The Productivity Effects of Human Resource Management Practices: Evidence from New Japanese Panel Data

by

Takao Kato*
Motohiro Morishima**

Working Paper No. 143

June 1995

Correspondence: Takao Kato
Department of Economics
Colgate University, Hamilton, NY 13346
Phone: 315-824-7562 Fax: 315-824-7726
Internet: TKATO@CENTER.COLGATE.EDU

*Associate Professor of Economics, Colgate University and Research Associate, The Jerome Levy Economics Institute

**Associate Professor of Human Resource Management, Keio University

ABSTRACT

This paper uses new Japanese panel data to estimate the impact of various human resource management practices (HRMP's) on productive efficiency. These include information sharing devices, such as joint labor-management committees(JLMC's) and non-union employee associations (NUEA's), and financial participation schemes, such as profit sharing plans(PSP's) and employee stock ownership plans (ESOP's). By merging data from a new survey concerning HRMP's among publicly-held Japanese firms with two other public data sources, we create for the first time a enterprise-level panel data set for Japanese firms that provides information annually for 1970-85 on both information sharing and financial participation. The data are then used to estimate translog production functions augmented by variables to capture the effects of information sharing and financial participation. The estimations yield the first econometric evidence on the productivity effects of diverse HRMP's in Japan. The key findings include: (i) there are significant productivity-enhancing effects for JLMC's, NUEA's, PSP's and ESOP's; (ii) these productivity gains will change as HRMP's age. For instance, the introduction of a JLMC boosts productivity initially by 9 percent annually. The productivity gains rise over time and reach their highest point (11 percent) 23 years after the introduction of the JLMC. After their highest point, the productivity gains gradually diminish and eventually call for the implementation of a new innovation in information sharing; (iii) there is a significant complementarity between information sharing and PSP's; and (iv) the favorable productivity effects of information sharing are reinforced by the presence of formal trade unions, pointing to a complementarity between information sharing and unions.

I. Introduction

Among the most important policy questions confronting the leading western economies today is how to raise the disappointing rate of productivity growth and thus improve economic competitiveness. In searching for the key to enhancing competitiveness, many economists and policymakers turn to the case of Japan's high postwar productivity growth.[1]

In accounting for Japan's strong economic performance, especially in manufacturing, many emphasize a Japanese system of labor-management relations that, compared to the traditionally adversarial system characteristic of the US, is perceived to be much more cooperative and based on far more trust between labor and management (e.g. Aoki, 1988; Levine and Tyson, 1990). The contribution of particular Japanese institutions is often stressed. Thus Hashimoto (e.g.,1990) directs attention to the role of three institutions — the shushin koyo system which guarantees long term employment, the nenko chingin system, which provides for seniority wages, and enterprise unionisms. For Koike (1988) the key is the scope and nature of on-the-job training received by the average Japanese worker typically by job rotation. Also, most authorities argue that the labor market exhibits far more flexibility than in the US.

In reviewing these different views we are struck by the scarcity of systematic investigation of the potentially important roles of Human Resource Management Practices (HRMP's) in Japan, especially various financial participation schemes and a variety of

---

[1]See, for instance, Blinder (1990), Thurow (1986), Levine and Tyson (1990), the MIT Commission on Industrial Productivity (1989).

information sharing devices. For financial participation, Freeman and Weitzman (1987) that use industry-level aggregate data to show the statistically significant positive correlations between bonuses and employment level. However, Brunello (1991) uses firm-level micro data, from which industry-level data are aggregated, to account for a number of potential biases inherent in the use of aggregate data, and finds no statistically significant positive correlations between bonuses and employment level for the electric machinery, car and steel industries.[2] Recently, Jones and Kato (1995) use firm-level panel data to find that the introduction of an ESOP will lead to a 4 to 5 percent increase in productivity; this productivity payoff does not appear immediately; and there is a modest productivity gain from the bonus system. For information sharing Morishima (1991a; 1991b) use firm-level micro data to find the statistically significant positive correlations between the extent of information sharing through Joint Labor Management Committees (JLMC's) and productivity, and the statistically significant correlations between stronger JLMC's and shorter and smoother wage negotiation.

Nevertheless, no study has been able to consider both financial participation schemes and information sharing devices simultaneously. This weakness in the available empirical evidence is especially troublesome since several authors have recently developed hypotheses that some HRMP's may be more effective when used in combination with other HRMP's (see, for instance, Fitzroy and Kraft, 1987; Weitzman and Kruse, 1990; Levine and Tyson, 1990; Jones and Pliskin, 1991; Ben-Ner and Jones, 1992; Ichniowski, Shaw and Prennushi, 1993).

A main obstacle to systematic studies of the economic effects of HRMP's in Japan was

---

[2]He does find, however, the statistically significant positive correlation between bonuses and employment level for the textiles industry.

the absence of micro data, especially panel data providing information on various HRMP's of Japanese firms. Thus, we decided to conduct a survey of Japanese firms, the HRM Survey of Japanese Firms, from which such panel data can be assembled. The survey was administered at Keio University's Keio Economic Observatory during the summer of 1993. The sample universe of the HRM Survey of Japanese firms was the Toyo Keizai Kaisha Shiki Ho that provides a list of all firms listed in Japan's three major stock exchanges, Tokyo, Osaka and Nagoya. In 1993 there were 2,127 firms listed in those three exchanges.[3]

The survey itself was preceded by a pilot phase in which an earlier version of the instrument was tested on human resource managers of several firms as well as on researchers of the Japan Institute of Labor, the Japan Productivity Center, and the Japan Securities Research Institute who conducted similar yet smaller surveys in the past. On the basis of what we learned from this, the questionnaire was revised. The final version of the questionnaires were mailed to all 2,127 firms using a list of addresses from the Toyo Keizai Kaisha Shiki Ho in August of 1993.

We received usable responses from 371 firms (a response rate of 17%). Among those, there were 226 firms in manufacturing. The response rate of 17% is comparable or slightly higher than most prior surveys of similar nature in Japan. For instance, in June of 1991, the Rengo Sogo Seikatsu Kaihatsu Kenkyu Jo (Rengo Research Institute of General Life Development) mailed their questionnaire asking various questions on labor conditions and information sharing to 6,800 firms in Japan and received usable responses from 689 firms (a response rate of 10%). In June of 1989, the Japan Productivity Center mailed their

---

[3]Our sample universe is virtually a list of all listed firms in Japan. The only listed firms not included in the sample universe are a very small number of firms listed only in other local stock exchanges (about three dozens).

questionnaire asking various questions on HRMP's to 1030 firms in Japan and received usable responses from 203 firms (a response rate of 19.7%).

In this paper we merge data from this new survey with two other public data sources to create for the first time a panel data set for Japanese manufacturing firms that provides information on both information sharing and financial participation, specifically JLMC's, Non-Union Employee Associations (NUEA's), Profit Sharing plans (PSP's) and ESOP's.

The data are then used to estimate translog production functions augmented by variables to capture the effects of information sharing through JLMC's and NUEA's, and financial participation by PSP's and ESOP's. We find significant productivity-enhancing effects for all four HRMP's. We further find that these productivity gains will change as HRMP's age. For instance, the introduction of a JLMC boosts productivity initially by 9% annually. The productivity gains will then rise as time goes by and will reach their highest (11%) 23 years after the introduction of the JLMC.

With regard to the interactions amongst these HRMP's, we find a significant complementarity between NUEA's and PSP's. However, we also find that ESOP's and information sharing either via JLMC's or via NUEA's are substitutes.

Finally, we explore the link between these HRMP's and trade unions. We confirm that the key findings concerning the productivity effects of these four HRMP's do not change when unions are considered. We further find that unions and information sharing are complementary.

Our findings, we believe, are particularly timely in light of the recent Dunlop commission report documenting a growing interest in employee participation and labor-management cooperation by both labor and management in the United States whereas

realizing that "employee participation and labor-management cooperation are fragile and are difficult to sustain and diffuse in the American environment (Commission on the Future of Worker-Management Relations, 1994: 56)." In contrast to the "American environment" that tends to limit the diffusion of employee participation and labor-management cooperation and restrict their survival once adopted, employee participation and labor-management cooperation are wide-spread and deep-rooted in Japan. A closer look at the Japanese experience of employee participation and labor-management cooperation and their effects on work-place productivity and, thus, competitiveness appears to be of particular public policy interest for many countries considering participatory HRMP's a way to improve their productivity performance and thus competitiveness.

The paper is organized as follows. In the next section, we provide institutional information on JLMC's, NUEA's, PSP's and ESOP's.[4] Section III offers theoretical arguments for the productivity effects of these practices, while section IV provides the basic empirical strategy. In section V we present our main empirical results, followed by a concluding section.

II. Institutions

A. Joint Labor Management Committees (JLMC's)

One of the core mechanisms for labor-management relations within a large Japanese

---

[4]The HRM Survey of Japanese Firms also asked about small group activities such as QC circles. Unfortunately, since many more firms declined to respond to these questions than questions on other HRMP's, including small group activities will result in a substantial reduction of the sample size of our panel data. Furthermore, our preliminary investigation including them suggested that they may be less important than other HRMP's. Thus, in this paper we decided not to consider them. However, we will revisit these in our future work where we do not have to be so parsimonious.

firm is the joint labor-management committees (JLMC's). Established at the corporate level and involving both top corporate and union representatives, JLMC's serve as a mechanism for information sharing and labor consultation on a large variety of issues ranging from basic business policies to working conditions. The Ministry of Labour survey conducted in 1988 showed that about 72% of the firms with 100 or more regular employees had a standing JLMC. Among large firms with 1,000 or more employees, 88.4% reported having standing JLMC's, while 63.3% of firms with fewer than 1,000 regular workers had JLMC's. While the proportion of firms with JLMC's is substantially higher in unionized firms (around 90%), 40.3% of non-union firms also reported having standing JLMC's. Our survey of Japanese Firms gives the most recent picture as of 1993. In our sample, close to 80% of firms reported to have standing JLMC's.

Unlike German works councils, the establishment of JLMC's is not obligatory under the Japanese law, and therefore, voluntary. When there is a union, labor-side representatives are almost always union representatives, while even in the absence of unions, the majority of labors-side JLMC members are elected by employee vote (about 70%, Koike, 1978). Thus, while the establishment of a JLMC is voluntary on the side of management, JLMC members usually legitimately represent the interests of the firm workforce, making JLMC's a form of representative participation (Levine and Tyson, 1988).

According to Shimada (1992), JLMC's were one of the many labor-management institutions proposed at the beginning of 1950s by the Japan Productivity Center. After a decade of tumultuous labor-management relations between 1945 and 1955, Japanese unions and management, with the endorsement from the central government, began to implement a number of well-known human resource management techniques including JLMC's, quality

control circles, and semi-annual bonus payments to all employees. JLMC's were the hallmark of the labor-management communication institutions proposed and widely diffused during the late 1950s and 1960s. According to our survey, in 1950 about 20 percent of firms had standing corporate JLMC's. During the next two decades, the institution diffused rapidly (at a rate of about 20 percentage points for each decade. Thus, by 1970 the figure had risen to close to 60 percent. For the next two decades the institution diffused steadily, and, as of 1993, fully 80 percent of firms reported to have standing JLMC's at the corporate level.

Many observers attribute the peaceful firm-level labor relations observed in Japanese firms to the establishment of JLMC's (Shimada, .1992; Inagami, 1988). Within JLMC's, which meet almost once a month (an average of 11 times a year according to our survey), a number of issues are discussed, ranging from basic business policies to social and athletic activities sponsored by the firm. According to a survey conducted by the Policy Planning and Research Department of the Ministry of Labour in 1985 on the types of issues discussed in JLMC's and the degree of employee participation in each issue (quoted in Inagami, 1988), firms use JLMC's at least for information sharing on a wide variety of issues. In particular, more than 60% of the firms use JLMC's for information sharing for basic management decisions such as business strategies and production and sales plans. However, in many cases, the degree of employee influence with regard to these issues is small, with almost 79% of the firms only sharing information but not going any further. In contrast, when the issues more directly relate to employment conditions (such as working hours and holidays, wages and bonuses, and layoffs and employment adjustment), a large proportion of firms use JLMC's to consult with labor and even to allow employee representatives to participate in joint decision making. For example, out of the firms that discuss wage and employment security

issues, more than 87% of the firms at least consult with labor representatives prior to making these plans and 32 to 34% of the firms practice joint decision making. Thus, for direct labor issues, JLMC's appear to go beyond simple information sharing and serve a function of labor-management consultation and even joint decision making. At the same time, however, such use of JLMC's blur the distinction between collective bargaining and joint consultation in Japanese labor-management relations, an issue which has attracted a policy debate recently (Morishima, 1992).

B. Non-Union Employee Associations (NUEA's)

Aside from JLMC's and formal trade unions, many Japanese corporations have an employee association often called SHAIN KAI, or SHINBOKU KAI. The nature and scope of these NUEA's have not been well understood largely due to the absence of reliable evidence. Our survey is one of the first to provide information in some detail on NUEA's. According to the survey, the majority of responding firms (53%) had a NUEA. They are more prevalent in firms without unions (81% of firms without unions had a NUEA whereas 48% of firms with unions had a NUEA). Two-third of firms with NUEA's reported the inclusion of senior managers in the membership of their NUEA's, and close to 80% of them reported the presence of company subsidy. In this regard, legally they cannot be considered trade unions. While comparable statistics are hard to obtain, Sato (1994) reports that in his sample of small and medium-sized firms (N=375), 63.7% had some type of NUEA's. The proportion was lower among unionized firms (43.3%) and increases as firm size goes down. Since other studies have also found that the proportion of firms with NUEA's also increases with declining firms size, we assume that the difference between our results and those of Sato

(1994) are because our sample mainly includes large firms. The function that is often associated with NUEA's, as the Japanese name implies, is to organize and sponsor social and recreational activities for company employees. Some argue, however, that in some cases, NUEA's play an important role of giving employees voice, especially in the absence of formal unions (Koike, 1988; 199, Osawa, 1989, 7; Sato, 1994). For example, Sato (1994) reported that in his survey, approximately one third of NUEA's are what he calls "NUEA's with Voice" whereas the rest are "NUEA's for social activities." Sato (1994) defines "NUEA's with Voice" as those that engage in negotiations over employment contract and/or those that have the ability to voice employee concerns in the management of the firms. According to a survey done by Tokyo Municipal Labor Research Center in 1990, about 32% of the NUEA's they surveyed had "union-like" functions, referring to the ability to negotiate employment conditions. Thus, available evidence suggests that NUEA's are more prevalent in smaller, non-union firms, and when established, approximately one-third of them act like "unions." However, even when NUEA's do not engage in contract negotiation, this does not preclude the possibility that they facilitate information sharing or effectively carry out other representational functions, similar to those associated with JLMC's. Sato (1994)'s evidence indicates that in his sample, 41.3% of the NUEA's are used by management as a mechanism to inform employees of the management policies and business plans, and 28.3% are used by management gather information on employees' reaction to management proposed management policies and business plans. These percentages increase when NUEA's have negotiating roles. Thus, the evidence indicates that similar to JLMC's, NUEA's also have information sharing and consultation functions, although to a lesser degree. In addition, according to Sato (1994), NUEA's also serve as management's tools to collect information on employee preferences and

wishes (54.9%) and, as noted earlier, to facilitate social activities among employees (82.4%). Finally, there is some evidence that union-like NUEA's are considered to be substitutes for bona fide labor unions by both management and labor. Sato (1994) reports that the proportion of employers who consider that unions "do not have a place in our firm" is higher among those firms with union-like NUEA's (30.5%) than the overall average (20.8%).

Our HRM Survey of Japanese Firms also reveals for the first time the diffusion of NUEA's among Japanese firms in the postwar era. In 1950 only one in ten firms had a NUEA. The proportion of firms with NUEA's grew steadily since then, reaching 45 percent by 1980. The diffusion of NUEA's slowed down during the last decade; in 1993, one in two firms reported to have a NUEA.

C. Profit Sharing Plans (PSP's)

PSP's are a pay system in which the total amount of bonuses are linked to a measure of firm performance, such as profit. The Japanese bonus payment system has attracted considerable attention and controversy, in particular the claim (e.g. Freeman and Weitzman, 1987) that it is a form of a PSP. In light of the ongoing debate between those who stress the profit sharing aspect of the Japanese bonus system (e.g., Freeman and Weitzman, 1987) and those who downplay it (e.g., Ohashi, 1989, Brunello, 1991), we consider only the least controversial (with respect to the profit-sharing aspect of the bonus payment system) types of the bonus payment system, i.e., the bonus payment system with a formal contract stipulating the terms of the profit-sharing plan.

According to our survey, one in four firms had a PSP in 1993.[5] The proportion of firms with a PSP was only 5 percent in 1960 and grew steadily to 14 percent by 1980. A significant diffusion occurred during 1980s, however, with the proportion of firms with PSP's growing to over 20 percent by 1990.

Our survey also reveals that PSP's are more prevalent in smaller firms. For instance, the proportion of firms with 5,000 or more employees that had a PSP was only 11 percent. PSP's are more wide-spread in the non-union sector (more than 40 percent of firms without union had a PSP in 1993).

The large majority (70 percent) of firms with a PSP reported separate profit-sharing plans for officers and non-officers. However, Japanese PSP's do not normally distinguish between union and non-union members (only one-thirds of firms with PSP's reported separate PSP's for union and non-union members). PSP's are mostly company-wide with only 12 percent of firms with PSP's reporting separate plans for different divisions and occupations. Moreover, nearly all Japanese PSP's are cash plans (98 percent), which is in sharp contrast to the U.S. where deferred plans are more popular (see Kruse 1993: 16-17). Being almost always cash plans, Japanese PSP's have no tax advantage. Thus, the role of public policy here again has been informal and educational, consisting largely of data gathering, information dissemination, and related activities.

The majority of Japanese PSP's (55 percent) do not have set formula for how the contribution should be tied to profits, which is also in contrast to PSP's in the U.S. where only 22 percent do not have set formula (Kruse, 1993: 75). Kruse (1993) reported that cash

---

[5]The figure is nearly identical to that reported by a large governmental survey called the General Survey of Wages and Hours Worked System (Chingin Rodojikan Seido to Sogo Chosa), 1985.

plans without a set formula were the most effective PSP's in terms of their productivity effects. This points to potentially strong positive productivity effects for Japanese PSP's.

D. Employee Stock Ownership Plans (ESOP's)[6]

Japanese ESOP's are perhaps best understood by comparing their main features with the better known U.S. ESOP's. Unlike U.S. ESOP's, Japanese corporations establishing an ESOP (called mochikabukai) do not receive any tax incentive to do so. To induce individual employees to participate in the ESOP, companies offer subsidies (typically the firm matching each employee's contribution by giving 5 to 10 percent of the contribution as well as bearing administrative costs). Whereas ESOP's elsewhere frequently are structured so as to encourage strong participation by top management, in Japan executives (as well as part time and temporary employees) are normally ineligible for membership. As is the norm elsewhere, individual participants' shares (and dividends) in the ESOP are held in trust. Unusually, however, each participant has a right to withdraw his/her shares, and share withdrawals are privately owned. Permission to withdraw is normally subject to the following requirements: (i) employees must keep at least 1,000 shares in the trust; and (ii) withdrawals are permitted only in 1,000 shares, round lots. It takes more than 20 years for the average participant to accumulate 2,000 shares so that he/she can withdraw 1,000 shares for the first time (Nomura Securities, 1990: 29). While members may freely exit completely from the ESOP, re-entry is restricted. Exiting employees will receive their shares in 1,000 shares, round lots, and must sell the remaining shares to the trust at the prevailing market price. Upon retirement, model

[6]For institutional information on Japanese ESOP's, I draw heavily on Jones and Kato (1993, 1995).

rules adopted by most ESOP's require retiring workers to exit completely from the ESOP. Finally, the general director (rijicho) represents stockholders in the ESOP. The general director is chosen by other participants, on a one-participant, one-vote basis.[7] At the general meeting of shareholders, the general director votes the stock held by the plan, deciding independently, rather than by tabulating votes of employee participants. The general director must be a participant in the ESOP and thus is not an executive.

Our survey shows that ESOP's are a relatively new and the most rapidly diffused innovation among various Japanese HRMP's. Thus, in 1960 the proportion of firms that had an ESOP was only 4 percent. The proportion grew rapidly during the next decade, reaching 26 percent by 1970. In 1967, a special government committee on foreign capital advocated employee ownership as a way to help prevent foreign takeovers of domestic firms. The government, using informal channels, encouraged firms to set up new ESOP trusts to accommodate employee investments in their stock. While the fear of foreign takeovers diminished in the 1970s, the idea of employee ownership took root. Perhaps partly due to this government initiative of 1967, the 1970s were characterized by an astonishing pace of diffusion of the institution, and the proportion of firms with an ESOP grew to 70 percent by 1980. The diffusion continued even after 1980, and in 1993 it became a universal phenomenon (97 percent of firms reported to have an ESOP in that year).

Our survey also shows that in 1993, almost 50 percent of the labor force in firms with

---

[7]In practice the general director sometimes assumes the directorship without formal election. (Based on interviews by Kato with the general directors and/or middle managers in charge of employee benefits of four manufacturing firms in Aichi and three non-manufacturing firms in Tokyo, summer 1991).

ESOP's participated in ESOP's.[8] Furthermore, concerning employee stakes, Jones and Kato (1995) report that, in 1988, ESOP's owned stock worth 4.1 trillion yen (about 32 billion dollars); this amounts to 1.7 million yen (about 14,000 dollars) per participant. Since the average workers' household (households whose head is a non-executive employee) owned net assets of 6.164 million yen in 1988,[9] this means that the average stake of ESOP participants in 1988 represents about 30 percent of the total value of the average workers' household's net assets.

However, according to Jones and Kato (1995), these plans do not own large percentages of company stock. For listed companies the proportion of stock owned by ESOP's has varied between 0.66 percent and 1.42 percent. In 1988 the average was lower than 1 percent and holdings over 5 percent were rare. However, while the total percentage of equity owned by plans is small, according to Nomura Securities (1990), in 21 percent of all listed Japanese firms, the ESOP is one of the ten largest shareholders.[10]

---

[8]Both in terms of the incidence of the plan and the rate of participation of employees, our survey results are comparable to the Survey of Stock Distribution (Kabushiki Bunpu Jyokyo Chosa), conducted annually since 1973 by the National Conference Board of Securities Exchanges (Zenkoku Shoken Torihikijyo Kyogikai). Since all firms listed on Japan's eight stock exchange markets respond to the survey every year, the survey provides the most accurate aggregate picture of the diffusion of Sops among firms listed on Japanese stock markets.

[9]This figure is from the Family Saving Survey (Chochiku Doko Chosa), conducted annually by the Japanese government's Management and Coordination Agency, Statistics Bureau.

[10]In addition, the importance of Sops in Japan may be illustrated by some comparisons with employee ownership in the U.S. Most importantly, in the U.S., there is on average a substantially lower incidence of plans, especially in manufacturing and sectors such as transportation and construction. (Compare, for example, our description of Japanese Sops with Joseph R. Blasi and Douglas L. Kruse, 1991: Chapter 1).

Second, the average account balance in a U.S. ESOP had grown to $12,977 by 1987 [U.S. General Accounting Office (U.S. GAO), 1990:4]. As such, this was below the $14,000 figure for Japanese Sops. However, participants in U.S. Sops nearly always include

II. Productivity Effects of HRMP's: Hypotheses

In general, formal economic theory is ambiguous as to the expected effect of participatory HRMP's on productivity. (For reviews, see the essays in Blinder, 1990). Focusing on individual motivation and performance, however, several hypotheses predict positive productivity effects, of which the following two (Goal Alignment Effects and Human Capital Effects) are perhaps most important. In addition, there are a number of hypotheses concerning the complementarities and substitutabilities of HRMP's.

---

executives and often exclude groups of non-executive employees. Since the average stake is strongly linked to earnings, it is almost certainly the case that the average non-executive's ownership stake in a U.S. ESOP will be substantially below that for participants in Japanese Sops, where executives are excluded.

Third, participation rates by non-executive employees in manufacturing firms that have plans seem to be broadly comparable in the U.S. Thus, for firms quoted on U.S. stock exchange markets, Blasi and Kruse (1991) assembled data for firms which are at least 4 percent employee held. For these they estimate that in 1988/89, on average 50 percent of employees were participants in Sops. But, since firms that were at least 4 percent employee held must have had much more ESOP activity than firms with Sops as a group, the participation rate in all firms with Sops (rather than only firms with "strong" Sops) must have been below 50 percent. By comparison, for all manufacturing firms quoted on Japanese stock exchanges with Sops in 1988, on average, 46 percent of employees were participants in the ESOP (Survey of Stock Distribution).

Fourth, there is much attrition in U.S. Sops and recently there has been a dramatic increase in the termination rate for U.S. plans -- from 15 percent between 1979-1985 to 30 percent between 1981-1987 (U.S. GAO, 1990:8). This contrasts sharply with the situation in Japan, where the rate of termination is negligible.

Last, we briefly consider the implications of employee ownership for employee influence in enterprise governance. Insofar as in neither case do Sops, on average, own large percentages of the market value of public corporations, the situations are quite similar. Thus Blasi and Kruse (1991:12) estimated that the total value of US Sops was less than 3 percent of the market value of all public companies. This compares with a comparable Japanese figure of 0.85 percent (Survey of Stock Distribution). However, for the 1000 U.S. public corporations with Sops in which employee ownership is strongest, the median ownership is estimated to be almost 10 percent (Blasi and Kruse, 1991:12). But even for these top 1000 U.S. Sops, non-managerial employee involvement and influence via Sops was typically modest. Thus it is estimated that fewer than 10 firms have non-managerial employees representing employee shareholders by serving on the board, and that only 5 percent are judged to have a "participatory" culture (Blasi and Kruse, 1991:216-230).

A. Goal Alignment Effects of HRMP's

Consider ESOP's first as they are the easiest example by which one can understand how the goal alignment effects arise. The most direct positive effects of ESOP's result from enterprise success being reflected in a higher price of its equity, and thus higher wealth for employees who own stock in the ESOP. In such cases, the interest of the firm is more aligned with the interest of its employees. For several reasons, these interest alignment effects of ESOP's can be expected to be more significant in Japan than in the U.S. Thus, while ESOP's in the U.S. often are structured to encourage strong participation by top management, normally executives are ineligible for membership in Japanese ESOP's (Jones and Kato, 1995). U.S. ESOP's frequently are designed to prevent participation by groups of non-executive employees, especially union members (Blasi, 1988). But in Japan typically all full-time non-executive employees are eligible for membership and, based on our interviews with managers of several Japanese manufacturing corporations, it appears that blue-collar workers actively participate in ESOP's. Moreover, the average ESOP participant owns a substantial amount of stock, worth 14,000 dollars on average. An almost identical argument can be developed for PSP's.

The goal alignment effects of information sharing via JLMC's and NUEA's are more subtle (but not necessarily weaker). First, information sharing is expected to reduce information asymmetry between labor and management and, consequently, avoid the development of adversarial labor-management relations. In labor-management relations, employers are said to have more information about the status of the firm and business strategies. Workers, under usual collective bargaining arrangements, have no means of obtaining such information except to resort to hard bargaining often coupled with the threat of

strikes (Tracy, 1986). Such behavior on the part of the unions and employees may lead to adversarial labor relations, which may, in turn, have negative consequences for productivity. Voluntary information sharing by management, via such mechanism as JLMC's and NUEA's, is likely to reduce the cost of such information asymmetry and is likely to have positive effects on productivity. Second, employers may be voluntarily share information to enhance worker loyalty, and all else equal, reduce turnover (Kleiner and Bouillon, 1991). Worker cooperation may also be obtained through higher workers commitment and loyalty. Enhanced worker loyalty, reduced turnover and cooperative behavior are all predicted to have positive effects on productivity. In economic terms, sharing information on private information which has been heretofore restricted to owners and top management is likely to lead to goal alignment and trust between labor and management. Better informed via JLMC's and NUEA's, workers, while still striving for their own benefit, may be more likely to be convinced that it is in their interest to cooperate with management and improve productivity and firm performance. They may see more clearly the path from their own behavior to enlargement of the benefits through firm prosperity. Also, information sharing is likely to curtail management's opportunistic behavior and increase the level of trust that labor has for management. In a repeated game situation where the interdependence between labor and management is likely to continue in the future, provision of private, business information is likely to enable labor to detect management's deception and curtail opportunistic behavior. Moreover, labor is more likely to develop trust in management that voluntarily shares information. Overall, by avoiding the negative consequences of management's moral hazard and increasing the positive effects of labor's cooperative behavior, information sharing is likely to have favorable effects on productivity. These effects are even more likely to be

enhanced when JLMC's and NUEA's go beyond simple information sharing, by allowing employee to participate (to varying degrees) in joint decision making. As indicated earlier, JLMC's and NUEA's often act as mechanisms for employee consultation and joint decision making. In these cases, the positive productivity effects are predicted to be even more pronounced.

B. Human Capital Effects of HRMP's

JLMC's and NUEA's may play an important role of providing employees a voice in the firm and thus reduce the costs of exit from the firm, saving specific human capital.[11] In the absence of unions, these arrangements may provide the sole voice mechanism, while in the presence of unions they may supplement the direct voice mechanism of unions. Also, in order to own shares privately, the average employee participant in a Japanese ESOP must stay with the firm for a significant number of years (Jones and Kato, 1995). This vesting feature would be expected to discourage employee turnover and promote the formation of more firm-specific human capital.

C. Complementary Effects of HRMP's

Information sharing and financial participation are likely to have complementary effects on productivity through goal alignment processes, with financial participation directly aligning employees' and management's goals, and information sharing indirectly aligning two parties' goals by modifying employee perceptions and expectations regarding management's behavior. Three specific mechanisms may be proposed. First, as Levine and Tyson (1990:

[11]In the context of trade unions, the argument was first developed by Freeman (1976).

209) argue that successful information sharing will require financial participation schemes that assure financial rewards for continued participation in information sharing by employees. Information sharing, which induces employees' cooperative behavior is not likely to be effective over a long haul in the absence of tangible rewards, since employees may lose interest in being cooperative and reduce their loyalty. Second, financial participation may also require information sharing to be effective, in part, due to the role which information sharing plays in reducing management's moral hazard. One of the important preconditions of a successful financial participation scheme is that employees need to trust that management is honest in reporting the status of the firm to both employees and outside markets. Voluntary information sharing, often involving private information not yet available to the outside investors, allows employees to monitor employer behavior more effectively. Management, which voluntarily shares financial and other business information knowing that such information may be used to discipline their own behavior, is also not likely to engage in deceptive and opportunistic behavior in financial participation schemes. Third, Weitzman and Kruse, 1990: 100) argue that profit sharing works only when the free rider problem is effectively eased. Arguably the free rider problem will be alleviated when workers develop a strong long-term commitment to the company, so that workers face a repeated game, and/or when workers engage in active peer monitoring. As discussed above, information sharing can be thought of a mechanism to facilitate the development of a long-term commitment to the firm by its workers.

D. Unions and HRMP's

The conventional wisdom is that unions will be expected to reduce the effectiveness of

HRMP's. This follows from diverse reasons --for example limited cooperation in general between a union and a body such a JLMC. However, in some circumstances, unions can be a complement to HRMP's. For instance, when unions are allowed to select labor representatives to corporate JLMC's, employees' skepticism about JLMC's can be reduced and their full participation can be encouraged. Moreover, unions can increase the effectiveness of information sharing by facilitating the dissemination of information shared during the corporate JLMC's meetings to the rank and file via formal and informal union meetings and newsletters.

Whole-hearted participation in information sharing is sometimes hampered by employee participants' fear that their suggestions to enhance productivity may result in the elimination of their jobs. Again, the presence of unions, who fight for the protection of jobs, can ease this kind of fear and thus encourage more whole-hearted participation of employees.

Furthermore, unions complement JLMC's by providing assurance and support to the voluntary nature of JLMC's. As noted earlier, JLMC's have no legal foundation in the Japanese labor their existence or functions, in contrast to labor unions which are grounded in the Japanese collective bargaining system. Thus, those JLMC's existing without union representation may be weaker due to the fact that the existence and strength of information sharing and consultation functions are entirely up to management's whim. They may be taken away any moment and labor's efforts to increase the level of participation through JLMC's may lack an effective power base. In contrast, when unions are present, they may provide further negotiating power to the labor side in maintaining or even increasing the strength of information sharing and consultation through JLMC's.

III. Basic Empirical Strategy and the Data

In estimating the impact of JLMC's, NUEA's, PSP's and ESOP's on productive efficiency, our basic empirical strategy is to use a production function framework.[12] Specifically we estimate equations of the general form:

(1) $Q = F(K, L, H, Z)$

where Q denotes a measure of output, K and L are a measure of total capital stock and total employment; H is a vector of variables representing the effects of JLMC's, NUEA's, PSP's and ESOP's on productivity; and Z is a vector of control variables such as managerial ability.

We estimate various specifications of Eq. (1) by using an important new sixteen year panel containing 65 firms over the 1970-1985 (accounting year) period. All observations are for manufacturing firms listed in Japan's three major stock exchanges, Tokyo, Osaka and Nagoya. This panel data set was assembled by merging three data bases. The data on JLMC's, NUEA's, PSP's and ESOP's were from our HRM Survey of Japanese Firms. The data on K and L were compiled from the Nikkei financial data tapes, Nikkei Needs. The data on value added as a proxy for Q were published in various special Data Bank issues of Weekly Oriental Economist (Weekly Toyokeizai) during 1974-1987 by the Oriental Economist (Toyokeizai Shinpo Sha). There were 65 manufacturing firms for which we have complete information on Q, K, L, H for each year from 1970 through 1985. In converting nominal variables into real variables, we used the Wholesale Price Indices (WPI) published by

[12]Our framework is similar to the one adopted by recent studies on the productivity effect of profit sharing in the U.S. and U.K. See, for instance, John R. Cable and Nicholas Wilson (1989, 1990), Sushil Wadhwani and Martin Wall (1990) and Kruse (1992).

the Bank of Japan to deflate all nominal variables.[13]

IV. Specifications and Results

We begin with the translog specification without interaction terms:

$$
\begin{aligned}
(2)\quad \ln Q_{it} = {} & \beta_K \ln K_{it} + \beta_L \ln L_{it} + \beta_{KK}(\ln K_{it})^2 + \beta_{LL}(\ln L_{it})^2 + \beta_{KL}(\ln K_{it} * \ln L_{it}) + \beta_J JLAGE_{it} \\
& + \beta_N NUAGE_{it} + \beta_P PSAGE_{it} + \beta_E ESAGE_{it} + \beta_{JJ}(JLAGE_{it})^2 + \beta_{NN}(NUAGE_{it})^2 \\
& + \beta_{PP}(PSAGE_{it})^2 + \beta_{EE}(ESAGE_{it})^2 + \beta_{JJJ}(JLAGE_{it})^3 + \beta_{NNN}(NUAGE_{it})^3 \\
& + \beta_{PPP}(PSAGE_{it})^3 + \beta_{EEE}(ESAGE_{it})^3 + \alpha_i + \tau_t + u_{it}
\end{aligned}
$$

where Q_{it} is output of firm i in year t; K_{it} is the capital stock; L_{it} is labor; $JLAGE_{it}$ is the age of a JLMC; $NUAGE_{it}$ is the age of an NUEA; $PSAGE_{it}$ is the age of a PSP; $ESAGE_{it}$ is the age of an ESOP; α_i is firm specific fixed effects; τ_t is year effects; and βs are slope coefficients. For the disturbance term, u_{it}, we assume $u_{it} \sim NID(0, \sigma^2)$.

Table 1 provides summary statistics of all variables to be used in the subsequent analysis. Output is measured by value added deflated by the WPI for manufacturing products at the 2-digit industry level (published by the Bank of Japan) for each accounting year. The capital stock is proxied by the fixed assets of the firm deflated by the WPI for capital goods (published by the Bank of Japan). Labor is measured by the number of workers (executives and temporary workers excluded).

---

[13]It does not appear that our sample is biased towards firms with progressive human resource management. As we discussed before, the proportion of firms with each HRMP in our sample is quite similar to the one derived from other, often larger governmental surveys. The only exception is NUEA's, i.e., our sample shows 53% and is lower than what Sato (1994) reports. However, as we discussed, this is attributable to the prevalence of small firms in his sample.

We use the age of each HRMP to capture its productivity effects.[14] For instance, the marginal productivity gains from a JLMC is defined as $MPG_J = \partial \ln Q/\partial JLAGE$. The percentage change in Q as a result of an additional year of the JLMC is approximated by $(e^{MPGj} - 1)*100$. To allow the MPG to change over time, moreover, we introduce the age of each HRMP in a cubic form. Thus,

(3) $\quad MPG_J = \beta_J + 2\beta_{JJ}JLAGE + 3\beta_{JJJ}JLAGE^2$

β_J measures the marginal productivity gains from a JLMC at the time of its introduction. One may argue that the MPG from a JLMC may be small to begin with because workers may not commit fully to this new practice initially. As time goes by, the commitment of workers to this practice will increase and so will the MPG. However, the law of diminishing returns will eventually set in and thus the MPG will diminish. The practice will finally lose its power and will require a new innovation. This hypothesis on the life cycle of a JLMC will be supported if the estimates on β_{JJ} and β_{JJJ} are positive and negative. Moreover, the critical age of the practice at which the law of diminishing returns will set in can be given by $\beta_{JJ}/3\beta_{JJJ}$.

We include year dummy variables (τ_t) to capture technological change and other shocks that are common to all firms. Firm specific fixed effects (α_i) capture the time-invariant heterogeneity of our firms. In particular, firm specific fixed effects will attempt to control for differences among firms in managerial abilities and worker quality. As Wadhwani and Wall (1990) argue in the case of profit sharing, an innovative HRMP might be adopted in firms that are better managed. If so, the coefficients on HRMP variables might indicate the effects of superior managers as well as the actual effects of HRMP's. If managerial differences across firms are largely time-invariant, firm specific fixed effects will help

---

[14]A similar approach is taken by Kumbhakar and Dunbar (1993).

separate the two effects. Moreover, as Michael A. Conte and Jan Svejnar (1990) argue in the case of ESOP's, firms with innovative HRMP's might have more productive and more qualified workers than do conventional firms. To the extent that they are time-invariant, firm specific fixed effects will also capture these quality differences.[15]

Table 2 reports the OLS estimates of Eq. (2). To see whether the translog production functions are well behaved, we calculated the elasticity of output with respect to capital and labor. Always we find positive elasticities.[16] The coefficient on $PSAGE^3$ is clearly not significantly different from zero even at the 10% level, suggesting that the MPG from PSP's is linear instead of quadratic. We reestimated Eq. (2), assuming that the MPG from PSP's is linear. The estimated coefficients on JLAGE, PSAGE, ESAGE are positive and significant at the 2% level and the estimated coefficient on NUAGE is positive and significant at the 10% level. These estimated coefficients suggest that the introduction of a JLMC will boost annual productivity by 9% over the first year. Likewise, the introduction of an NUEA, a PSP, and an ESOP will enhance annual productivity by 2%, 6%, and 2% over the first year. These productivity gains will however change over time. Figure 1 was drawn using the estimated coefficients on JLAGE, $JLAGE^2$, $JLAGE^3$, which are all significant at the 2% level. As the figure shows, the MPG will initially rise as the JLMC ages. At age 23, the JLMC will reach its peak performance or almost a 11 percent increase in annual productivity as a result of having the JLMC one more year. Then the JLMC will begin to lose its efficacy gradually. We interpret this life cycle pattern of JLMC's as follows. Workers are initially not entirely

---

[15]A similar argument is made for the case of profit sharing by Masao Nakamura and Alice Nakamura (1989) and Ronald G. Ehrenberg (1990).

[16]We also estimated the Cobb-Douglas specifications. F tests indicate that the translog is the preferred specification.

committed to this new management initiative. However, as time goes by, the workers' commitment will increase. At the same time, both management and labor will refine the JLMC based on learning by doing. As a result, the efficacy of JLMC's will rise as they age. However, after 23 years, there will not be much room for learning by doing and the enthusiasm amongst managers and workers will also fade away.

Figure 2 was drawn likewise and indicate the opposite dynamic pattern for ESOP's. as Figure 2 shows, the MPG from ESOP's will decline from 2% to zero during the first 16 years, and will bounce back after. The estimated coefficients on ESAGE, $ESAGE^2$, and $ESAGE^3$ are all significant at the 5% level.[17] As described above, the typical worker will need to wait for 20 years till he can actually withdraw his share to realize capital gains. One may be able to argue that the strong goal alignment effects as well as the human capital effects of ESOP's are truly felt only after many years, say 16 years.

As discussed before, the MPG from PSP's is found to be monotonically diminishing from 6%, suggesting that the law of diminishing returns appears to set in even at earlier stages of the plan.

We now consider the interactions amongst these HRMP's. To this end, we add to Eq. (2), the following six interaction terms: JLAGE*NUAGE; JLAGE*PSAGE; JLAGE*ESAGE; NUAGE*PSAGE; NUAGE*ESAGE; and PSAGE*ESAGE. The coefficients on the interaction terms will indicate the complementarities and substitutabilities of these four HRMP's. In Table 3 we report OLS estimates of Eq. (2) augmented by these interaction terms. With regard to the interactions between information sharing and financial participation,

---

[17]One can draw a similar graph for NUEA's. However, since the coefficients on NUAGE, $NUAGE^2$, and $NUAGE^3$ are not all precisely estimated, one has to interpret the graph with much caution.

the estimated coefficients on NUAGE*PSAGE is positive and significant at the 5% level, confirming our prior that information sharing and financial participation by PSP's are indeed complementary. However, the estimated coefficients on JLAGE*ESAGE and NUAGE*ESAGE are negative and significant at the 2% level, pointing to the substitutabilities between information sharing and ESOP's. We are not totally sure of this anomaly. One possibility is that while information sharing may solicit workers' cooperation as employees of the firm, ESOP's may induce their sense of "ownership" of the firm, thus directing their attention to the total value of the firm as reflected in the stock value. Since the total value of the firm (at least in the short run) may be not attained only through employees' cooperative behavior only, but may be attained through such actions as layoff and downsizing, the existence of both ESOP's and information sharing may create conflicting motives in employees. While ESOP's create a sense of ownership and interests in the total value of the firm, information sharing may be conducive in creating a sense of loyalty as employees of the firm and interest in the long-term survival and growth of the firm.

Finally, we consider the issue of trade unions. First, one may argue that the observed productivity effects of these HRMP's are capturing the alleged productivity effects of unions.[18] The estimates reported in Tables 4A and 4B indicate whether and how much the results of Tables 2 and 3 change when we add UNAGE (age of unions) and $UNAGE^2$ and $UNAGE^3$ to control for the alleged productivity effects of unions (we add UNAGE only and then later add

---

[18]Very few attempts have been made to investigate the effects on firm performance of Japanese unions. Muramatsu (1983) used aggregate data grouped by industry and firm size to estimate production functions augmented by union density, and found significant positive effects on productivity of unions. However, Brunello (1992) recently used firm-level micro data to correct for aggregation bias and obtained the opposite result, i.e., that Japanese unions reduce productivity.

it in cubic form). It turned out that the introduction of unions does not change none of our key findings.

Second, to see if there is any interaction between HRMP's and unions, we add four interaction terms: UNAGE*JLAGE; UNAGE*NUAGE; UNAGE*PSAGE; and UNAGE*ESAGE to Eq. (2). The coefficients on the interaction terms will indicate the complementarities and substitutabilities of HRMP's and unions. In Table 5 we report OLS estimates of Eq. (2) augmented by these interaction terms. With regard to the interactions between information sharing and unions, the estimated coefficients on UNAGE*JLAGE are positive and significant at the 1% level whether UNAGE is introduced in linear form or in cubic form, indicating that information sharing via JLMC's and unions are complementary. Concerning the interactions between financial participation and unions, the coefficient on UNAGE*ESAGE is negative and significant at the 1% level when UNAGE is introduced in linear form, pointing to the substitutabilities between ESOP's and unions. However, the substitutabilities between ESOP's and unions are not particularly robust because the coefficient on UNAGE*ESAGE is no longer significant even at the 10% level when UNAGE is introduced in cubic form.

V. Conclusions

We report the first results for Japanese firms on the effects of four important HRMP's by estimating production functions using a unique new panel data set containing firms with varying ages of HRMP's. We find significant productivity-enhancing effects for all four HRMP's. We further find that these productivity gains will change as these HRMP's age. For instance, the introduction of a JLMC boosts productivity initially by 9% annually. The

productivity gains will then rise as time goes by and will reach their highest (11%) 23 years after the introduction of the JLMC. After that the productivity gains will gradually diminish and eventually call for a new innovation in information sharing.

With regard to the interactions amongst these HRMP's, we find a significant complementarity between NUEA's and PSP's. However, we also find that ESOP's and information sharing either via JLMC's or via NUEA's are substitutes.

Finally, we explore the link between these HRMP's and trade unions. We confirm that the key findings concerning the productivity effects of these four HRMP's do not change positive and significant at the 1% level when UNAGE is introduced in cubic form, indicating that information sharing via JLMC's and unions are complementary. Concerning the interactions between financial participation and unions, the coefficient on UNAGE*ESAGE is negative and significant at the 1% level when UNAGE is introduced in linear form, pointing to the substitutabilities between ESOP's and unions. However, the substitutabilities between ESOP's and unions are not particularly robust because the coefficient on UNAGE*ESAGE is no longer significant even at the 10% level when UNAGE is introduced in cubic form.

V. Conclusions

We report the first results for Japanese firms on the effects of four important HRMP's by estimating production functions using a unique new panel data set containing firms with varying ages of HRMP's. We find significant productivity-enhancing effects for all four HRMP's. We further find that these productivity gains will change as these HRMP's age. For instance, the introduction of a JLMC boosts productivity initially by 9% annually. The

REFERENCES

Aoki, Masahiko. Information, Incentives, and Bargaining in the Japanese Economy. New York and Cambridge: Cambridge University Press, 1988.

____."Toward an Economic Model of the Japanese Firm." Journal of Economic Literature, March 1990, 28 (1), pp. 1-27.

Ben-Ner, Avner, and Jones, Derek C. "A New Conceptual Framework for the Analysis of the Impact of Employee Participation, Profit Sharing and Ownership on Firm Performance." Department of Economics Working Paper No. 92/1, Hamilton College, February 1992 and forthcoming, Industrial Relations.

Blasi, Joseph R. Employee Ownership: Revolution or Ripoff? Cambridge: Balinger, 1988.

Blasi, Joseph R. and Kruse, Douglas L. The New Owners. New York: Harper Business, 1991.

Blinder, Alan S. ed. Paying For Productivity. Washington, D.C.: Brookings Institution, 1990.

Brunello, Giorgio. "Bonuses, Wages and Performances in Japan: Evidence from Micro Data." Ricerche Economiche, April-September 1991, 45 (2-3), pp. 377-396.

Cable, John R. and Wilson, Nicholas. "Profit Sharing and Productivity: An Economic Analysis of UK Engineering Firms." Economic Journal, June 1989, 99 (396), pp. 366-375.

____."Profit Sharing and Productivity: Some Further Evidence." Economic Journal, June 1990, 100 (401), pp. 550-555.

Conte, Michael A. and Svejnar, Jan. "Productivity Effects of Worker Participation in Management, Profit-Sharing, Worker Ownership of Assets and Unionization in U.S. Firms." International Journal of Industrial Organization, March 1988, 6 (1), pp. 139-151.

Ehrenberg, Ronald G. "Comment," in Blinder, Alan S., ed., Paying For Productivity, Washington, D.C.: Brookings Institution, 1990, pp. 88-94.

Fitzroy, Felix R. and Kraft, Kornelius. "Cooperation, Productivity and Profit Sharing." Quarterly Journal of Economics, February 1987, 102 (1), pp. 23-35.

Freeman, Richard B. "Individual Mobility and Union Voice in the Labor Market." American Economic Review, May 1976, 66 (2), pp. 361-368.

Freeman, Richard B. and Weitzman, Martin L. "Bonuses and Employment in Japan." Journal of the Japanese and International Economies, June 1987, 1 (2), pp. 168-194.

Hashimoto, Masanori. The Japanese Labor Market in a Comparative Perspective with the United States. Kalamazoo, Michigan: Upjohn Institute for Employment Research, 1990.

Ichniowski, Casey, Shaw, Kathryn, and Giovanna Prennushi. "The Effects of Human Resource Management Practices on Productivity." Paper presented at School of Industrial and Labor Relations, Cornell University, September, 1993.

Inagami, Takeshi. Japanese Workplace Industrial Relations Industrial Relations Series, No. 14. Tokyo: The Japan Institute of Labour, 1988.

Jones, Derek., and Kato, Takao. "The Productivity Effects of Employee Stock Ownership Plans and Bonuses: Evidence from Japanese Panel Data." American Economic Review, forthcoming in June 1995.

Jones, Derek C., and Pliskin, Jeffrey. "The Effects of Worker Participation, Employee Ownership and Profit Sharing on Economic Performance: A Partial Review," in Russell, Raymond, and Rus, Veljko, eds., Ownership and Participation: International Handbook of Participation in Organizations, Vol.2. Oxford: Oxford University Press, 1991, pp. 43-63.

Kleiner, Morris M. and Marvin L. Bouillon. "Information Sharing of Sensitive Business Date with Employees." Industrial Relations, Vol. 30 (No. 3, Fall), 1991, pp. 480-491.

Koike, Kazuo. Worker Participation (Rodosha no Keiei Sanka), Tokyo: Nihon Hyoron Sha, 1978.

___. Understanding Industrial Relations in Modern Japan, London: Macmillan Press, 1988.

Kruse, Douglas L. "Profit-Sharing and Productivity: Microeconomic Evidence from the United States." Economic Journal, January 1992, 102 (410), pp. 24-36.

---. Profit Sharing: Does It Make a Difference? Kalamazoo, Michigan: W.E.Upjohn Institute for Employment Research, 1993.

Kumbhakar, Subal C., and Dunbar, Amy E. "The Elusive ESOP-Productivity Link: Evidence from U.S. Firm-level Data." Journal of Public Economics, September 1993, 52, pp. 273-83.

Levine, David I. and Tyson, Laura D'Andrea. "Participation, Productivity and the Firm's Environment," in Blinder, Alan S., ed., Paying For Productivity, Washington, D.C.: Brookings Institution, 1990, pp. 183-236.

MIT Commission on Industrial Productivity. Made in America: Regaining the Productive Edge, New York: HarperPerennial, 1989.

Morishima, Motohiro. "Information Sharing and Firm Performance in Japan: Do Joint Consultation Committees Help?" Industrial Relations, Winter 1991a, 30 (1), pp. 37-61.

Morishima, Motohiro. "Information Sharing and Collective Bargaining in Japan: Effects on Wage Negotiations." Industrial and Labor Relations Review, April 1991b, 44 (3), pp. 469-485.

---. "Use of Joint Consultation Committees by Large Japanese Firms." British Journal of Industrial Relations, Vol. 30, September 1992, pp. 405-423.

Nakamura, Masao and Nakamura, Alice. "Risk Behavior and the Determinants of Bonus Versus Regular Pay in Japan." Journal of the Japanese and International Economies, September 1989, 3 (3), pp. 270-291.

Nomura Securities. Handbook of ESOP's (Mochikabu Seido no Unei Jitsumu). Tokyo: Business Law Research Association (Shoji Homu Kenkyu Kai), 1990.

Ohashi, Isao. "On the Determinants of Bonuses and Basic Wages in Large Japanese Firms." Journal of the Japanese and International Economies, December 1989, 3 (4), pp. 451-479.

Osawa, Machiko. "The Service Economy and Industrial Relations in Small and Medium Size Firms in Japan." Japanese Labor Bulletin, July 1, 1989, pp. 4-8.

Sato, Hiroki. "Industrial Relations in Non-unionized Firms (Misoshikikigyo ni okeru Roshikankei)." Monthly Journal of Japan Institute of Labour, October 1994, pp. 24-35.

Shimada, Haruo. "Japan's Industrial Culture and Labor-Management Relations." In Shumpei Kumon and Henry Rosovsky, eds., The Political Economy of Japan, Volume 3: Cultural and Social Dynamics. Stanford: Stanford University Press, 1992, pp. 267-291.

Thurow, Lester. ed. The Management Challenge: Japanese Views, Cambridge: MIT Press, 1986.

Tracy, Joseph S. "An Investigation into the Determinants of U.S. Strike Activity." American Economic Review, Vol. 76 (No. 3), 1986, pp. 423-436.

U.S. General Accounting Office (U.S. GAO). Employee Stock Ownership Plans: Participants' Benefits Generally Increased But Many Plans Terminated. Washington, D.C.: GAO, 1990.

Wadhwani, Sushil and Wall, Martin. "The Effects of Profit-Sharing on Employment, Wages, Stock Returns and Productivity: Evidence from UK Micro-data." Economic Journal, March 1990, 100 (399), pp. 1-17.

Weitzman, Martin, L. and Kruse, Douglas L. "Profit Sharing and Productivity," in Blinder, Alan S., ed., Paying For Productivity, Washington, D.C.: Brookings Institution, 1990, pp. 95-140.

Table 1 —— Summary Statistics: Means (Standard Deviation)

Variable	Description	Means (Standard Deviation)
Q	Value added in 1970 yen	$30.118*10^6$ ($67.567*10^6$)
K	Capital stock in 1970 yen	$22.844*10^6$ ($32.025*10^6$)
L	Employment	$6.1594*10^3$ ($10.864*10^3$)
JLAGE	Age of Joint Labor Management Committees (JLMCs)	22.598 (11.676)
NUAGE	Age of Non-Union Employee Associations (NUEA)	7.4058 (11.685)
PSAGE	Age of Profit Sharing (PS) plans	0.81731 (3.9383)
ESAGE	Age of Employee Stock Ownership Plans (ESOPs)	6.6779 (6.8835)
UNAGE	Age of trade unions	26.688 (10.669)
Observations	1040	
Number of firms	65	
Time period	1970-1985	

Sources: Human Resource Management Survey of Japanese Firms, Nikkei NEEDS, and Weekly Oriental Economist.

Table 2 —— OLS Estimates of Translog Production Function, Augmented By Human Resource Management Practices (Dependent Variable = lnQ)

Variable	(i)	(ii)
lnK	1.9833 (2.485)	1.9705 (2.490)
lnL	-4.1091 (6.355)	-4.1024 (6.369)
$(lnK)^2$	-0.88311E-01 (4.030)	-0.87992E-01 (4.044)
$(lnL)^2$	-0.14603 (4.372)	-0.14597 (4.373)
(lnK)*(lnL)	0.29756 (7.188)	0.29724 (7.197)
JLAGE	0.87234E-01 (7.395)	0.86951E-01 (7.510)
NUAGE	0.19696E-01 (1.867)	0.19758E-01 (1.876)
PSAGE	0.57897E-01 (2.960)	0.56096E-01 (4.159)
ESAGE	0.22984E-01 (2.479)	0.23207E-01 (2.550)
$JLAGE^2$	0.77064E-03 (2.372)	0.78086E-03 (2.481)
$NUAGE^2$	-0.10330E-02 (1.690)	-0.10321E-02 (1.690)
$PSAGE^2$	-0.21529E-02 (1.085)	-0.19052E-02 (4.939)
$ESAGE^2$	-0.14609E-02 (2.253)	-0.14683E-02 (2.274)
$JLAGE^3$	-0.11099E-04 (2.517)	-0.11226E-04 (2.615)
$NUAGE^3$	0.16574E-04 (1.563)	0.16522E-04 (1.560)
$PSAGE^3$	0.59376E-05 (0.127)	
$ESAGE^3$	0.30011E-04 (2.232)	0.30139E-04 (2.249)
Observations	1040	1040
Number of firms	65	65
Time period	1970-1985	1970-1985
R-squared	0.9625491	0.9625484

Notes: Absolute values of t statistics are in parentheses. All models include time dummies and firm specific fixed effects.

Sources: Human Resource Management Survey of Japanese Firms, Nikkei NEEDS, and Weekly Oriental Economist.

Table 3 —— OLS Estimates of Translog Production Function, Human Resource Management Practices Interacted with Each Other (Dependent Variable = lnQ)

Variable	(ii)
lnK	1.9057 (2.421)
lnL	-3.8175 (5.988)
$(lnK)^2$	-0.83419E-01 (3.864)
$(lnL)^2$	-0.14343 (4.372)
(lnK)*(lnL)	0.28284 (6.915)
JLAGE	0.74375E-01 (6.152)
NUAGE	0.21739E-01 (1.651)
PSAGE	0.69142E-01 (2.247)
ESAGE	0.76751E-01 (6.077)
$JLAGE^2$	0.15063E-02 (4.325)
$NUAGE^2$	-0.66867E-03 (1.054)
$PSAGE^2$	-0.54709E-03 (0.781)
$ESAGE^2$	0.11310E-03 (0.166)
$JLAGE^3$	-0.79824E-05 (1.802)
$NUAGE^3$	0.10256E-04 (0.976)
$ESAGE^3$	0.22961E-04 (1.679)
JLAGE*NUAGE	0.15569E-03 (0.436)
JLAGE*PSAGE	-0.19811E-02 (1.291)
JLAGE*ESAGE	-0.22969E-02 (5.642)
NUAGE*PSAGE	0.15322E-02 (2.148)
NUAGE*ESAGE	-0.69980E-03 (2.481)
PSAGE*ESAGE	0.94679E-03 (0.602)
Observations	1040
Number of firms	65
Time period	1970-1985
R-squared	0.9644948

Notes: Absolute values of t statistics are in parentheses. All models include time dummies and firm specific fixed effects.

Sources: Human Resource Management Survey of Japanese Firms, Nikkei NEEDS, and Weekly Oriental Economist.

Table 4A —— OLS Estimates of Translog Production Function, Augmented By Human Resource Management Practices, Unions Considered (Dependent Variable = lnQ)

Variable	(i)	(ii)
lnK	2.0283 (2.559)	2.2012 (2.778)
lnL	-4.1075 (6.378)	-4.1331 (6.450)
$(lnK)^2$	-0.89351E-01 (4.102)	-0.92765E-01 (4.275)
$(lnL)^2$	-0.14683 (4.399)	-0.14239 (4.198)
(lnK)*(lnL)	0.29776 (7.211)	0.29588 (7.148)
JLAGE	0.86372E-01 (7.455)	0.71294E-01 (5.565)
NUAGE	0.20099E-01 (1.908)	0.16842E-01 (1.596)
PSAGE	0.57483E-01 (4.247)	0.51961E-01 (3.831)
ESAGE	0.24082E-01 (2.639)	0.16481E-01 (1.761)
$JLAGE^2$	0.79672E-03 (2.530)	0.20323E-02 (3.836)
$NUAGE^2$	-0.10635E-02 (1.740)	-0.91524E-03 (1.493)
$PSAGE^2$	-0.19440E-02 (5.023)	-0.17252E-02 (4.414)
$ESAGE^2$	-0.15019E-02 (2.325)	-0.12253E-02 (1.888)
$JLAGE^3$	-0.11405E-04 (2.655)	-0.29590E-04 (3.545)
$NUAGE^3$	0.17007E-04 (1.605)	0.15433E-04 (1.454)
$ESAGE^3$	0.30718E-04 (2.292)	0.24130E-04 (1.773)
UNAGE	0.11758 (1.203)	0.25469 (2.421)
$UNAGE^2$		-0.18727E-02 (3.028)
$UNAGE^3$		0.24935E-04 (2.656)
Observations	1040	1040
Number of firms	65	65
Time period	1970-1985	1970-1985
R-squared	0.9626058	0.9630634

Notes: Absolute values of t statistics are in parentheses. All models include time dummies and firm specific fixed effects.

Sources: Human Resource Management Survey of Japanese Firms, Nikkei NEEDS, and Weekly Oriental Economist.

Table 4B —— OLS Estimates of Translog Production Function, Augmented By Human Resource Management Practices, Unions Considered (Dependent Variable = lnQ)

Variable	(i)	(ii)
lnK	1.9496 (2.473)	2.1188 (2.679)
lnL	-3.8263 (6.001)	-3.8268 (6.013)
$(lnK)^2$	-0.84525E-01 (3.910)	-0.87097E-01 (4.032)
$(lnL)^2$	-0.14436 (4.399)	-0.13492 (4.029)
(lnK)*(lnL)	0.28364 (6.934)	0.27704 (6.735)
JLAGE	0.73809E-01 (6.098)	0.61687E-01 (4.677)
NUAGE	0.22572E-01 (1.711)	0.19220E-01 (1.451)
PSAGE	0.69832E-01 (2.268)	0.64481E-01 (2.087)
ESAGE	0.77504E-01 (6.125)	0.68852E-01 (4.914)
$JLAGE^2$	0.15159E-02 (4.350)	0.24705E-02 (4.591)
$NUAGE^2$	-0.68110E-03 (1.074)	-0.54878E-03 (0.860)
$PSAGE^2$	-0.66008E-03 (0.931)	-0.33403E-03 (0.421)
$ESAGE^2$	0.84803E-04 (0.124)	0.21208E-03 (0.309)
$JLAGE^3$	-0.80391E-05 (1.814)	-0.24435E-04 (2.907)
$NUAGE^3$	0.10752E-04 (1.022)	0.88028E-05 (0.832)
$ESAGE^3$	0.23397E-04 (1.710)	0.17261E-04 (1.241)
JLAGE*NUAGE	0.13260E-03 (0.371)	0.16250E-03 (0.455)
JLAGE*PSAGE	-0.18276E-02 (1.186)	-0.20593E-02 (1.269)
JLAGE*ESAGE	-0.22948E-02 (5.637)	-0.21071E-02 (4.769)
NUAGE*PSAGE	0.14307E-02 (1.986)	0.16747E-02 (2.130)
NUAGE*ESAGE	-0.70814E-03 (2.509)	-0.72023E-03 (2.556)
PSAGE*ESAGE	0.85011E-03 (0.539)	0.87277E-03 (0.551)
UNAGE	0.96690E-01 (0.998)	0.18097 (1.737)
$UNAGE^2$		-0.14645E-02 (2.354)
$UNAGE^3$		0.21163E-04 (2.286)
Observations	1040	1040
Number of firms	65	65
Time period	1970-1985	1970-1985
R-squared	0.9645325	0.9647415

Notes: Same as Table 4A.

Table 5 —— OLS Estimates Of Translog Production Function, Human Resource Management Practices and Unions Interacted (Dependent Variable = lnQ)

Variable	(i)	(ii)
lnK	1.6202 (2.050)	1.7166 (2.190)
lnL	-3.6124 (5.562)	-3.5679 (5.578)
$(lnK)^2$	-0.78029E-01 (3.586)	-0.76707E-01 (3.570)
$(lnL)^2$	-0.15740 (4.685)	-0.12973 (3.861)
(lnK)*(lnL)	0.28418 (6.838)	0.26350 (6.422)
JLAGE	0.43961E-01 (2.676)	-0.14704E-01 (0.774)
NUAGE	0.27422E-02 (0.191)	0.92267E-02 (0.653)
PSAGE	0.11473E-01 (0.323)	0.87364E-02 (0.250)
ESAGE	0.10440 (5.185)	-0.19381E-01 (0.669)
$JLAGE^2$	-0.30681E-03 (0.606)	-0.18383E-02 (2.243)
$NUAGE^2$	-0.11553E-02 (1.841)	-0.12901E-02 (2.066)
$PSAGE^2$	-0.24317E-02 (3.904)	-0.25679E-02 (4.180)
$ESAGE^2$	0.18082E-03 (0.246)	-0.12921E-02 (1.675)
$JLAGE^3$	-0.11048E-04 (2.537)	-0.17103E-04 (2.028)
$NUAGE^3$	0.12096E-04 (1.135)	0.14761E-04 (1.403)
$ESAGE^3$	0.29978E-04 (2.230)	0.20176E-04 (1.490)
UNAGE	0.12981 (1.272)	0.20095E-01 (0.183)
UNAGE*JLAGE	0.23171E-02 (3.464)	0.61691E-02 (6.253)
UNAGE*NUAGE	0.60728E-03 (1.571)	0.49394E-03 (1.287)
UNAGE*PSAGE	0.14523E-02 (1.322)	0.15529E-02 (1.438)
UNAGE*ESAGE	-0.29835E-02 (4.583)	0.86926E-03 (0.946)
$UNAGE^2$		-0.41264E-02 (5.010)
$UNAGE^3$		0.58840E-05 (0.609)
Observations	1040	1040
Number of firms	65	65
Time period	1970-1985	1970-1985
R-squared	0.9635293	0.9648199

Notes: Absolute values of t statistics are in parentheses. All models include time dummies and firm specific fixed effects.
Sources: Human Resource Management Survey of Japanese Firms, Nikkei NEEDS, and Weekly Oriental Economist.

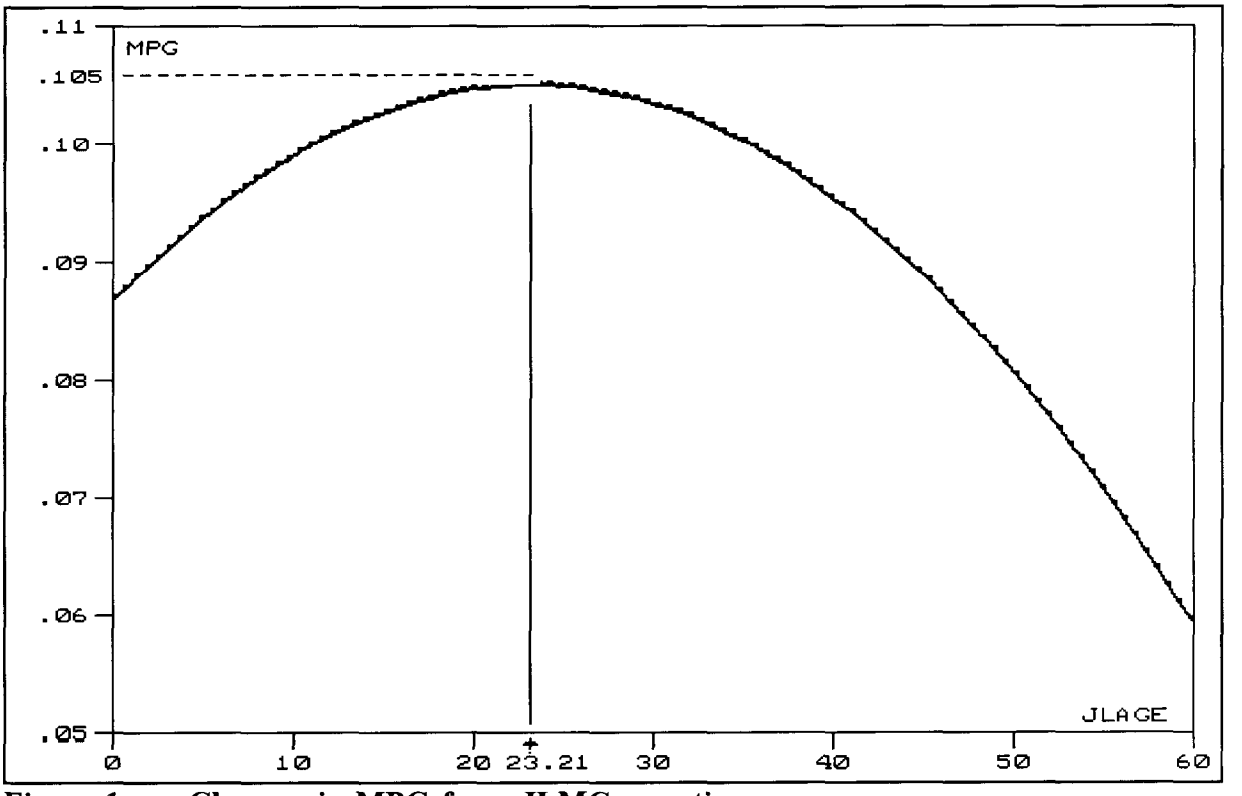

Figure 1 — Changes in MPG from JLMC over time

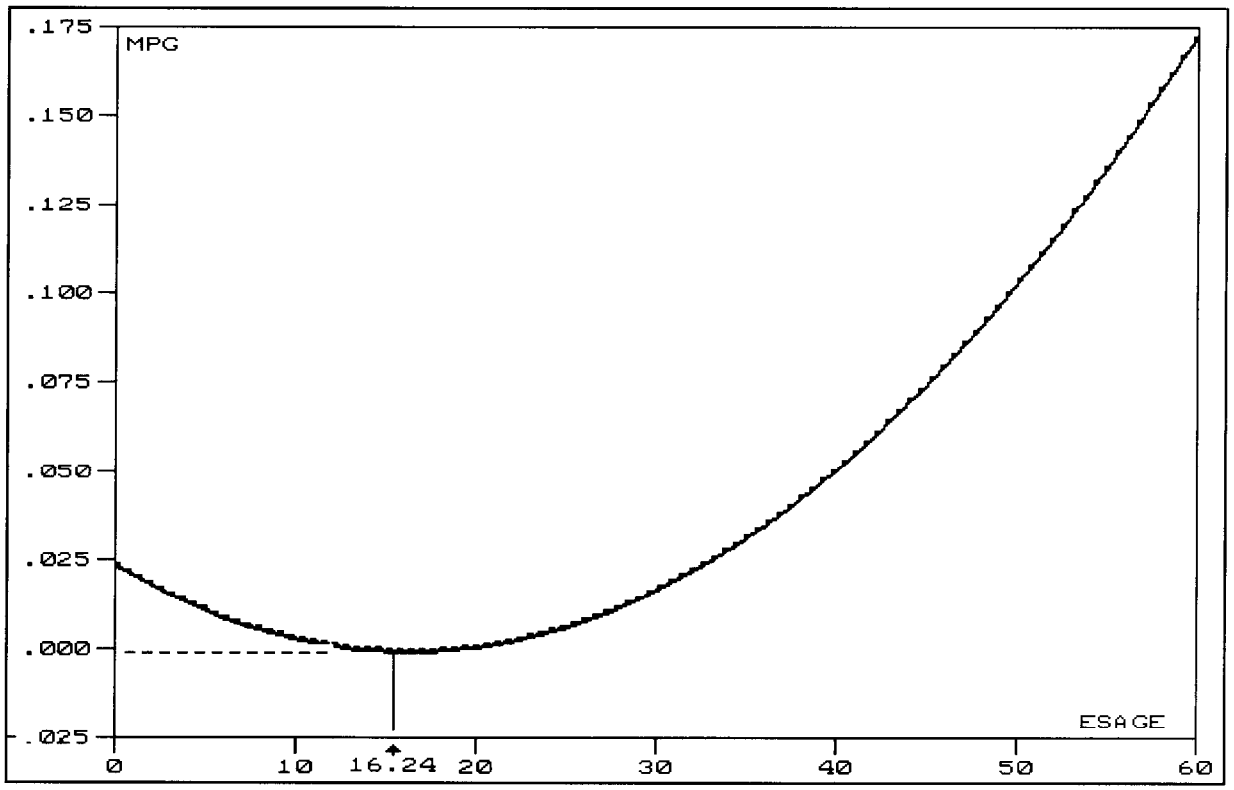

Figure 2 — Changes in MPG from ESOP over time