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THE EFFECTS OF HUMAN RESOURCE MANAGEMENT PRACTICES ON FIRM PRODUCTIVITY – PRELIMINARY EVIDENCE FROM FINLAND

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ABSTRACT: This paper presents the first empirical evidence on the nature and effects of human resource practices (HRM) in the Finnish manufacturing sector. In the analysis, we use the novel survey on HRM practices, based on a representative random sample from the population of the Finnish manufacturing firms who had 50 or more employees in 2005. In the sample, we have firm-level information on several HRM and employee participation practices of 398 firms, which is 38% of the firms in the population and almost 50% of the survey respondents. To study how HRM practices affect the level of firm productivity, we first combined the HRM survey data with financial statement data and then estimated cross-sectional and panel data estimators for the Cobb-Douglas production functions. We find that both the incidence of employee participation practices and the incidence of HRM tools have increased in the manufacturing sector from 2002 to 2005. The empirical findings support the view of a positive association with the HRM practices and the level of firm productivity. Perhaps more importantly, however, we find that not all forms of employee financial and decision-making participation practices have favorable productivity effects: consultative committee and profit sharing scheme has a positive effect, but other practices do not have statistically significant effects.

JEL Codes: M54, J53, L23,

Keywords: new workplace practices; HRM; employee participation; productivity

1. Introduction

The accelerating trends of globalization have affected Finnish firms noticeably during the last 15 years. While some issues have attracted considerable public and research interest in Finland (e.g. firms' competitiveness, internationalization of Finnish firms, heightened international competition, outsourcing), understanding the changes in internal organization of firms has remained a major challenge. Evidence from the US, Japan and the UK suggests that human resource management (HRM) practices, such as increased employee participation in decision making and compensation systems that relate employee compensation to firm or group performance, have become increasingly common (e.g. Conyon and Freeman 2004; Blasi and Kruse 2006; Kato 2006). Anecdotal evidence suggests that the organizing of work and the ways in which labor is used have also been changing in Finnish firms during the last years.

In this paper, we present the first empirical evidence on the effects of HRM practices on firm productivity in the Finnish manufacturing sector. In the analysis, we use a new survey data set on firms' HRM practices, based on a representative random sample of the manufacturing firms who had 50 or more employees in 2005. The survey includes firm-level data on HRM practices and employee participation of 398 firms, which is 38% of the firms in the population and almost 50% of the respondents.[1] An important feature of the survey data set is that it can be linked to financial statement data sets. With this combined data, we are able to analyze empirically the adoption patterns of various HRM practices and their effects on firm productivity in the Finnish manufacturing sector.

The key preliminary findings are the following. First, based on the analysis of the HRM survey data, both the incidence of employee participation practices and the incidence of human resource management tools have increased from 2002 to 2005. This finding indicates significant changes in a way of a work is organized, managed and rewarded

in the Finnish manufacturing sector (firms employing at least 50 employees). In addition, this development is in line with the previous studies from the US, Japan and the UK.

Second, the empirical findings support a positive association with the HRM practices and the level of firm productivity. Perhaps more importantly, however, we find that not all forms of employee financial and decision-making participation practices have favorable productivity effects: consultative committee and profit sharing scheme has a positive effect, but other practices are statistically insignificant. Being the case, the findings suggest that an implementation might be more important than an adoption of an individual HRM practice, at least from a productivity point of view.

The paper is organized as follows. Section 2 presents conceptual framework. Section 3 summarizes the data sets used in the empirical analysis. Section 4 describes research hypotheses and empirical strategy. Section 5 reports our preliminary findings. Section 6 concludes.

2. Conceptual framework

This paper links to the growing number of theoretical and empirical studies that have analyzed the impact of new workplace HRM practices on firm productivity. The major conceptual framework is the complementarities of new workplace practices in a production process. This concept means that the returns of a workplace innovation can be substantially higher when they are combined with other workplace innovations rather than introduced alone. For instance, the effects of increased employee discretion, such as teamwork, might be higher when they are introduced in tandem with performance-based pay.

The theoretical framework to analyze complementarities has been laid out in the several previous contributions (e.g. Aoki 1990; Ben-Ner and Jones 1995; Milgrom and Roberts 1995; Dessein and Santos 2006). Aoki (1990) carefully describes case examples of

internal operational practices in Japanese firms. Though he mainly focuses on a stylized model of Japan firm (so called J-model) and then compares the model to the firm models constructed by Western economists, he argues that the primary incentive scheme in the J-model (i.e. employee hierarchical ranks) complements the non-hierarchical operational coordination (e.g. formal information sharing, team working, job rotation) helping to maintain organizational effectiveness. Ben-Ner and Jones (1995) develop a new conceptual framework to study how distinct types of employee ownership rights, based on *employee return rights* (i.e. no rights, profit sharing, employee stock ownership plans (ESOPs)) and *employee control rights* (i.e. no rights, participation in control, sharing of control, dominant control), affect individual-level motivation, individual-level performance, organizational structural variables and organizational performance. They argue that control and return rights interact strongly; for example, the productivity effects of the combined rights may not only exceed the sum of the separate effects but may even be of opposite sign over certain ranges of combinations. Therefore, return and control rights held by employees must be combined to have a significant individual motivational effect. Ownership arrangements that entail only limited employee rights in control and returns are likely to be anchored in groups rather than the entire organization, which can strengthens group identity leading to pursuit group objectives, possibly at the expense of the beneficial cooperation among groups. Milgrom and Roberts (1995) use the mathematical theories of supermodular optimization and games for the analysis of systems marked by complementarity. In this framework, they obtain comparative static conclusions that enable to interpret observed changes in the strategies and organizational structures of manufacturing firms as optimizing responses to the changes in a business environment. The results also suggest how the strategy and structure of a firm might evolve over time when a firm adopts new features that are complementary with existing workplace practices and polices. Dessein and Santos (2006) propose a new theory of adaptive

organizational design that can account for the trend towards new workplace practices, involving less specialized job assignments, more teamwork, and more intensive communication. In the paper, they endogenize an organization's choice of adaptiveness in a changing market environment and analyze how the organization should be structured in terms of how many tasks to give to employees and how much to promote communication between them. The paper shows that intensive communication, broad task assignments and employee flexibility are complementary organizational design variables for a wide variety of communication technologies.

Empirical studies on the performance effects of new workplace HRM innovations have been conducted in several contributions (e.g. Ichniowski et al. 1997, Black and Lynch 2001, and Black et al. 2004 for the US; Kato and Morishima 2002 for Japan; Conyon and Freeman 2004 for the UK). Ichniowski et al. (1997) study the productivity effects of HRM practices in a specific production process; namely a production of steel in one specific steelmaking process at US steel mills. Since it was difficult to obtain data on HRM practices of these steel mills from public data sources, they collected their own longitudinal productivity and HRM data by personally visiting in 26 steel plants. Their empirical results consistently support the view that the adoption of a coherent system of new workplace HRM practices and extensive reliance on incentive pay produces substantially higher productivity levels than more "traditional" approaches. In addition, adopting individual work practice innovations in isolation has statistically insignificant effect on productivity. Black and Lynch (2001) find that workplace practices do matter, irrespective of how a production function was estimated in their establishment-level study. Perhaps more importantly, however, they find that it is not that much whether or not a workplace practice is adopted but rather how that is actually implemented within the establishment that is associated with higher productivity. For example, total quality management (TQM) system has an insignificant or even negative effect

on productivity, whereas increasing the proportion of workers meeting regularly to discuss workplace issues or extending profit sharing also to production workers has a significant and positive impact on productivity. In addition, they find important differences across plants depending on the type of labor-management relations used within a plant. For example, unionized plants that have adopted new workplace practices have substantially higher productivity than similar nonunion plants with more traditional labor-management relations. Kato and Morishima (2002) report the first results for Japanese manufacturing firms on the productivity effects of clusters of employee participation practices. In the study, they combined firm financial statement data with the HRM survey data on JLMCs (join labor-management committees), SFCs (shop-floor committees), ESOPs (employee stock ownership plans) and PSs (profit-sharing schemes). The key finding is that moving from the traditional system of no HRM practices to a highly participatory cluster of HRMs will lead to a significant 8-9 percent increase in productivity. The findings also suggest that the goal-alignment process needs to be supported both by direct methods (i.e. employee financial participation) and indirect ones (i.e. employee participation in decision-making). Conyon and Freeman (2004) examine the use and consequences of shared compensation schemes in a sample of UK workplaces and firms in the 1990s. They find that shared compensation practices are substantial and are growing in the UK; upwards of half of workplaces have some form of shared compensation scheme. In addition, those firms and workplaces with such compensation plans are more likely to establish formal communication and consultation channels with workers and also tend to outperform other firms. In part, according to Conyon and Freeman, the growth of the practices in the UK can be attributed to government policies that introduced tax incentives to encourage shared compensation plans in an attempt to enhance firm productivity. Black et al. (2004) study how US manufacturing workers fare when firms adopt high-performance workplace practices (HPWPs) such as employee

involvement programs, job rotation, self-managed teams, company-provided training, and incentive-based compensation plans. They find evidence that HPWPs benefit workers economically; workers' wages are higher in the firms that use HPWPs than in more traditionally organized firms. However, these monetary gains do not seem to be distributed evenly with employees; nonproduction workers appear to be paid a wage premium, whereas compensation for production workers seems to be unaffected in HPWP establishments. The authors suggest that this is one channel that is linked to an increase in within-establishment wage inequality.

New workplace HRM practices, and its broader concept organizational innovations[2], are importantly related to the use of information and communication technology (ICT). For example, OECD (2002) argues that ICT is the key to enable firms to adopt new organizational innovations. This in turn improves firm productivity.[3] Brynjolfsson and Hitt (1997) explore the link between computers and productivity growth. They find that computers make a positive contribution to output growth, but, as a general purpose technology, computers are a part of a larger system of technological and organizational changes that contribute positively to firm productivity. This view is supported by Milgrom and Roberts (1990) who argue that to be successful firms need to adopt ICT as part of a cluster of mutually reinforcing organizational approaches. Brynjolfsson and Hitt (2000) review extensively both the case literature and econometric evidence on how investments on information technology (IT) at the firm-level are linked to higher productivity and organizational transformation. The following findings emerge: First, a significant value of information technology is its ability to enable complementary organizational investments, such as business processes and work practices. Second, these investments increase productivity by reducing production costs and by enabling firms to increase output quality in the form of new products or in improvements in intangible aspects of existing products and services (e.g. convenience, timeliness, quality, and variety).

3. Data

3.1. HRM survey data

Our firm population is all Finnish manufacturing firms[4] employing 50 or more employees[5] in Statistics Finland's business register in September 2005 (i.e. TOL 2002 categories 15-37, based on SIC/NACE 2002 classification). By using this definition, the size of the population is 1,054 firms.

An interviewer from a telephone survey firm[6] called these firms in a random order[7] and asked a firm's switchboard operator to connect to a manager who is in charge of human resource management issues in Finland. By following this simple searching procedure, altogether 832 calls were made between December 2005 and January 2006. The HRM survey includes 398 firms that fully participated in the survey, which is 38% of the firms in the population and almost 50% of respondents.[8]

Table 1. The distribution of firms by industries (based on SIC/NACE 2002 classification).

	(1)	(2)	(3)	(4)
D Manufacturing	**# of firms in the sample**	**%**	**# of firms in the population**	**%**
DA Manufacture of food products, beverages and tobacco	28	7 %	86	8 %
DB Manufacture of textiles and textile products	11	3 %	23	2 %
DC Manufacture of leather and leather products	3	1 %	8	1 %
DD Manufacture of wood and wood products	28	7 %	67	6 %
DE Manufacture of pulp, paper and paper products; publishing and printing	55	14 %	149	14 %
DF Manufacture of coke, refined petroleum products and nuclear fuel	0	0 %	3	0 %
DG Manufacture of chemicals, chemical products and man-made fibres	25	6 %	55	5 %
DH Manufacture of rubber and plastic products	25	6 %	61	6 %
DI Manufacture of other non-metallic mineral products	16	4 %	51	5 %
DJ Manufacture of basic metals and fabricated metal products	62	16 %	165	16 %
DK Manufacture of machinery and equipment n.e.c.	70	18 %	183	17 %
DL Manufacture of electrical and optical equipment	40	10 %	113	11 %
DM Manufacture of transport equipment	22	6 %	46	4 %
DN Manufacturing n.e.c.	15	4 %	44	4 %
Total	400	100 %	1054	100 %

Table 1 shows the distribution of firms by the manufacturing industries. As can been seen from Table 1, the relative shares of firms are almost the same in columns (2) and (3), deviating only one or two percentage points between the sample and the population.

Table 2 groups manufacturing firms in the sample and the population into five categories by firm size (proxied by employees). It is evident from Table 2 that the relative shares of firms are very similar in columns (2) and (4).

Table 2. The distribution of firms by size.

	(1)	(2)	(3)	(4)
Size (proxied by size of personnel)	**Sample**	**%**	**Population**	**%**
50-99 persons (category 5)	185	46 %	494	47 %
100-249 persons (category 6)	108	27 %	326	31 %
250-499 persons (category 7)	54	14 %	134	13 %
500-999 persons (category 8)	38	10 %	71	7 %
over 1,000 persons (category 9)	15	4 %	29	3 %
Total	400	100 %	1054	100 %

To provide a reader a better understanding on the contents of the HRM survey, we next describe it in more detail. The survey consists of five main sections: 1) firm basic information, 2) employee financial participation and participation in decision-making, 3) the use of ICT, 4) employee training and 5) firm ownership and organization. In Section 1, it was first verified that a survey respondent was truly a manager who was in charge of a firm's human resource management issues in Finland. If the respondent was truly that person, the survey continued with questions on the amount of firm sales, the number of employees, the number of products and the strength of competition in a firm's main markets. Otherwise, a survey interviewer did his/her best to reach a target respondent in a firm. Section 2 focuses on employee participation in a firm, both in decision-making and in financial participation. For example, we asked whether employees' representative is a member of the board of the directors and whether a firm has a profit sharing plan. Section 3 deals with the use of ICT in a

firm. For example, one question inquired the share of firm employees that use computers almost daily in their work. Section 4 focuses on employee training that is organized by a firm. For example, we asked whether a firm has a formal training strategy and whether a firm has organized multi-skill and IT-training on employees. Section 5 examines firm ownership structure, organizational changes and outsourcing.

The HRM survey questionnaire has altogether 79 main questions and several subquestions, conditional on a respondent's answers. The duration of a survey fluctuated (depending on a respondent's answers), but an average running time was about 30 minutes. We next examine Section 2 in more detail, since it includes the questions on employee participation in decision-making and employee financial participation.[9]

Section 2 has seven subsections. For example, we asked about employee participation in firm management, the use of consultative committee, the existence of a trade union representative, working environment and human resource management tools. In addition, a respondent was asked to what extent firm employees participate in decision-making on business strategy, work safety issues, the adoption of new technology etc.

The questions focused mainly on the presence of a practice. However, in some cases, if a firm had adopted a specific practice, we also asked about the usefulness of the practice from a firm's viewpoint. For example, we first asked about the presence of employee participation in the boards of the directors. And if a firm had an employee representative in the board, we then asked a respondent to assess, how useful s/he assesses employee representative in the board on a five-step scale from a firm's viewpoint.

Table 2 presents the incidence of some employee participation practices in the sample in 2002 and 2005. Interestingly, in the period from 2002 to 2005, both the incidence of employee participation and the incidence of HRM tools has increased. For example, balanced scorecard (+23 percentage points), consultative committees (+17 percentage points),

job rotation (+13 percentage points), formal employee recruiting criteria (+13 percentage points), quality circles (+12 percentage points), initiative system (+11 percentage points), TQM (+9 percentage points), whereas of employee financial participation practices only the share of firms using profit sharing (+12 percentage points) and personnel stock ownership (+4 percentage points) has increased in the period. In sum, Table 2 indicates clear changes in a way of a work is organized, managed and rewarded in the Finnish manufacturing firms (who had at least 50 employees).

Table 2. The incidence of employee participation practices in 2002 and 2005.

	(1)	**(2)**	**(3)**
Employee participation practice	**Share of firms with a practice in 2002**	**Share of firms with a practice in 2005**	**Change**
Employee representative in the board of the directors	13%	12%	+ 1% points
Consultative committee between employees and management at the firm-level	57%	74%	+ 17% points
The share of employees belonging to trade unions	84% (mean)	84% (mean)	no change
Union representative (i.e. shop steward) in a firm	89%	93%	+ 4% points
Quality circles	43%	55%	+ 12% points
Autonomous/self-governing teams	26%	35%	+ 6% points
The share of employees belonging to autonomous teams	45% (mean)	45% (mean)	no change
Job rotation	71%	84%	+ 13% points
Employees can make initiatives on their duties and work environment (i.e. initiative system)	65%	76%	+ 11% points
Formal employee recruiting criteria, such as a sufficient educational level	44%	57%	+ 13% points
TQM	32%	41%	+ 9 % points
Balance scorecard (or equivalent)	41%	64%	+ 23% points
Formal and written reward strategy	36%	46%	+ 10 % points
Nomination and compensation committee	5%	7%	+ 2% points
Profit sharing	55%	67%	+ 12% points
Personnel fund	6%	5%	- 1% points
Stock option scheme	9%	9%	no change
Firm personnel (managers and/or employees) owns a firm's shares	46%	50%	+ 4% points

3.2. Financial statement data

Our firm-level financial statement data are combined from three data sources, i.e. Balance Consulting Oy, Suomen Asiakastieto Oy and Talouselämä TE600.[10] In principle, these three data sets include comparable financial statement information, but firm populations differ to somewhat, partially depending on the purpose of which the data have been collected. For example, *Balance Consulting's* data set includes detailed financial statement information on income statements and balance sheets of about 12,000 Finnish firms with turnover in an excess of EUR 1.7 million. On the contrary, *Suomen Asiakastieto's* data have financial statement information on about 80,000 Finnish business units. One major difference between the data sets is that *Suomen Asiakastieto's* data also include smaller firms and other business forms than corporations, since the firm is the leading business and credit information company in Finland. *Talouselämä Top600* data consists of the 600 largest firms in Finland, based on firms' annual sales.

The main financial statement data source is *Suomen Asiakastieto's* data, which encompass around 95% of surveyed firms. In a few cases, when we did not find financial statement information form *Suomen Asiakastieto's* data, we did our best to obtain missing financial statement information from *Balance Consulting's* and *Talouselämä's* data sets. Table 3 describes the number of surveyed firms for which we have financial statement information.

Table 3. The number of HRM survey firms with financial statement information.

	2002	**2003**	**2004**	**2005**
Firms with financial information data (% of the surveyed firms)	386 (97%)	387 (97%)	395 (99%)	394 (99%)

4. Research hypotheses and empirical strategy

4.1. Research hypotheses

Our estimation strategy and research hypotheses are based on a concept of organizational innovation. Following OECD (2002) and Gera and Gu (2004), Table 4 categorizes forms of organizational innovations into three groups: 1) production and efficiency practices, 2) human resource management practices, and 3) product/service quality-related practices. Though all the three practices might contribute significantly to firm performance, in this paper the research focus is on column (2) of Table 4, i.e. human resource management (HRM) practices.

Table 4. Types of organizational innovations.

(1) Production and efficiency practices	(2) Human resource management practices	(3) Product/service quality-related practices
Business re-engineering	Performance-based pay	Total quality management (TQM)
Downsizing	Flexible job design and employee involvement	Improving coordination with customers/suppliers
Flexible work arrangement	Developing employee's skills	Improving customer satisfaction
Outsourcing	Labor-management cooperation	
Greater integration among functional areas		
Decrease in the degree of centralization		

Source: OECD (2002), Gera and Gu (2004).

Column (2) in Table 4 consists of four human resource management practices: performance-based pay, flexible job design and employee involvement, developing employee's skills, and labor-management cooperation. Based on Gera and Gu (2004), Table 5 presents various strategies for implementing human resource management practices, and these strategies cover a broad range of personnel management elements (or correspondingly

personnel economics areas). Being the case, a broad set of various strategies suggest that firms can implement their own HRM strategy in various ways. For example, when a firm is choosing its optimal strategies for performance-based pay, it can choose whether to adopt an individual employee-level incentive system, group incentive system based on productivity/quality, profit sharing plan, merit pay and skill-based pay, or some combination.

Table 5. Strategies of human resource management practices.

(1) **Human resource management practices**	**(2)** **Strategies**
Group A. Performance-based pay	* Individual incentive systems * Productivity/quality sharing & other group incentives * Profit sharing plan * Merit pay and skill-based pay
Group B. Flexible job design and employee involvement	* Employee suggestions programs * Flexible job design * Greater reliance on job rotation and multi-skill * Information sharing with employees * Quality circles, problem-solving teams * Self-directed work groups * Joint labor-management committees
Group C. Developing employee's skills	* Formal job-related training * On-the-job training * Participation in training subsidies program * Participation in other training program

Source: Gera and Gu (2004); authors

Based on Table 5, in the empirical analysis we categorize our HRM variables into three groups: A. Performance-based pay, B. Flexible job design and employee involvement and C. Developing employees' skills. The expected effect of these strategies on firm productivity might not be evident a priori[11], but, for example, the theories of individual motivation, goal-alignment and human capital support for a positive effect on firm productivity (e.g. Kato and Morishima 2002). Based on the categorizing of the strategies in Table 5, we form three research hypotheses.

Hypothesis H1 is based on the quite large empirical literature on the productivity effects of other forms of employee financial compensation that are alternative to

the traditional fixed-wage arrangements, such as employee profit-sharing and employee stock ownership plans (ESOPs). Typically studies of firms with employee profit-sharing plans find a positive relationship between profit-sharing and firm productivity. This is the key conclusion of several surveys and studies including, for example, Weitzman and Kruse (1990), Cable and Wilson (1990), Wadhwani and Wall (1990), Jones and Pliskin (1991), Kruse (1992), and Kauhanen and Piekkola (2002).

Empirical findings based on studies of firms with employee stock ownership plans also find support the existence of a positive relationship between ESOPs and firm productivity or performance. Though many surveys point out (e.g. Kruse 2002) that the empirical evidence in support of this positive link is probably less robust than for profit sharing, there is evidence that employee stock ownership plans can be associated positively with enhanced business performance in a variety of institutional settings including Japan (Jones and Kato1995) and the U.S. (Kumbhakar and Dunbar 1993).

To test hypothesis H1, we use four performance-based pay indicator variables from the HRM survey: *profit-sharing*, *personnel fund*, *stock option scheme* and *personnel share ownership*.[12] All the variables measure the incidence of a performance-based scheme in a firm, i.e. they are binary variables (1= if a firm has a scheme in the year t, 0 otherwise).

> *H1: The average level of firm productivity is higher in firms that have adopted performance-based pay practices compared to firms that have not adopted such practices.*

Hypothesis H2 is focuses on flexible job design and employee involvement practices. It is based on the multidisciplinary evidence that highlights the benefits of decentralized decision-making and empowering individual employees to make decisions over organizing production. For example, an employee may have important private information on

a production process, and by sharing this private information with management and co-employees he/she may enhance a firm's performance (e.g. Ichniowski et al. 1997; Hamilton et al. 2004). Similarly, a firm's management may voluntarily share information to employees to enhance employee commitment and loyalty, which in turn can have a positive effect on firm productivity. In addition, this top-down information sharing may increase the level of trust that employees have for management and therefore reduce management's opportunistic behavior (e.g. Lazear 1998).

A firm may adopt flexible job design and employee involvement practices, for example, by a suggestion scheme (preferably with monetary rewards) allowing employees to make valuable proposals for production process improvements, but which not give employees a direct decision-making power over production. Alternatively, when management also highlight employee participation in decision-making, a firm may use self-directed/problem-solving teams that can have a relatively independent decision-making power over organizing production and responsibility for most production decisions.

Based on the HRM survey, we use the following four indicator variables (1= if a firm has a practice in the year t, 0 otherwise) for flexible job design and employee involvement practices: *employee representative in the board of the directors, consultative committee, teams and job rotation*. The presence of employee representative in the board of the directors may understand as a proxy variable for information sharing with employees and enhancing labor-management cooperation. Similarly, the indicator variable for consultative committee may be interpreted as a proxy for information sharing with employees and enhancing labor-management cooperation, but as well as an indicator for joint labor-management committees. The indicators for self-directed/problem-solving teams and job rotation strategies perhaps are self-explanatory.

H2: The average level of firm productivity is higher in firms that have adopted flexible job design and employee involvement practices compared to firms that have not adopted such practices.

Hypothesis H3 is examines the effect of education on individual wages. Empirical researchers have found that an additional year of post high-school education can raise wages of a worker between 5-12% (Black and Lynch 2001). Based on this result, researchers have inferred that education also increases firm productivity, since the development of wages cannot deviate substantially from the development of productivity in competitive labor markets. In addition, empirical research has focused on the effects of on-the job training (e.g. Bartel 2000; Zwick 2006; Maliranta and Asplund 2007). This field of literature typically finds that on-the-job training improves firm productivity, despite time costs associated with training and the risk that trained employees would leave the firm.

Employee training strategies, however, can vary largely between firms. For example, some firms may adopt an employee training policy, which states that it is not in their obligation and interest to develop employees' skills and therefore do not organize training at all. On the other hand, firms may have customized corporate universities for developing employees' skills. Besides on-the-job training that is organized by an individual firm, firms and their strategic partners may establish joint-training networks that enable collaborative learning processes.

Hypothesis H3 states that firms can enhance their productivity by adopting employee training practices in order to develop employees' working skills. Our indicator variable for hypothesis H3 measures whether a firm has a formal and written employee training strategy (1= if a firm has a practice in the year t, 0 otherwise).[13]

H3: The average level of firm productivity is higher in firms that have adopted developing employees' skills practices compared to firms that have not adopted such practices.

We also include control variables for information and communication technology (ICT) and foreign ownership in our specifications. Researchers in the 1980s found little evidence on the positive link between computer use and productivity (e.g. Bailey and Gordon 1988), whereas more recent empirical work with micro-data has found a positive link between computers and productivity (e.g. Brynjolfsson and Hitt 2000). In the empirical analysis, we use a variable for ICT use in a firm, i.e. the share of personnel using computers almost daily in their job. This variable captures the outcomes of past and present ICT investments, being a more comprehensive measure than an ICT investment that captures only current ICT investment activities. Foreign ownership, i.e. firms in which over 50% of the equity is in foreign ownership, can also be an import driver for a firm's productivity, for example by facilitating the transfer of new production technologies and HRM practices. Earlier empirical research found that foreign-owned firms are more productive on average than domestic-owned firms (e.g. Aitken and Harrison 1999; Griffith 1999; Ilmakunnas and Maliranta 2004), but more recent analysis has shown that a large part of differences in average productivity is attributable to differences between multinationals and non-multinationals rather than to "an origin of ownership of a country" (e.g. Criscuolo and Martin 2003).

4.2. Empirical strategy

To test empirically research hypotheses H1-H3, we estimate cross-sectional and panel data estimators for the Cobb-Douglas production function.[14] We assume a Cobb-Douglas form of production technology, since in the related literature it has been used in the evaluation of the

effects of ESOPs and stock option schemes on firm productivity (e.g. Jones and Kato 1995; Conyon and Freeman 2004; Jones, Kalmi and Mäkinen 2006).

A firm's Cobb-Douglas production function is denoted by $f(.)$, which relates the level of firm productivity y_i (proxied by annual sales) to inputs used in a production process and adopted HRM practices:

(1) $y_i = f(k_i, l_i, \overline{x}_i; \overline{\beta})$, where i=1, ..., N.

In Equation (1) k_i is capital, l_i is labor, $\overline{x}_i$ is a vector of variables on HRM practices that a firm has adopted, ICT use, foreign ownership and other control variables, such as manufacturing industry and geographical area dummies. A vector of unknown parameters to be estimated is $\overline{\beta} = (\beta_1, \beta_2, ..., \beta_k)$. After taking the natural logarithm of a Cobb-Douglas production function, we specify a loglinear statistical model with respect to sales, labor and capital as follows:

(2)
$$\ln y_i = \beta_1 + \beta_2 \ln k_i + \beta_3 \ln l_i + \overline{\beta}_x \overline{x}_i + \varepsilon_i,$$
$$\varepsilon_i \sim iid\ N(0, \sigma^2) \text{ and } E(\varepsilon_i \,|\ln k_i, \ln l_i, \overline{x}_i) = 0.$$

In Eq. (2) capital k_i is the book value of total assets (at the end of year) and labor l_i is the (mean) number of employees. The vector of other explanatory variables $\overline{x}$ includes the HRM variables of interest, and, depending on the model specification, a set of dummy variables: manufacturing industry dummies to control for possible industry specific effects and geographical area dummies to control for higher level of economic activity and market areas in Finland, and year dummies to control for macro shocks that are common to all firms. In sum, we try to explain the conditional expectation

(3) $E(\ln y_i \,|x_i) = \beta_1 + \beta_2 \ln k_i + \beta_3 \ln l_i + \overline{\beta}_x \overline{x}_i.$

Tables 7 and 8 describe summary statistics for key variables, both in cross-section 2005 and panel data 2002-2005.

Table 7. Summary statistics for cross-section 2005.

Variable	Name	Observations	Mean	Std. Dev.	Min	Max
ln(S)	Natural logarithm of firm sales (proxy for value-added)	388	17.12	1.30	14.18	21.74
ln(L)	Natural logarithm of employees	388	5.05	1.00	3.37	9.57
ln(K)	Natural logarithm of book value of firm assets (proxy for capital)	388	16.77	1.54	13.34	23.63
conc	1 if a firm has consultative committee, 0 otherwise	388	0.742	0.44	0	1
team	1 if a firm has teams, 0 otherwise	388	0.340	0.47	0	1
jobrota	1 if a firm uses job rotation, 0 otherwise	388	0.838	0.37	0	1
share	1 if a firm's personnel/ management owns firm shares, 0 otherwise	388	0.513	0.50	0	1
ps	1 if a firm has profit-sharing scheme, 0 otherwise	388	0.678	0.47	0	1
opt	1 if a firm has stock option scheme, 0 otherwise	388	0.098	0.30	0	1
fts	1 if a firm uses formal employee training strategy, 0 otherwise	388	0.407	0.49	0	1
ICT_use	Share of employees using computers almost daily	386	0.573	0.30	0.1	1
fown	1 if a firm's major owner is foreign, 0 otherwise	388	0.206	0.41	0	1

Table 8. Summary statistics for panel data 2002-2005.

Variable	Name	Firm-year obs	Mean	Std. Dev.	Min	Max
ln(S)	Natural logarithm of firm sales (proxy for value-added)	1449	17.02	1.33	12.63	21.88
ln(L)	Natural logarithm of employees	1449	5.01	1.05	1.39	9.63
ln(K)	Natural logarithm of book value of firm assets (proxy for capital)	1449	16.72	1.55	13.29	23.67
erbd	1 if employees' representative in the board of the directors, 0 otherwise	1449	0.127	0.33	0	1
conc	1 if a firm has consultative committee, 0 otherwise	1449	0.671	0.47	0	1
team	1 if a firm has teams, 0 otherwise	1449	0.305	0.46	0	1
qc	1 if a firm uses quality circles, 0 otherwise	1449	0.497	0.50	0	1
jobrota	1 if a firm uses job rotation, 0 otherwise	1449	0.779	0.42	0	1
ps	1 if a firm has profit-sharing scheme, 0 otherwise	1449	0.629	0.48	0	1
perfun	1 if a firm has personnel fund, 0 otherwise	1449	0.061	0.24	0	1
opt	1 if a firm has stock option scheme, 0 otherwise	1449	0.091	0.29	0	1

All monetary variables are deflated using the CPI deflator at 2005 constant Euros obtained from Statistics Finland.

5. Empirical findings

Table 9 describes the estimation results for the OLS cross-sectional models and the fixed effects panel data model with the robust standard errors (i.e. Huber/White/sandwich estimator). In the cross-sectional models for 2005 in columns (1)-(2), the sample size of firms is 366, which is marginally less than the number of firms that participated in the HRM survey (398 firms). The reason is that we excluded from the combined data set a HRM survey respondent's "cannot say" answers (for the HRM explanatory variables in columns (1) and (2)) and outlier observations with large residuals by using the Cook's D statistic (with a cut-off point of 4/N-k-1). In the fixed effects model in column (3), the sample size is 394 firms/1469 firm-year observations.[15] The following key findings emerge for Table 9.

First, the estimates for capital and labor inputs are highly significant in columns (1)–(3). The output elasticity of capital is in the range of 0.35-0.47 and the output elasticity of labor in the range of 0.52-0.63. The Wald tests for the hypothesis of constant returns to scale are significant indicating that the production function is first-order homogenous; meaning that a doubling of both capital and labor inputs at the same time results in a doubling of the output (ceteris paribus).

Second, when focusing individual strategies for human resource management practices, i.e. the strategies for the groups A (performance-based pay strategies), B (flexible job design and employee involvement strategies) and C (developing employees' skills strategies) in Table 5, we first note that in column (1) the parameter estimate for the incidence of a profit sharing scheme (group A strategy) is significant 0.084 at the 3% level supporting the research hypothesis H1. By using a simple formula, $\{\exp(\beta_{profit\ sharing}) - 1\} \times 100$, this would indicate about 8.8% positive effect on the level of firm productivity, which is in line with the previous empirical studies on the productivity effects of profit sharing plans. Second, the

coefficient for personnel share ownership (group A strategy) is significant -0.09 at the 2% level; the sign of coefficient being against our prior expectations. One reason for this might be that the indicator variable picks up not only those firms that use firm shares as a form of employee financial participation, but also firms where a selective group of personnel owns a majority of a firm's shares, since about 50% of the respondents answered that personnel owns firm shares in 2005.[16] The coefficients for personnel fund and stock option scheme indicators (group A strategies) were both statistically insignificant. When focusing individual HRM strategies in group B, the parameter estimate of consultative committee (0.11) gives statistically significant support at 1% level for the research hypothesis H2. However, the HRM strategies based on employee representative in the board of the directors, the use of teams and job rotation were all statistically insignificant. The parameter estimate for formal training strategy (group C strategy) is 0.045 but only insignificant at 23% level. Though this does not support the research hypothesis H3, a positive but insignificant parameter estimate might partially reflect heterogeneity in implementing the strategies for developing employees' skills within firms. The coefficient for the ICT use is positive 0.09, but significant only at 17% level, where as the coefficient for foreign ownership indicator is 0.14 and highly significant at 1% level. To find additional statistical evidence on the link between HRM practices and firm productivity (not reported in the paper), we tested by the Wald tests whether the HRM variables are jointly significant within group A, within group B, and then jointly in all three groups. The p-values were highly significant (0.06 for group A; 0.00 for group B; 0.00 for groups A,B and C) giving an additional statistical support for the link between HRM practices and firm productivity. Finally, we tested normality of residuals by the Shapiro-Wilk, the Shapiro-Francia and the Skewness-Kurtosis tests. All tests suggest normality supporting our statistical inference.

Third, the previous evidence suggests that firms may simultaneously use several HRM strategies. Therefore, we tabulated HRM strategies (categorical variables) within groups A and B into 2x2 contingency tables and tested pairwise whether strategies are statistically independent by the Pearson chi-square and the Fisher's exact tests. We find significant evidence on the dependence at a reasonable significant levels in the both groups; especially between share ownership and profit sharing, stock option scheme and profit sharing, consultative committee and job rotation, and self-directed teams and job rotation. This evidence indicates that it might be statistically difficult to be able to isolate the individual effects of these variables on firm productivity. Therefore, we conducted a principal-component analysis for the HRM strategies within groups A and B, and then estimated the model in column (1) with the first principal-components (PCA) as explanatory variables.[17] In column (2), the first principal component for performance-based pay strategies in group A is positive 0.045 at 1% significant level. This gives an additional statistical support for the research hypothesis H1, indicating about 4.5% effect on firm productivity. For the research hypothesis H2 (flexible employee and employee involvement strategies), the estimate for the first PCA component is positive 0.023, but significant at 12% level. However, if one is willing to accept this "near 10% significant level", the estimate indicates about 2.3% effect on firm productivity, supporting the research hypothesis H2. The parameter estimates for formal training strategy, ICT use, and foreign ownership are close to those of reported in column (1). Finally, we test by the Wald test (not reported here) whether the HRM strategy variables (i.e. the first principal component for performance-based pay, the first principal component for flexible job design and employee involvement, and formal training strategy) are jointly significant. The Wald test shows strong statistical support (at 1% level) for the link between HRM practices and firm productivity.

Table 9. The Cobb-Douglas production function estimates for cross-section 2005 and panel data 2002-2005.

	(1)	(2)	(3)
Explanatory variables	OLS 2005	OLS 2005 & PCA components	Fixed Effects 2002-2005
ln(L)	0.528 *** (0.00)	0.523 *** (0.00)	0.632 *** (0.00)
ln(K)	0.465 *** (0.00)	0.470 *** (0.00)	0.352 *** (0.00)
Group A. Performance-based pay practices Profit-sharing scheme (dummy variable 0/1)	0.084 ** (0.03)	-	0.058 * (0.08)
Personnel fund (dummy variable 0/1)	0.062 (0.36)	-	-0.061 (0.28)
Personnel owns firm shares (dummy variable 0/1)	-0.091 ** (0.02)	-	-
Stock option scheme (dummy variable 0/1)	-0.083 (0.12)	-	-0.061 (0.30)
First PCA-component for group A	-	0.045 *** (0.01)	-
Group B. Flexible job design and employee involvement practices Consultative committee (dummy variable 0/1)	0.105 *** (0.01)	-	0.074 ** (0.04)
Employee representative in the board of the directors (dummy variable 0/1)	0.045 (0.43)		0.038 (0.47)
Teams (dummy variable 0/1)	-0.043 (0.24)	-	0.038 (0.34)
Job rotation (dummy variable 0/1)	0.006 (0.91)	-	-0.051 (0.13)
First PCA-component for group B	-	0.023 (0.12)	-
Group C. Developing employees' skills practices Formal training strategy (dummy variable 0/1)	0.045 (0.23)	0.044 (0.22)	-
ICT-use (share of employees using computers almost daily)	0.089 (0.17)	0.096 (0.14)	-
Foreign ownership (more than 50% of a firm's equity in foreign ownership)	0.142 *** (0.00)	0.156 *** (0.00)	-
Firms / Firm-year obs.	366 / -	366 / -	394 / 1469
R^2	0.94	0.94	0.56 (within)
Industry and geographical area dummies	yes	yes	no
Year dummies	no	no	yes

Notes The dependent variable is ln(sales). *** Significant at 1% level, ** at 5% level, * at 10% level, respectively. Absolute p-values in parentheses. Standard errors are based on a robust variance estimator, i.e. the Huber/White/sandwich estimator. In column (3), all monetary variables are deflated by using the CPI deflator at 2005 constant Euros obtained from Statistics Finland.

Fourth, we use the fixed effects estimator instead of the OLS estimator in column (3), since the fixed effects estimator allows to control for unobserved time-invariant effects, such as managerial ability, employee quality and organization structure if it is reasonable to assume that these are time-invariant in the time-period. Thus, by using the fixed effects estimator, we can separate firm fixed effects and common time-specific effects from several other factors that possibly have effects on firm productivity. However, a trade-off between the OLS and the fixed effects estimators is that we cannot use time-invariant explanatory variables (e.g. ICT use, foreign ownership) in column (3). The estimate for profit sharing scheme drops that of 0.084 in column (1) to 0.058 being statistically significant at 8% level. However, all the other strategies for performance-based pay in group A are insignificant. For the flexible job design and employee involvement strategies in group B, we find that the parameter estimate for the use of consultative committee is significant 0.038 at the 4% level, but other three strategies are statistically insignificant.

6. Conclusions

In this paper, we present the first empirical evidence on the effects of HRM practices on firm productivity in the Finnish manufacturing sector. We utilize a new survey data set on HRM practices in the firm-level, based on a representative random sample of the Finnish manufacturing firms who had 50 or more employees in 2005. The survey includes data on several HRM and employee participation practices of 398 firms, which is 38% of the firms in the population and almost 50% of the respondents. In the empirical analysis, the survey data was combined with financial statement data sets.

Based on the HRM survey data set, we find clear evidence that the incidence of some forms of employee participation practices has increased substantially from 2002 to

2005. Interestingly, both the incidence of employee participation practices and the incidence of human resource management tools has increased in the period, such as balanced scorecard (+23 percentage points), consultative committees (+17 percentage points), job rotation (+13 percentage points), formal employee recruiting criteria (+13 percentage points), quality circles (+12 percentage points), initiative system (+11 percentage points), TQM (+9 percentage points), whereas of employee financial participation practices only the share of firms using profit sharing (+12 percentage points) and personnel stock ownership (+4 percentage points) has increased in the period. This growth is in line with the previous empirical evidence from the US, Japan and the UK and indicates changes in a way of a work is organized, managed and rewarded in the Finnish manufacturing sector (at least in firms employing 50 employees or more).

Our empirical findings support a positive association with the HRM practices and the level of firm productivity. Perhaps more importantly, however, we find that not all forms of employee financial and decision-making participation practices have favorable productivity effects. For example, of individual performance-based pay practices (group A in Table 5), it appears to be profit sharing plan that has the most profound effect on the level of firm productivity, whereas the adoption of a personnel fund and a stock option scheme are statistically insignificant. This finding might be related to free-rider problems associated with collectively rewarding payment schemes: an individual who increases his effort will bear the full cost of the increase in effort, but will realize only a small part of the resulting increase in output (e.g. Alchian and Demsetz 1972). Another possible explanation comes from psychological expectancy theory (Vroom 1995). According to this “line-of-sight” argument, rewards based on performance can only be motivating if, by their actions, employees can influence the measures on which performance-pay is based. This is likely to be the case with profit scheme plans, where employees can be able to perceive a direct link between their

actions and the profit scheme reward. From the strategies for flexible job design and employee involvement (group B) and for developing employees' skills (group C), our statistical findings indicates that allowing employee voice in the form of consultative committee seems to matter more for the level of productivity than employee representation in the board of the directors, teams, job rotation and formal training strategy. This preliminary finding indicates that, at least from the productivity point of view, a focus should perhaps be more on an implementation than an adoption of an individual HRM strategy.

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Endnotes

[1] Because of a budget constraint, we limited the maximum number of respondents to 400 in the survey.
[2] Organizational innovation is a broad concept. It can include several practices on firm strategies, structure and behavioral dimensions. Based on OECD (2002), we divide organizational innovation practices on three categories: 1) production and efficiency practices, 2) human resource management practices and 3) product/ service quality-related practices.
[3] For example, ICT enables firms to adopt organizational changes in the areas of production, human resource management and quality-related practices. As a consequence, firms can increase flexibility in production and input use.
[4] To keep our study comparable with previous studies, we focus on manufacturing firms.
[5] We decided to focus on firms employing at least 50 persons, since smaller firms may not use modern HRM practices. In addition, smaller firms might be reluctant to participate in surveys, e.g. due to the lack of a respondent's time.
[6] The survey was conducted by a firm that is specialized on telephone surveys in Finland.
[7] We received contact information for firms in the population from Statistics Finland. The order of firms in a file was randomized twice. We did it first, and, without knowing this, also a telephone survey firm randomized the order of firms.
[8] We set a priori a cut-off point to 400 firms because of a budget constraint.
[9] Mäkinen and Kalmi (2006) describe the HRM survey data set in more detail.
[10] See www.balanceconsulting.fi/esittely/english.shtml, www.asiakastieto.fi/en/index.shtml and www.talouselama.fi/ te500list_eng.te.
[11] There are potentially important costs that can be associated with the strategies in Table 5. For example, badly implemented employee involvement might increase principal-agency and coordination costs.
[12] Our profit-sharing variable perhaps corresponds closest to that of presented in column (2) of Table 5. However, personnel fund, stock option scheme and personnel share ownership can be understood as a form of group incentive or group-based performance pay in column (2).
[13] In the HRM survey, we also asked whether a firm has organized ICT - and multi-skill training for their employees, but these two variables were highly correlated with the formal and written training strategy variable.
[14] Some of the previous studies on new workplace practices have been done on a case study basis (e.g. Ichniowski (1992)). Though these studies have increased our understanding on the adoption and effects of new workplace practices, it is challenging to generalize these findings more broadly.
[15] In a few cases, when a firm's financial statement information was missing in 2003 or 2004, the missing observation was substituted by the mean of previous and following year's observations.
[16] The HRM survey question was: "Does firm personnel, including managers, owns firm shares?", which also may carry information on firms that are owned by a small group of shareholders, such as family firms or firms that are jointly owned by managers and employees.
[17] The interpretation of PCA components can be challenging, especially when they are used as explanatory variables in empirical models. One rule to choose the number of components is eigenvalues. They need to be clearly larger than one, which is the case for the first components in column (2) of Table 9 (not reported here). Another reason why we only use the first components is that we like to construct an index of HRM practices for groups A and B. Therefore, the parameter estimates of PCA components in column (2) should interpreted as "an aggregate effect" (of a group of HRM practices) on firm productivity.

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