of 510 (51 companies * 10 years).

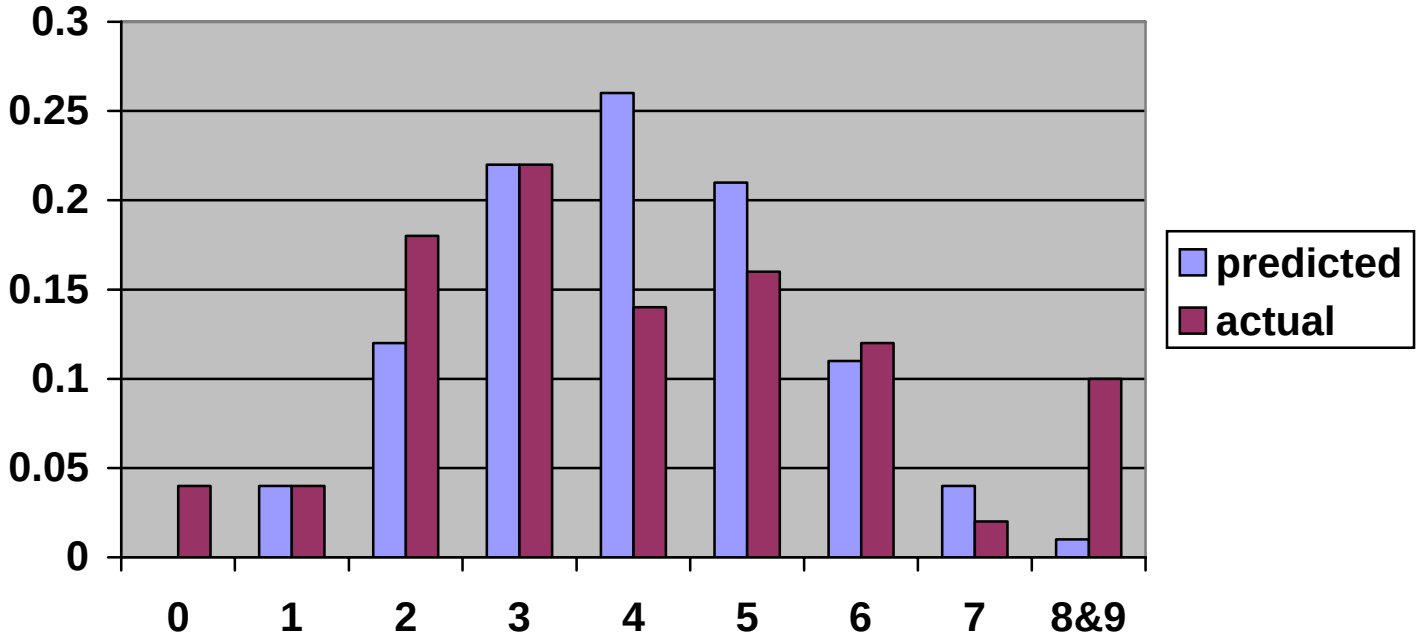
Table 5: Markov Chain Average Transition Matrix for the Numbers of Programs in Year *t* to Year *t*+1

YEAR T	YEAR t+1								
	0	1	2	3	4	5	6	7	8&9
0	0. 821	0. 09	0. 014	0	0. 026	0. 038	0. 014	0	0
1	0. 048	0. 698	0. 19	0. 032	0. 016	0	0	0. 016	0
2	0	0. 034	0. 793	0. 103	0. 034	0. 034	0	0	0
3	0	0	0. 036	0. 881	0. 071	0. 012	0	0	0
4	0	0	0	0. 058	0. 788	0. 096	0. 038	0. 019	0
5	0	0	0	0. 081	0. 054	0. 784	0. 081	0	0
6	0	0	0	0	0	0. 061	0. 878	0. 042	0. 02
7	0	0. 059	0	0	0	0. 059	0	0. 706	0. 176
8&9	0	0. 05	0	0	0	0	0	0	0. 95

SUMMARY STATISTICS FROM MARKOV ANALYSIS

	0	1	2	3	4	5	6	7	8&9
The initial vector for 1986 is	0. 24	0. 22	0. 10	0. 14	0. 10	0. 02	0. 12	0. 04	0. 04
The 1995 vector is	0. 04	0. 04	0. 18	0. 22	0. 14	0. 16	0. 12	0. 02	0. 10
The equilibrium vector is	0. 02	0. 04	0. 10	0. 26	0. 15	0. 14	0. 14	0. 03	0. 12
It takes 20 iterations to reach equilibrium.									

Figure 1: The Distribution of Firms by Number of EI Policies Compared to the Expected Distribution from Hypergeometric Distribution of Sampling without Replacement



Source: Actual distribution, table 1; expected distribution, tabulated using hypergeometric distribution calculator http://www.adsciengineering.com/hpdcalc/ with N = 459; number of desirables (EI policies) of 204, and sample size of 9.

Appendix Table A: Complementarity between EI and other HR programs

The number of other HR programs adopted in 1995 (#establishments)	The number of EI programs Adopted in 1995									
	0	1	2	3	4	5	6	7	8	Average # EI Programs
4-6 (2)	0	0	1	0	0	0	0	0	1	5
6-8 (4)	1	0	2	0	0	0	1	0	0	2.5
8-10 (4)	0	0	1	1	0	2	0	0	0	3.8
10-12 (19)	0	2	4	6	4	2	1	0	0	3.2
12-14 (13)	1	0	1	4	0	2	2	1	2	4.5
14-16 (9)	0	0	0	0	3	2	2	0	2	5.6

Source: Interviews at 51 manufacturing establishments.

Appendix Table B: Descriptive Statistics of Explanatory Variables

Variable name	Variable Definition	Mean	Standard Deviation
Union	=1 if a plant has a union representation; =0 otherwise;	0.54	
Age of plant	Age of plant in years	37.32	29.71
Log Plant Size	Log of the Number of Production Workers in a plant	7.011	0.645
Durable Manufacturing	=1 if a plant manufactures durable products; =0 otherwise;	0.645	
Restructuring	=1 if a plant has recently been restructured; =0 otherwise;	0.17	
Selection	=the total number of selection programs used in a plant including a detailed screening process, personal interview, aptitude test, physical exam, reference check, and probationary period; takes a value from 0-6;	4.88	1.23
Appraisal	=the total number of performance appraisal programs used in a plant including assessment centers, formal review sessions, and a standardized evaluation form; takes a value from 0-3;	1.52	0.92
Training	=the total number of training programs used in a plant including on-the-job training, team building training, on-site training, and tuition reimbursement; takes a value from 0-4;	3.36	0.65
Ind. incentive pay	=1 if a plant has adopted the individual incentive pay plan; =0 otherwise;	0.55	
Gain sharing or group bonus	=1 if a plant has adopted a gain sharing plan or group bonus program; =0 otherwise;	0.40	
Other firm-level incentive Pay	=1 if a plant has adopted an ESOP, cash or deferred profit sharing, or employee stock purchase plan; =0 otherwise.	0.74	
Management granting autonomy	The degree of manager giving employees autonomy in the scale of 1-5;	3.51	0.93
Niche market	The degree of a plant's focusing on niche market in the scale of 1-5;	3.20	1.38
Growth of market share	The degree of a plant's focusing on growth of market shares in the scale of 1-5;	3.63	1.33
Maximizing shareholder value	The degree of a plant's focusing on maximizing shareholder value in the scale of 1-5;	3.67	1.57
Short-term profit maximization	The degree of a plant's focusing on short-term profit maximization in the scale of 1-5;	3.51	1.14
EI	Previous number of EI programs adopted	3.65	2.07