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# ABSTRACT

## Does Employee Stock Ownership Work? Evidence from Publicly-Traded Firms in Japan*

This paper provides novel evidence on the effects of employee stock ownership (ESO), a prominent example of shared capitalism. In so doing, we take advantage of our access to new panel data on Japanese ESO plans for a highly representative sample of publicly-traded firms in Japan (covering more than 75% of all firms listed on Tokyo Stock Exchange) over 1989-2013. Unlike most prior studies, we focus on the effects of changes in varying attributes of existing ESO – the effects on the intensive margin. Our fixed effect estimates show that an increase in the strength of the existing ESO plans measured by stake per employee results in statistically significant productivity gains. Furthermore, such productivity gains are found to lead to profitability gains since wage gains from ESO plans are statistically significant yet rather modest. Our analysis of Tobin's Q suggests that the market tends to view such gains from ESO plans as permanent. We further find that increasing the stake of the existing core participants is more effective in boosting gains from ESO plans than bringing in more employees into the trust. We use unique instruments (the peer firm's matching grant rate and abnormal return) to account for possible endogeneity of our ESO variables, and show that the estimated positive gains from ESO plans are not biased upward and likely to be lower bounds. We also find evidence for complementarity between ESO plans aimed at incentivizing non-executive employees and stock option aimed at incentivizing executives. Finally the positive effects on productivity, profitability, wages and Tobin's Q are found to be larger when the proportion of powerful institutional investors and foreign investors are greater; and smaller for larger firms that are more subject to the free-rider problem.

**JEL Classification:** J54, M52, G32

**Keywords:** employee stock ownership, shared capitalism, group incentive, productivity, Tobin's Q, managerial entrenchment

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# Does Employee Stock Ownership Work?
# Evidence from Publicly-Traded Firms in Japan

## I. Introduction

There has been a remarkable rise in the use and interest in Performance Related Pay (PRP) around the world (see, for instance, Lemieux, MacLeod and Parent, 2009; Bloom, 2011; and Bryson, et al, 2012). There are two types of PRP: (i) group incentive schemes which link the financial well-being of workers to group performance such as firm performance; and (ii) individual incentive pay which links pay to individual performance. The focus of this paper is group incentive schemes.

Group incentive pay is also called employee financial participation which includes employee stock ownership, profit sharing, broad-based stock option, and gainsharing/team incentive pay. With the rising use and interest in such employee financial participation schemes, many studies have examined their effects on organizational performance in industrialized countries.[1] Most prior studies consider either Employee Stock Ownership (ESO) plans through which the firm forms an ESO trust consisting of its non-executive employees and promotes ownership of its own shares by the trust[2] or Profit Sharing Plans (PSPs) in which at least part of the compensation for employees is dependent on firm performance (typically profit).[3] Moreover, an increasing number of firms (in particular "New Economy" firms) are extending the use of

[1] For surveys of the literature on financial participation schemes, see for instance Blasi, Conte and Kruse (1996) on employee stock ownership, Jones, Kato and Pliskin (1997) on profit sharing, gain sharing/team incentives, and more recently Blasi, et.al. (2008) and Jones (2018). For a Meta-analysis of the literature, see Doucouliagos (1995). For a more theoretical survey of the literature, see Gibbons (1997) and Prendergast (1999).

[2] See, for instance, Jones and Kato (1995), Blasi, Conte and Kruse (1996) and Kruse and Blasi (1997).

[3] For detailed discussion on the definition of PSPs, see Kruse (1993) and Jones, Kato and Pliskin (1997).

stock option plans to include non-executive employees in recent years.[4] Finally, with the rising popularity of "High Performance Workplace Practices (notably self-directed teams)", more firms are introducing team incentive pay which makes at least part of the compensation for employees dependent on performance at a more disaggregate level such as the department and the work group.[5] Most recently the shared capitalism literature has been documenting the growing importance of such financial participation schemes as an alternative form of capitalism (see, for instance, Bryson and Freeman, 2008, and Kruse, Blasi and Park, 2008).[6]

One of the most frequently addressed questions in the literature is whether the introduction of group incentive pay leads to an increase in organizational productivity and if so, how much. By now we have a rich body of evidence on this question (for a recent review, see Bloom and Van Reenen, 2011). Earlier cross-sectional studies, using a large representative survey of firms/establishments, show cross-sectional estimates on the relationship between organizational productivity and the incidence of group incentive pay. A number of subsequent studies obtain organizational-level panel data and provide fixed effect estimates to show that such correlational evidence does not simply reflects an association between unobserved characteristics of organizations (e.g., managerial quality) and the incidence of group incentive pay and that group incentive pay may have a causal relationship with productivity (see, for instance, Jones and Kato, 1995). More recently detailed econometric case studies of organizations provide compelling evidence on the productivity change before and after the introduction of group incentive pay and related HRM practices (see, for example, Hamilton,

[4] See, for instance, Sesil, Kroumova, Blasi and Kruse (2002) and Conyon and Freeman (2004).

[5] See, for example, Hamilton, Nickerson and Owan (2003), Jones and Kato (2011) and Jones, Kalmi and Kauhanen (2010) for teams and TIPs.

[6] The literature on individual incentive pay is equally rich, including a variety of econometric case studies, field experiments, and laboratory experiments (see, for instance, Dohmen and Falk, 2011, Lazear, 2000, and Shearer, 2004).

Nickerson and Owan, 2003 and Jones, Kalmi and Kauhanen, 2010).

In short, most studies on the effects of group incentive pay estimate the effects of the incidence of group incentive pay--- on the extensive margin. There is a disproportionate dearth of evidence on the effect of changes in various attributes of group incentive pay—on the intensive margin.

We believe that the effects on the intensive margin are a mostly unexplored yet potentially fruitful area of inquiry. First, studies of the effects on the extensive margin can be subject to serious measurement errors. As an illustration, consider two firms responding affirmatively to a survey question, “does your firm use group incentive pay?” Studies of the effects on the extensive margin deem those two firms “firms with group incentive pay” and assume that both firms will have the same magnitude of the effects of group incentive pay. Nonetheless, it is plausible that one firm’s group incentive plan applies to only a small proportion of the firm’s labor force, and the other firm’s scheme covers all employees. Studies of the effects on the extensive margin yield the estimate on the productivity effects of group incentive pay that is incorrectly assumed to be identical for both firms. Clearly studies of the effects on the intensive margin are less subject to such measurement errors.

Second, studies of the effects on the intensive margin provide richer policy implications. While studies of the effects on the extensive margin help practitioners and policymakers decide whether to introduce group incentive pay, intensive margin studies will go beyond the question of whether and help practitioners and policymakers design specific attributes of group incentive pay program. Furthermore for firms that already adopted group incentives, intensive margin studies help them improve the existing programs by modifying their attributes.

Finally with its growing importance, the effects on the intensive margin rather than on the

extensive margin are becoming more relevant (see Jones, et al., 2017). For instance, when most firms use group incentive pay, estimating the effects of group incentive pay on the extensive margin is less relevant, and what really matters is the scope and intensity of the use of the existing group incentives, in other words, the effects on the intensive margin.

There are a number of cross-sectional studies on the effects on the intensive margin (e.g., Jones and Kato, 1993, Kruse, 1993, Pendleton and Robinson, 2010), and as discussed above, while providing insightful and useful findings, such cross-sectional studies cannot yield any causal evidence. Few attempts have been made to use panel data on varying attributes of group incentive pay for a large representative sample of firms, and provide fixed effect estimates on the intensive margin effects of the group incentives. This paper provides such evidence, using reliable panel data on the attributes of Japanese ESO plans for a large representative sample of Japanese firms listed on Tokyo Stock Exchange over the 1989-2013 (accounting year) period.

Our fixed effect estimates show that an increase in the strength of the existing ESO plan measured by stake per employee results in statistically significant productivity gains. Furthermore, such productivity gains are found to lead to profitability gains since wage gains from ESO plans are statistically significant yet rather modest. Our analysis of Tobin's Q suggests that the market tends to view such gains from ESO plans as permanent. We further find that increasing stake of the existing core participants is more effective in boosting gains from ESO plans than bringing in more employees into the trust. Reassuringly our key results are found to be mostly robust to the use of instrumental variables to account for possible endogeneity of ESO plans. Finally we explore possible interplays between ESO plans and firm characteristics such as ownership structure and firm size/age. First, the positive effects on productivity, profitability, wages and Tobin's Q are found to become larger as the proportion of powerful institutional

investors and foreign investors rises, implying that the growing importance of such powerful outside shareholders may be reducing the adverse managerial entrenchment effect of ESO plans. This means that employee stock ownership and external monitoring may work as complements in improving productivity. Second, gains in productivity and profitability from ESO plans are found to be greater for smaller firms implying the possibility of free-riding in larger firms.

The paper is organized as follows. In the next section, we provide some background information on ESO plans (institutional information and basic statistics). In section III we provide theoretical discussions on the possible effects of ESO plans on the intensive margin. Section IV presents the basic empirical strategy and main results. Additional analyses concerning the heterogeneous effects of ESO plans are presented in the following section. The concluding section follows.

## II. Japanese Employee Stock Ownership Plans

Unlike the U.S. where different forms of employee stock ownership schemes (e.g., ESOPs, ESPPs, and 401K) coexist, there is essentially only one form of employee stock ownership in Japan. The firm voluntarily establishes an ESO trust (called mochikabukai) for non-executive employees (executives are ineligible for ESO plans). Unlike the U.S., there is no tax incentive for the establishment of Japanese ESO plans. Participation in Japanese ESO plans is also voluntary (executives are not allowed to participate), and to induce individual employees to participate in the ESO plan, 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.) As is the norm elsewhere, individual participants' shares (and dividends) in the ESO plan are held in trust. Unusually, however, each participant has a right to withdraw the shares in round lots and share

withdrawals are privately owned. While members may freely exit completely from the ESO plan, re-entry is restricted. Upon retirement, model rules adopted by most ESO plans require retiring workers to exit completely from the ESO plan, and withdraw all of their shares. Such withdrawn shared are owned privately and thereby can be sold freely at the prevailing market price. Finally, general director (rijicho) represents stockholders in the ESO plan. 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 ESO plan and thus is not an executive. Unlike U.S. ESOPs, Japanese ESO plans are not leveraged.

As discussed in Kato (2003), ESO plans grew remarkably in Japan during Japan's rapid growth era and managed to weather Japan's Great Recession in the 1990s and early 2000s. According to Tokyo Stock Exchange (TSE), in 2013, 91 percent of firms listed on TSE are reported to have ESO plans.[8] Using most up-to-date data on key attributes of ESO plans for a balanced panel of 572 firms provided by TSE, we produce Figure 1. The figure depicts changes in key attributes of ESO plans of publicly-traded firms in Japan for which we can get data consistently over 1989-2013. As such, the figure captures changes in ESO plans on the intensive margin. In terms of participation rates, the proportion of the labor force in listed firms with ESO plans who participate in the plans has been on a gradual upward trend from below 50 percent in early 1990s to over 60% in mid-2000 and dropped again near 50 percent after the financial crisis.[9] Concerning employee stakes, in 2009,

[7] In practice the general director sometimes assumes the directorship without formal election.

[8] As discussed in detail in Owan, Kato, and Miyajima (2016), the data used to calculate the proportion of TSE-listed firms with ESO plans are based on ESO plans managed by five largest securities firms. Firms with ESO plans managed by trust banks and smaller securities firms were not counted as firms with ESO plans. As such, the true proportion of TSE-listed firms with ESO plans is higher than 91 percent (at least 95% according to some industry experts).

[9] Our participation rate is the number of participants divided by the number of employees of

the average participant owns stock worth close to 1.5 million yen that constitutes close to 40% of the value of total financial asset holdings of the average employee household (according to the 2009 National Survey of Family Income and Expenditure).[10] However, these plans do not own large percentages of company stock. For listed companies the proportion of stock owned by ESO plans has been rising recently yet it is still around 2 percent (2.09 in 2013).[11]

## III. The Effects of ESO plans: Theoretical Explorations and Testable Hypotheses

The most direct positive effects of ESO plans result from enterprise success being reflected in a higher price of its equity, and thus higher wealth for employees who own stock in the ESO plan. Financially, the interest of the firm is more aligned with the interest of its employees through ESO plans. The improved goal alignment would lead to more active participation and involvement in various productivity-enhancing activities such as small group activities (hallmark of Japanese management) by employees, and to smoother and less costly collective bargaining.

Furthermore, goal alignment facilitated by ESO plans could makes a broader range of relational contracts between the firm and the employees feasible. There are at least two mechanisms. First, as discussed in Baker, Gibbons and Murphy (1994), there is a tension between the power of incentive and the firm's incentive to renege---in order to induce sufficient worker effort, the amount of compensation for hard work will need to be large but the large compensation will raise the firm's

---

stock-issuing parent company but employees in the subsidiaries including those in the second and third tiers are typically eligible for ESO plans, leading to overestimation of participation rates. Therefore, the trend depicted in Figure 1 may be exaggerated by reorganization of many Japanese companies, which span off their cost-center operations as subsidiaries.

[10] We use data on the value of total financial asset holdings for all households headed by standard employees, excluding all other employee households headed by non-standard employees (such as part-time workers, temporary contract and subcontract workers). Ideally we should use the value of total financial asset holdings for all households headed by standard employees who work in firms listed on TSE. Unfortunately such data are not available.

[11] We also produce the same figure, using the whole data (unbalanced panel) instead of the balanced panel, and find qualitatively similar changes in the three key attributes over the same time period. These as well as other unreported results are available upon request from the corresponding author at tkato@colgate.edu.

incentive to renege on the promise to pay this compensation. Since ESO plans serves as an alternative incentive mechanism by linking the worker's hard work to his/her financial well-being, the amount of compensation for hard work will not need to be as large as otherwise, and hence the firm's incentive to renege on the promise will be reduced.

Another possible mechanism is that with ESO, the firm tends to find it more costly to renege on the relational contracts, for ESO plans give the workers more ways to punish the firm. They could sell the stock in the market or vote against the management proposals at shareholders' meetings.

In sum, ESO plans could help the firm form new relational contracts or reinforce the existing ones which encourage workers to exert high efforts and stay longer to maintain firm-specific human capital, resulting in higher enterprise productivity.

Finally, previous research has often pointed to the peer monitoring effect that arises from ESO plans. Normally when team incentives are provided, free riding can occur. However, if there is peer monitoring and peer pressure imposes discipline, the free rider problem afflicting team incentives will be lessened and their productivity effect will be restored (Knes and Simester 2001). This mechanism works when a team is organized at a size that makes peer monitoring possible, and when there are expectations of a long-term relationship with colleagues (Che and Yoo 2001).

Turning to the effects on managers of ESO plans, there are some possible adverse effects on managers and firm performance. First, the early literature on employee ownership suggests that employee ownership can dilute the residual claimant status of managers and hence managerial incentive while making the job of managers more difficult—increased voice of workers may make it difficult for managers to take actions to improve efficiency such as wage cuts, lay-offs, or reorganization (Jensen and Meckling, 1976). Second, employee ownership may lead to more managerial entrenchment. Since employee owners are insider owners, in principle managers and employee owners form an insider coalition against the shareholder interest, resulting in insider entrenchment and worsening firm performance.

Therefore, the adoption of an ESO plan could involve tradeoffs between positive and negative effects and either effect may dominate the other depending on differences in the proportion of the total shares owned by the ESO plan. In fact, Guedri and Hollandts (2008) put forth the hypothesis that the relationship between the ESO stockholding and corporate performance can be depicted as an inverted U curve, and using cross-section data from 230 of the 250 representative firms that comprise France's stock index, they have obtained results that are consistent with their hypothesis. Kim and Ouimet (2012) used panel data for U.S. firms to show that the ESOP adoption effect had on average a significantly positive influence on wages and corporate value when the ESO share was below 5%, but the positive effects were offset by the negative effects when the ESO share was above 5%

Finally in theory group incentive pay such as ESO plans can lead to adverse worker sorting—ESO plans attract low-ability workers who see ESO plans an opportunity to free ride on high-ability workers. We believe that such worker sorting effects are less relevant to listed firms in Japan that continue to use implicit long-term employment contracts for their core employees and their turnover is low (Kambayashi and Kato, 2016).

Based on the above discussions on the possible effects of ESO plans on the intensive margin, we now derive a number of empirically testable hypotheses. Our panel data allow us to construct multiple variables that can capture changes in the existing ESO plans on the intensive margin. First, ESO per employee$_{it}$ is the average value of the stock owned by the ESO plan per employees of firm *i* in year *t*. We consider this variable an overall measure of the strength of ESO plans. ESO per employee$_{it}$ can be further decomposed into two components: ESO per participant$_{it}$ (the average value of the stock owned by the ESO plan per ESO plan participants of firm i in year t) and participation rate$_{it}$ (the proportion of ESO plan participants of firm i in year t). In other words, the overall strength of ESO plans comes from two separate sources: (i) greater stake of ESO plan participants (depth); and (ii) higher participation rate (breadth). Lastly, ESO share$_{it}$ is the proportion of the total shares owned by the ESO plan. This variable gauges the relative power of the ESO trust vis-à-vis other shareholders.

Using those specific variables, we convert our theoretical explorations into the following testable hypotheses:

**Hypothesis 1:** An increase in ESO per employee (overall) boosts the goal alignment effect of ESO plans and hence enterprise productivity.

**Hypothesis 2:** An increase in ESO per participant (depth) boosts the goal alignment effect of ESO plans and hence enterprise productivity.

**Hypothesis 3:** An increase in participation rate (breadth) boosts the goal alignment effect of ESO plans and hence enterprise productivity.

**Hypothesis 4**: An increase in ESO share (insider share) causes the managerial shirking and managerial entrenchment effects of ESO plans to rise, resulting in worsening productivity and profitability.

**Hypothesis 5:** An increase in ESO per employee (overall) also leads to an increase in profitability if not all productivity gains from ESO plans are captured by workers through an equal amount of wage gains.

**Hypothesis 6:** An increase in ESO per participant (depth) also leads to an increase in profitability if not all productivity gains from ESO plans are captured by workers through an equal amount of wage gains.

**Hypothesis 7:** An increase in participation rate(breadth) also leads to an increase in profitability if not all productivity gains from ESO plans are captured by workers through an equal amount of wage gains.

We also consider a possibility that complementary practices affect our analyses. One of the most important changes in the workplace across the world in the last three decades is the rising prominence of a new work system often called the High Performance Work System (HPWS). In short, in the HPWS, first workers work in team, and produce product as well as engaging in problem solving activities and producing valuable local knowledge through their collective efforts and share it with management. Workers also deal with local shocks often autonomously through collaboration among themselves. Second, to sustain the interest and desire

of workers to take full advantage of such problem solving activities on top of their regular production activities, the firm often pays efficiency wage (high wage/benefits). Furthermore, the interest alignment between workers and the firm is fostered by (i) financial participation schemes by which the financial wellbeing of workers is more tied to the final wellbeing of the firm (ESO plans); and (ii) information sharing mechanisms through which management shares important information with workers, and fosters their loyalty and commitment to the firm. Third, in the HPWS, workers are often provided with strong job security which will enable them to take advantage of the aforementioned opportunities wholeheartedly without fearing any job loss. Finally, careful screening and training are integral part of the HPWS (see, for instance, Ichniowski, Shaw and Prennushi, 1997). The HPWS emerged first in Japan in the 1960s and diffused widely among large and well-established firms in the late 1960s and the 1970s (see, for instance, Kato and Morishima, 2002 and Ichniowski and Shaw, 2003).[12] The HPWS is often considered a significant example of a system with powerful institutional complementarities (Aoki, 1990, Milgrom and Roberts, 1994, Williamson, 1996, Koike, 2005, and Morita, 2005).

A key insight of institutional complementarities is that one practice such as ESO plans works better when used in tandem with all other complementary practices. Keeping this complementarity issue in mind, we will explore possible interplays between the above hypothesized ESO plan effects and firm characteristics such as ownership structure, firm size and firm age, and the incidence of stock option. First, as powerful institutional investors and foreign investors increase their share of the stock and enhance their influence on the firm's corporate governance, management's ability to deviate from short-term profit maximization will be constrained. This has two implications. On the one hand, the existence of powerful outside owners may limit the management's ability to commit to job security—integral part of the High Performance Work System (HPWS), which is expected to lower the observed effect of ESO plans. On the other

[12] For more detailed analysis of the rise of the High Performance Work System in Japan, see Koike, 2005, Aoki, 2000, Itoh, 1994, Morita, 2001; 2005, Moriguchi and Ono, 2006 and Rebick, 2005).

hand, it may effectively counteract the adverse effect on productivity and profitability of ESO plans by preventing the management from colluding with ESO plan participants and engaging in entrenchment at the cost of shareholders. As such, it is an empirical question whether we observe greater or smaller overall productivity gains and profitability gains from ESO plans as institutional investors and foreign investors increase their share.

Second, whether the effects of ESO plans are to be more limited for smaller and less-established (younger) firms is *a priori* unknown. One hypothesis is that a smaller size will mitigate free-riding and a better growth prospect of younger firms will improve the return to forming a more cooperative and participatory relational contract or corporate culture associated with employee financial participation, leading to a better productivity gain of ESO plans. But, there is another view. Since the HPWS practices that are complementary to ESO plans are less pervasive among smaller and younger firms, productivity gains from ESO plans may be more limited for such smaller and younger firms. We plan to examine those two opposing hypotheses.

Third, stock option is an alternative to ESO plans as a means to increase stake of core employees. As such, stock option may make ESO plans somewhat redundant and thereby less effective, limiting productivity gains from ESO plans. Productivity gains from ESO plans may be smaller for firms that use stock option. Stock option programs introduced at most Japanese firms, however, target only executives or senior managers. In contrast, ESO plans cover all employees except for executives, to whom executive stock ownership or stock option plans are typically offered. As such, if the benefit of goal alignment is greater when both management and employees hold the company stock, the two programs may not be substitutes, or even exhibit complementarity.

## IV. Data, Basic Empirical Strategy and Main Results

### IV.1 Effects on Productivity through Multiple Channels

In estimating the impact of ESO plans on productive efficiency, our basic empirical strategy is to use a production function framework. Specifically we estimate equations of the general form:

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

where Q denotes a measure of output, K and L are a measure of total capital stock and total employment; E is a vector of variables representing the effects of ESO plans on productivity; and Z is a vector of control variables such as managerial ability and other human resource management practices.

We estimate various specifications of Eq. (1) by using an important new panel mainly assembled by merging two data bases. First, data on ESO plans are from the Survey of Current Status of Employee Stock Ownership (SCSESO) over FY1989-2013 conducted initially by National Conference of Stock Exchanges (FY1989-1998) and later by Tokyo Stock Exchange (FY1999-2013). This survey relies on the data provided by major securities firms and we were given full access to roughly 80 percent of all firms with ESO plans that are listed on Tokyo Stock Exchange over 1989-2013.[13] Since well over 90 percent of firms listed on Tokyo Stock Exchange have ESO plans, our data cover more than 75 percent of all firms listed on Tokyo Stock Exchange. As such, our data cover an unusually representative sample of publicly-traded firms in Japan.[14] Our final sample contains 1,613 firms over the 1989-2013 (accounting year) period. Second, using unique firm identifiers, the ESO plan data were merged with Nikkei NEED database (corporate financial and stock market information, and corporate governance evaluation system) that provides corporate accounting and stock price information as well as ownership and corporate governance data for all publicly-held firms in Japan. The resulting database was further linked to the Development Bank of Japan data which provide additional data on firm-level average wage and average tenure of all employees. All nominal variables are converted to real variables, using various price indices

[13] Tokyo Stock Exchange gave us access to the data with the condition that the securities firms which manage the ESO trusts also agree with the use. One of them did not give us its consent. There are also ESO trusts that are managed by smaller securities firms and trust banks, whose information is not surveyed by Tokyo Stock Exchange. Reassuringly for key firm characteristics such as total assets, PBR, and Tobin's Q, our sample mean is found to be similar to the population mean.

[14] Nikkei Needs do not report value added for most stock-holding companies. As such we exclude a small number of stock-holding companies. In addition, there are a handful of firms for which the number of employees on a consolidated basis who are eligible for ESO diverges considerably from the one on a non-consolidated basis. We also exclude such firms.

constructed by Bank of Japan and Statistics Bureau. [15]

We begin with the following translog production function with firm fixed effects, augmented by our summary ESO plan variable, ESO per employee:

$$(1) \quad lnQ_{it} = \beta_K lnK_{it} + \beta_L lnL_{it} + \beta_{KK}(lnK_{it})^2 + \beta_{LL}(lnL_{it})^2 + \beta_{KL}(lnK_{it}*lnL_{it}) + \beta_E ln(\text{ESO per employee}_{it-1}) + X_{it}\lambda + \alpha_i + \tau_t + u_{it}$$

where $Q_{it}$ is output of firm i in year t; $K_{it}$ is the capital stock; $L_{it}$ is labor; $X_{it}$ is a vector of time-variant control variables including Average employee $\text{tenure}_{it}$, $\ln(\text{firm age}_{it})$, industry-specific quadratic time trends; $\alpha_i$ is firm specific fixed effects; $\tau_t$ is year effects; and $\beta$s are slope coefficients. For the disturbance term, $u_{it}$, we assume $u_{it} \sim NID(0, \sigma^2)$.

Output is measured by value added deflated by Corporate Goods Price Index for each industry published by the Bank of Japan for each accounting year. The capital stock is proxied by the fixed assets of the firm deflated by Corporate Goods Price Index for capital goods. Labor is measured by the number of workers (executives and temporary workers excluded). For both capital and labor, we use the average of beginning value and ending value of each accounting year.

We include year effects ($\tau_t$) to capture technological change and other shocks that are common to all firms. As we have stated earlier, industry-specific quadratic time trends will additionally capture industry-specific productivity changes. Firm specific fixed effects ($\alpha_i$) capture the time-invariant heterogeneity of our firms. In particular, firm specific fixed effects will attempt to control for differences among firms in corporate culture and traditions, managerial abilities, worker quality and other human resource management practices. As Wadhwani and Wall (1990) argue in the case of profit sharing and Jones and Kato (1995) in the case of employee ownership, a stronger form of ESO plan might be adopted in firms with progressive corporate culture and traditions. If so, the coefficients on an ESO plan variable might indicate the effects of progressive corporate culture/traditions as well as the actual effects of ESO plans. Firm specific fixed effects

[15] For more information on the data and additional analyses of the data, see Owan, Kato, and Miyajima (2016).

will help separate the two effects, for corporate culture/traditions are largely time-invariant. Moreover, as Conte and Svejnar (1990) argue, firms with ESO plans 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 worker quality differences. They will also capture differences among firms in their use of other human resource management practices such as the separation payment system (Taishoku Kin Seido), the Joint Consultation Committees (Roshi Kyogi Sei) and QC circles, again to the extent that these practices are time-invariant.

ESO per employee is lagged since raising stake per employee may not lead to stronger goal alignment right away. Eq. (1) assumes that ESO per employee is not endogenous. We will relax this assumption below and provide IV estimates of Eq. (1).

Tables 1 and 2 present summary statistics, and the first column of Table 3 presents the fixed effect estimates of Eq. (1). Frist, to see whether the translog production functions are well behaved, we calculated the elasticity of output with respect to capital and labor evaluated at the mean values. First, reassuringly estimated elasticities are always positive. We also estimated a simpler Cobb-Douglass production function and found fairly close estimated elasticities.[16] Since F-test indicates that translog is preferred to CD, we report the translog results throughout the paper.

The estimated coefficient on $\ln(\text{ESO per employee}_{it})$ is positive and statistically significant at the 1 percent level, supporting Hypothesis 1. A 10-percent increase in ESO stake per employee (our summary measure of ESO plan on the intensive margin) is found to lead to a modest yet non-trivial productivity gain (0.95-percent increase in productivity after one year of lag).

To decompose the productivity effect of ESO on the intensive margin, we divide ESO per employee into ESO per participant and participation rate, and estimate a slightly modified translog production function:

[16] Furthermore, to account for possible endogeneity of labor input and selection, we also consider a method proposed by Levinsohn and Petrin (2003). Reassuringly there is no discernible change in the results although they are somewhat less precisely estimated.

(2) $$\ln Q_{it} = \beta_K \ln K_{it} + \beta_L \ln L_{it} + \beta_{KK}(\ln K_{it})^2 + \beta_{LL}(\ln L_{it})^2 + \beta_{KL}(\ln K_{it} * \ln L_{it}) + \beta_{E1}\ln(\text{ESO per participant}_{it-1}) + \beta_{E2}\ln(\text{Participant rate}_{it-1}) + X_{it}\lambda + \alpha_i + \tau_t + u_{it}$$

The fixed effect estimates of Eq. (2) are presented in the second column of Table 3. The estimated coefficient on ln(ESO per participant$_{it-1}$) is positive and statistically significant at the 1 percent level, supporting Hypothesis 2. A 10-percent increase in ESO plan stake per participant will lead to a 1.2 percent increase in productivity. The estimated coefficient on ln(participation rate$_{it-1}$) is also positive and statistically significant at the 1 percent level, again favoring Hypothesis 3. However, the estimated elasticity of output with respect to participation rate is roughly one third of the estimated elasticity of output with respect to stake per participant. Stake appears to play a much greater role in the productivity effect of ESO than participation rate. In other words, deepening the existing ESO plan (raising stake of core ESO plan participants) appears to be a more effective way to raise productivity than broadening the existing ESO plan (increasing participation rate).

Finally we consider a potentially negative effect of ESO and introduce ESO share$_{it}$.

(3) $$\ln Q_{it} = \beta_K \ln K_{it} + \beta_L \ln L_{it} + \beta_{KK}(\ln K_{it})^2 + \beta_{LL}(\ln L_{it})^2 + \beta_{KL}(\ln K_{it} * \ln L_{it}) + \beta_{E1}\ln(\text{ESO per employee}_{it-1}) + \beta_{E2}\ln(\text{ESO share}_{it-1}) + X_{it}\lambda + \alpha_i + \tau_t + u_{it}$$

For efficiency, we use our summary measure of the goal alignment effect of ESO plans, ESO per employee$_{it}$ instead of its decomposed two measures. The third column of Table 3 shows the fixed effect estimates of Eq. (3). First, reassuringly the estimated coefficient on ln(ESO per employee$_{it}$) is again positive and statistically significant at the 1 percent level, and the size of the coefficient is comparable to that of our benchmark model of Eq. (1). In contrast, the estimated coefficient on ln (ESO share$_{it}$) is negative and statistically significant at the 1 percent level, pointing to the adverse managerial shirking and entrenchment effect of ESO plans (Hypothesis 4). The absolute value of the estimated output elasticity with respect to ESO per employee$_{it}$ is more than three times larger than the absolute value of the estimated output elasticity with respect to ESO share$_{it}$,

pointing to an overall positive effect of ESO plans on the intensive margin.[17]

### IV.2 Possible Endogeneity of ESO plans and IV Estimations

It is, however, possible that our FE estimates are biased upward due to endogeneity of ESO plans. For example, Japan's celebrated Small Group Activities (SGAs), such as QC circles and kaizen, come up with an idea to enhance productivity which is private information to insiders (workers). Or, engineers and marketing staff know that their company has promising investment opportunities or is incubating innovative products. Based on such private information, workers may increase their contributions to their ESO plans if they are already a plan participant or decide to join ESO plans. Unfortunately such productivity-enhancing firm-specific shocks are private information and unobservable to econometricians. It follows that the FE estimates will lead us to attribute such productivity gains from unrelated sources (such as SGAs) incorrectly to productivity gains from ESO plans---productivity gains from ESO plans will be biased upward.

To address such possible endogeneity of the ESO plan variables, we consider the instrumental variable (IV) approach. Finding valid instruments is almost always an elusive enterprise. In our quest for such valid instruments, we conducted extensive interviews with veteran managers of a leading securities firm who are in charge of managing ESO plans. The interviews revealed that ESO plan directors of individual firms tend to learn about their peer firms' ESO plans including employer matching rates through the following two channels. First, as described above, each individual firm's ESO plan is managed by a major securities firm, and the director of ESO plan is in regular communication with the manager of the securities firm who is in charge of managing its ESO fund. Through such regular communication with the securities firm's manager, the ESO director often learns about its peer firms' ESO plans. Second, ESO plan

[17] We also estimated, adding $\ln(\text{ESO share}_{it})^2$ to see if the negative managerial shirking and entrenchment effect of ESO plans is non-linear as Guedri and Hollandts (2008) found for French ESOPs. We found no consistent evidence for such non-linear effect.

directors learn about their peer firms' ESO plans through *Kabushiki Konwakai,* Association of Shareholder Affairs, which is a long-established network of investor relations practitioners including ESO directors that are organized along sectors.[18] Therefore, we define the peer group of a focal firm as all other firms in the same industry, which entrust the same securities firm with the task of managing ESO fund and accounts. In order to keep at least three firms in the same peer group consistently over time, when needed, we put together neighboring industries to form coherent peer groups.

Using these peer groups, we construct the following two variables as IVs. First, as described in section II, the firm with ESO plans matches each employee participant's contribution by varying generosity, ranging between 0 to 100 percent of employee contributions. Most importantly as shown in Table 4, the employer contribution matching rate is reasonably time-variant, making it a promising instrument in our fixed effect models. We use the highest matching rate among the firm's peers because the aforementioned interviews indicate that ESO directors are more acutely aware of such peer leader's changes. Suppose firm i learns that its peer leader with the most generous employer matching rate raises its matching rate further. Firm i will follow this industry leader's rate increase by raising its own matching rate. On the one hand, such raised generosity of the focal firm's ESO plan will result in an increase in ESO per employee. On the other hand, it is unlikely that a hike in the employer matching rate of the peer leader is significantly correlated with the focal firm's productivity after controlling for industry time trend in the quadratic form. As such, we are reasonably confident that the highest matching rate among the firm's peers meets the exclusion restriction.

Second, we use the average abnormal shareholder return of firm i's peers as another instrument. To illustrate how this variable can be a valid instrument, consider an increase in the average abnormal return of the peer firms relative to that of the focal firm. This causes two

[18] *Tokyo Kabushiki Konwakai,* the oldest such organization, was established in 1931 by Tokyo Stock Exchange.

concerns for the focal firm's management team. First, it raises the possibility that the focal firm underperforms its competitors, which in turn would lead the shareholders to demand the management's explanation for it. Second, when its peer firms enjoy rising abnormal return, the focal firm may be more fearful of becoming a takeover target.[19] To ease the pressure from the shareholders as well as increasing takeover threat, the focal firm would promote ESO through raising its contribution matching rate, holding promotional seminars, using informal encouragement by the managers and other means. It follows that the focal firm's ESO per employee will increase. The resultant increase in ESO per employee is largely due to the management's effort to ease the market pressure in the face of rising attractiveness of its peer firms, and hence has less to do with the focal firm's productivity. Thus, we are again reasonably sanguine about the average abnormal shareholder return satisfying the exclusion restriction. Additionally, note that we control for the productivity trend in the quadratic form at the industry level, which should also mitigate the bias caused by correlated unobservables. Our proposed set of IVs passed standard diagnostic tests including the Hansen J test of over-identifying restrictions as well as Kleibergen-Paap rk LM test of under-identification in the baseline models for value added, wage and Tobin's Q.

The IV (FE 2SLS) estimates of Eqs. (1)-(3) are shown in the fourth to sixth columns, Eqs. (1)'-(3)'. Although the first stage regression results are not shown in the table, both the coefficients of Highest matching rate$_{it}$ and Average abnormal shareholder return$_{it}$ are of the expected signs. The IV estimates of our baseline equation with the summary measure of ln(ESO per employee$_{it}$) passed both Kleibergen-Paap rk LM test of under-identification and the Hansen J test of over-identifying restrictions, pointing to the relevance of our IVs and satisfying the exclusion restriction. The estimated coefficient on ln(ESO per employee$_{it}$) is positive and statistically significant at the 1 percent level, confirming that our earlier result without IV of the positive productivity effect of ESO on the intensive margin is not caused by the aforementioned

[19] Edmans, Goldstein, and Wei (2012) present a similar argument and provide supporting evidence.

possible upward bias due to endogeneity of ESO. In fact, the IV estimates of the coefficient on ln(ESO per employee$_{it}$) is considerably larger than the OLS estimates. As discussed in the large empirical literature on the returns to schooling that has grappled with a similar puzzle---the IV estimates of the returns to schooling are often substantially larger than the OLS estimates (see, for instance, Harmon, Oosterbeek, and Walker, 2003), there are a number of possible reasons why the IV estimates of the productivity effect of ESO exceed the OLS estimates.

First and perhaps most important, the size of the productivity effect of ESO may differ from one peer group of firms to another---heterogeneous effect. The large and significant IV estimates of the productivity effect of ESO may be indicating that the productivity effect of ESO is greater for a subset of our Japanese firms experiencing changes in the IVs---the peer leader's employer matching rate and the peer's average abnormal return---, as compared to other firms with little change in the IVs. One possible peer group of firms with little change in the peer leader's matching rate and the peer's average abnormal return is a group of firms in a well-established, mature, and stable industry. In such firms there may be only limited scope for further productivity gains from grassroots innovation activities such as SGAs (Ghosh, Kato, and Morita, 2018's case study of an auto parts supplier and a metal producer in Japan demonstrates the diminishing effectiveness of Japan's once celebrated bottom-up innovation activities in such mature industries). In short, ESO helps align the interest between the firm and workers, and hence workers under ESO are more motivated to participate in grassroots innovation activities such as SGAs, which result in productivity gains. For established, mature and stable industries, however, there is limited room for productivity gains through such grassroots innovation activities, and hence the goal alignment effect of ESO may not result in significant productivity gains.

Second, there may be a time-variant unobservable variable that is positively (negatively) correlated with the ESO plan variables, AND is negatively (positively) correlated with productivity. For example, the firm introduces another form of performance-related pay that can be a substitute for ESO plans. The firm's employees may decide to reduce their contributions to

their ESO plans or even exit as a result of the introduction of their substitute plan. Suppose that the introduction of such a new performance-related pay boosts productivity. Since we are not controlling for the introduction of a new performance-related pay, and such a time-variant unobservable variable cannot be accounted for by firm fixed effects, the fixed effect estimate of the productivity effect of ESO plans without IV may be biased downward. The IV estimates correct such downward bias of the OLS estimates and hence are greater than the OLS estimates.

Third, there may be considerable measurement errors with our ESO variables which bias the OLS estimates downward. Again, the IV estimates suffer less from such measurement error bias, and are thus larger than the downward-biased OLS estimates.

Turning to the decomposed specifications, Eqs. (2) and (3), our IVs are found not to perform as well as in the case of the baseline model of Eq. (1), failing to pass the test of under-identification implying that the coefficients are not effectively identified due to weak instruments. As such, the IV estimates of Eqs. (2) and (3) ought to be interpreted with caution. That being said, all the coefficients are sizable and have the same signs as the OLS estimates.[20] Especially our earlier result from the fixed effects models that stake (depth of the ESO participation) appears to play a much greater role in the productivity effect of ESO than participation rate (breadth) continue to be valid here.

In sum, while our IVs perform well in the baseline model but not so well in the decomposed models, it is reassuring that the estimated coefficients on the ESO plan variables are always larger in the IV estimation than in the OLS estimation, suggesting that the usual concern over possible overestimation of the effects of ESO plans due to endogeneity may not be serious.

[20] Hasen J test of over-identification cannot be calculated because the equations are exactly identified (i.e. the number of endogenous variables is equal to the number of instruments).

### IV.3 Effects on Other Corporate Performance Measures

We now examine whether the positive productivity effect of ESO plans lead to improved profitability, measured by ROA. Specifically we estimate a slightly modified version of Eqs. (1) - (3):

$$(4)\quad ROA_{it} = \beta_K \ln(\text{total asset})_{it} + \beta_L \ln(\text{leverage})_{it} + \beta_{KK}(\text{capital labor ratio})_{it} + \beta_E \ln(\text{ESO per employee}_{it-1}) + X_{it}\lambda + \alpha_i + \tau_t + u_{it}$$

$$(5)\quad ROA_{it} = \beta_K \ln(\text{total asset})_{it} + \beta_L \ln(\text{leverage})_{it} + \beta_{KK}(\text{capital labor ratio})_{it} + \beta_{E1} \ln(\text{ESO per participant}_{it-1}) + \beta_{E2} \ln(\text{Participant rate}_{it-1}) + X_{it}\lambda + \alpha_i + \tau_t + u_{it}$$

$$(6)\quad ROA_{it} = \beta_K \ln(\text{total asset})_{it} + \beta_L \ln(\text{leverage})_{it} + \beta_{KK}(\text{capital labor ratio})_{it} + \beta_{E1} \ln(\text{ESO per employee}_{it-1}) + \beta_{E2} \ln(\text{ESO share}_{it-1}) + X_{it}\lambda + \alpha_i + \tau_t + u_{it}$$

The fixed effect estimates of Eqs. (4)-(6) with and without IVs are reported in Table 5. In essence, we find similar but somewhat weaker results than for the productivity effects of ESO, suggesting that the productivity gains from ESO translate into profitability gains but on a smaller scale. This implies that the productivity gains from ESO plans may be captured in part by wage increases. More specifically, Column 1 (Equation 4) has a coefficient of 0.00963 for ESO per employee$_{it-1}$, so if the ESO per employee increases by 10%, then the ROA should increase by 0.096 percentage points. Since the average ROA in our sample is 4.71% (Table 1), this means a profit increase of around 2.04%, which is translated into 0.65% of value added given the 32% of average capital share of income in Japan. Note that a 10% increase in the ESO per employee leads to a 0.95% increase in value added according to Table 3. This implies that roughly two thirds (=0.65/0.95) of the productivity gains from ESO plans remain as profit. This picture does not change significantly when we use the IV estimates in Eq. (1)', which leads to the conclusion that almost four fifth (=0.434/4.71*100*0.32/3.69) of the productivity gains from ESO plans is left as profit.

To confirm this conjecture, we further estimate the effect on wages of ESO plans by

estimating a slightly modified version of Eqs. (4)-(6) with $\ln(wage_{it})$ as the dependent variable and one additional control, average employee age. The results are shown in Table 6. Similarly to the results for productivity and profitability gains, we find statistically significant wage gains from ESO. While the size of the wage gains is quite modest in the OLS estimates in Eqs. (7)-(9), as shown in Table 6, they turn out to be quite sizable and significant at the 5 % level in the IV estimates in Eqs. (7)'-(8)'. For instance, a 10-percent increase in ESO per employee is found to lead to a modest 0.2-percent increase in wages if the result in Eq. (7) is used, but is found to result in 2.0% increase in wages according to the one in Eq. (7)', which is near one third of the productivity gain found earlier in Eq. (1)'. Interestingly, this 2SLS estimate of the effect on employee wage (account for one third of the productivity gain) is consistent with the fixed effect estimate of the effect on profitability (account for two thirds of the productivity gain). Furthermore, only raising stake results in significant and positive wage gains whereas increasing participation rate leads to no wage gain after accounting for possible endogeneity. Overall, Hypotheses 4-7 are supported.

Finally, to see if productivity gains and profitability gains are viewed as temporary or permanent by the market, we estimate the effect on Tobin's Q of ESO. The estimation equations are identical to Eqs. (4)-(6) with Tobin's Q as the dependent variable rather than ROA. Table 7 presents the results. The results are overall comparable to those for the effects on productivity and robust to the use of instrumental variables. Specifically the coefficient for ESO per $employee_{it-1}$ in Eq. (10) of Table 7 is 0.167, suggesting that an increase of 10% in the ESO per employee would lead to an increase in the corporate value by 1.67%. This scale of increase is almost the same as the scale of the rate of increase in the ROA (2.04%) calculated in Eq. (4) of Table 5. However, when we compare the gains using the IV estimates from Eq. (4)' of Table 5 and Eq. (10)' of Table 7, the numbers change substantially to 2.61% (Tobin's Q) vs. 9.21% (ROA), suggesting that the market is likely to regard the long-term profitability gains from ESO plans as much smaller than the short-term gains.

In addition, according to Eq. (11) of Table 7, increasing stake of the existing core participants is more effective in boosting Tobin's Q from ESO than bringing in more employees

into the plan. This is robust to the use of IVs and the difference is even more discernible in Eq. (11)'.

## V. Heterogeneous Effects

### V.1 Ownership Structure

The observed effects on productivity, profitability, wages, and Tobin's Q of ESO plans may differ, depending on the strength of market pressure. On the one hand, as the proportion of stock owned by powerful institutional investors and foreign investors rises, these outside owners may press the management to focus more on the short-term profit, weaken its commitment to job security, and thus undermine the effectiveness of the High Performance Work System (HPWS). This might lower the observed effect of ESO plans. On the other hand, with the proportion of powerful outside investors increasing, management's ability to collude with ESO plan participants and engage in entrenchment at the cost of shareholders may diminish. As such, the adverse effect on productivity and profitability of ESO plans may be lessened, and thereby we may observe greater overall productivity gains and profitability gains from ESO plans. In short, it is an empirical question whether the effect on productivity and profitability of ESO plans is larger or smaller for firms with greater proportions of shares owned by institutional investors or foreign investors. To this end, we repeat the analysis in the last section, adding an interaction term involving our summary ESO plan variable (ESO per employee) and a variable measuring the strength of the influence of powerful outside investors. We use the two investor groups—institutional investors and foreign investors—as powerful outside investors. Specifically for each firm we first calculate the proportion of share owned by institutional investors. We normalize it by subtracting the market mean from it and then dividing the resulting difference by the market standard deviation. Then, average it over 1989-2013 to construct a time-invariant variable, institutional $\text{investor}_i$. Likewise, we construct foreign $\text{investor}_i$, time-averaged normalized proportion of foreign investors.

The results are summarized in Table 8. When value added is chosen as the dependent variable (Column 1), the estimated coefficient on $\ln(\text{ESO per employee}_{i\,t-1})$*$\text{institutional investor}_i$ is

positive and statistically significant at the 5 percent level. Likewise, the estimated coefficient on $\ln(\text{ESO per employee})_{t-1}$*foreign $\text{investor}_i$ is also positive and statistically significant at the 5 percent level. Both results are consistent with the positive role of powerful outside investors in preventing management and employee owners from colluding and exploiting shareholders, and hence limiting the adverse effect of ESO plans through managerial shirking and entrenchment. The size of the estimated coefficient on $\ln(\text{ESO per employee}_{i\,t-1})$*institutional $\text{investor}_i$ in column (1) implies that the productivity effect of ESO plans will be zero when institutional $\text{investor}_i$ is equal to -2.5 (=-0.088/0.035). In other words, for firms with the proportion of institutional investors being lower than mean by two and a half standard deviations, there is no productivity gain from ESO plans. Likewise, the size of the estimated coefficient on $\ln(\text{ESO per employee})_{t-1}$*foreign $\text{investor}_i$ in column (2) also implies that for firms with the proportion of foreign investors being lower than mean by two and a half standard deviations, the productivity effect of ESO plans is zero.

We repeat the same analysis for ROA, wages, and Tobin's Q. As shown in the table, overall, we find similar positive interplays between ESO plans and the strength of outside investor influence. Particularly noteworthy is that workers also gain more from increasing their stake in the ESO plans in the presence of more powerful institutional and foreign investors through receiving a modest yet still positive share of additional productivity gains from ESO plans.

### V.2 Other firm characteristics: stock option, firm size and firm age

Lastly, we consider three additional possible interplays between ESO plans and other firm characteristics. The preceding analysis implies that raising stake of core existing ESO plan participants is more effective than increasing participation rates. An alternative device to raise stake of core employees can be stock option. Presumably the use of stock option for managers as an alternative to ESO plans may make ESO plans somewhat redundant and less effective as a means to raise stake of core employees, resulting in more limited gains from ESO plans. On the other hand, as we discussed earlier, the stock option programs usually target only executives or senior managers and may work as complements to ESO plans when introduced together---ESO aimed at goal

alignment effects for non-executive employees and stock option aimed at goal alignment for executives. To study such an interplay between the use of stock option and the ESO plan effects, we add an interaction term involving ESO per employee$_{it-1}$ and stock option$_{it-1}$ (=1 if firm i uses stock option in year t-1, 0 otherwise) to our initial production function estimation, Eq. (1). [21] The first column of Table 9 shows the fixed effect estimates of such augmented Eq. (1). Note that the stock option variable is time-varying.

The estimated coefficient on the interaction term is positive and statistically significant at the 1 percent level, suggesting that stock option programs make ESO plans more effective, and that the goal alignment effect dominates any negative effect arising from substitutability between the two. We speculate that having both executives and employees own the company stock may help enforce the corporate culture that emphasizes maximizing the firm value. The average effect of stock option on the other hand is zero given that the mean of ln(ESO per employee$_{it-1}$) is 12.85 (i.e. -0.465+12.85*0.0356 ≅0).

The second and third columns of Table 9 show the results for possible interplays between ESO plans and firm size as well as firm age. Standardized firm size/age measures are constructed in the same way as institutional investor$_i$ and foreign investor$_i$. Specifically for each firm we start with ln(number of employees $_{it}$) and ln(firm age $_{it}$) and calculate their normalized measures by subtracting the market mean from it and dividing the resulting difference by the market standard deviation. Then, average it over 1989-2013 to construct a time-invariant variables, standardized firm size measure$_i$ and standardized firm age measure$_i$.

Since firm size and firm age are correlated with the proportion of institutional/foreign investors, we include the interaction between ln(ESO per employee$_{it-1}$) and institutional investor$_{it-1}$ to avoid omitted variable bias. The estimated coefficient on the interaction term involving ESO per

[21] Data on stock options were obtained from publicly available information in Nikkei NEEDS-cges (Corporate governance evaluation system), and the results should be interpreted with caution because it is not clear what the scope of the stock option system is—whether it is made available only to directors, senior managers, or to all managers. Few companies offer stock options to non-managerial employees.

$employee_{it-1}$ and firm size is negative and statistically significant at the 1 percent level. ESO plans appear to yield greater productivity gains for smaller firms. Likewise, the estimated coefficient on the interaction term involving ESO per $employee_{it-1}$ and firm age is also negative yet not statistically significant.

As expanded in section III, the observed relationship between the size of the productivity gains from ESO plans and firm size is consistent with what we have learned in the literature of free-riding. The goal alignment and the formation of relational contract should have a greater incentive effect in smaller firms because the return to efforts is higher and peer monitoring to reduce free-riding is more feasible in smaller firms. The lack of significant relationship between the size of the productivity gains from ESO plans and firm age may be due to two countervailing effects. On the one hand, young firms have better growth prospect that makes the productivity effect of ESO plans greater. On the other hand, however, the Japanese High Performance Work System (HPWS)--a complementary cluster of human resource management practices that often include ESO plans as its integral part–are more pervasive among more established (older) firms in Japan. ESO plans in such mature Japanese firms are likely to be greater as a result of their use of various complementary HRM practices.

## VI. Conclusions

This paper has provided novel evidence on the effects of employee stock ownership, using reliable panel data on Japanese Employee Stock Ownership (ESO) plans for a highly representative sample of publicly-traded firms in Japan (covering more than 75 percent of all firms listed on Tokyo Stock Exchange) over 1989-2013. Unlike many prior studies, we have focused on the effects of changes in varying attributes of existing employee stock ownership—the effects on the intensive margin. Furthermore, we have done so not only for productivity but also for ROA, wages, and Tobin's Q. Our fixed effect estimates have shown that an increase in

the strength of the existing ESO plan measured by stake per employee results in a statistically significant and modest yet meaningful gain in productivity. Furthermore, we have confirmed that such productivity gains lead to considerable profitability gains since wage gains from ESO plans are significant yet rather modest. Our analysis of Tobin's Q has suggested that the market considers profitability gains from ESO plans long-term gains.

We have used unique instruments---the peer firms' employer matching grant rate and abnormal return to account for possible endogeneity of our ESO variables, and have shown that the above estimated positive gains from ESO plans using simple OLS fixed effect models are not biased upward and likely to be lower bounds.

By decomposing our summary ESO plan variable into ESO plan participant's average stake (depth) and participation rates (breadth), we have found that increasing stake of the existing core participants is more effective in boosting gains from ESO plans than bringing in more employees into the ESO plan. In addition, we have found that ESO plans improve productivity more discernibly for firms that also use stock option, pointing to possible complementarity between Japanese ESO plans that are aimed at incentivizing non-executive employees exclusively and Japanese stock option that are targeted primarily at executives.

Although we have found a significantly negative effect of the ESO share—the proportion of shares owned by the ESO plan—on firm productivity, the coefficient becomes insignificant once endogeneity is accounted for. As such, compared to other ESO variables, we are less confident on the observed negative effect of the proportion of shared owned by the ESO plan. This may reflect the fact that a majority of ESO plans have a very low share—less than 1%—and very few firms exceed five percent, the level perceived as giving the management the opportunity to form influential insider coalition against the shareholder interest according to Kim and Ouimet (2014).

We have also uncovered that the positive effects on productivity, profitability, wages and Tobin's Q are larger when the proportion of powerful institutional investors and foreign investors rises. The growing importance of such powerful outside shareholders may be making it more difficult for management to take advantage of the rise of insider ownership through ESO plans and engage in managerial entrenchment.

Finally we have found more limited productivity gains from ESO plans for larger firms, which is consistent with the standard view that group incentive pay is less effective in larger firms due to the free-riding effect.

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Table 1 Summary Statistics: Key variables

| Variable | | Mean | Std. Dev. | Min | Max | Observations |
|---|---|---|---|---|---|---|
| ln(ESO per employee$_{it}$) | overall | 12.8472 | 1.0656 | 3.2453 | 17.2601 | 21591 |
| | between | | 1.0252 | 6.5953 | 16.2699 | 1647 |
| | within | | 0.5551 | 4.4654 | 15.8294 | 13.1093 |
| ln(ESO per participant$_{it}$) | overall | 13.7618 | 0.7842 | 4.9619 | 19.1868 | 21591 |
| | between | | 0.7228 | 8.9807 | 16.9432 | 1647 |
| | within | | 0.4778 | 5.2168 | 17.4650 | 13.1093 |
| ln(participation rate$_{it}$) | overall | -0.9146 | 0.6632 | -7.5063 | 2.4456 | 21591 |
| | between | | 0.6299 | -4.8862 | 1.6161 | 1647 |
| | within | | 0.3278 | -7.1883 | 1.4390 | 13.1093 |
| ESO share$_{it}$ (%) | overall | 1.4897 | 1.5381 | 0.0001 | 24.5104 | 21591 |
| | between | | 1.8865 | 0.0026 | 23.9458 | 1647 |
| | within | | 0.5971 | -4.6158 | 9.3649 | 13.1093 |
| ln(value added$_{it}$) | overall | 9.6808 | 1.3153 | 2.2012 | 15.0226 | 21591 |
| | between | | 1.3132 | 5.2353 | 14.9627 | 1647 |
| | within | | 0.3539 | 3.8918 | 11.7806 | 13.1093 |
| ln(average wage$_{it}$) | overall | 15.4452 | 0.2823 | 8.2908 | 16.6812 | 21576 |
| | between | | 0.2164 | 14.1627 | 16.4512 | 1643 |
| | within | | 0.2006 | 8.9305 | 16.4843 | 13.1321 |
| ROA$_{it}$ | overall | 0.0471 | 0.0425 | -0.6138 | 0.4877 | 21591 |
| | between | | 0.0428 | -0.2314 | 0.4094 | 1647 |
| | within | | 0.0302 | -0.3902 | 0.4034 | 13.1093 |
| Tobin's Q$_{it}$ | overall | 1.0050 | 0.6659 | 0.1170 | 13.3954 | 21591 |
| | between | | 0.6320 | 0.1447 | 7.8118 | 1647 |
| | within | | 0.4834 | -2.7570 | 10.9421 | 13.1093 |
| lnL$_{it}$ | overall | 7.1068 | 1.1809 | 4.6052 | 12.4913 | 21591 |
| | between | | 1.1648 | 4.6052 | 12.2164 | 1647 |
| | within | | 0.2525 | 5.0709 | 10.0832 | 13.1093 |
| lnK$_{it}$ | overall | 10.3597 | 1.5375 | 5.5866 | 16.4059 | 21591 |
| | between | | 1.4991 | 5.6668 | 16.1853 | 1647 |
| | within | | 0.3672 | 7.7403 | 12.0969 | 13.1093 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED

Table 2 Summary Statistics: Control variables

| Variable | | Mean | Std. Dev. | Min | Max | Observations |
|---|---|---|---|---|---|---|
| ln(firm age$_{it}$) | overall | 3.9537 | 0.4124 | 0 | 4.8520 | 21591 |
| | between | | 0.4998 | 0.6931 | 4.7517 | 1647 |
| | within | | 0.1241 | 2.3473 | 4.7848 | 13.1093 |
| Average employee age$_{it}$ | overall | 38.5721 | 3.7185 | 24.4000 | 57.4000 | 21586 |
| | between | | 3.6750 | 25.8600 | 55.1591 | 1646 |
| | within | | 1.9497 | 27.3352 | 49.4312 | 13.1142 |
| Average employee Tenure$_{it}$ | overall | 14.7845 | 4.4574 | 1.0000 | 29.1000 | 21587 |
| | between | | 4.7566 | 1.2000 | 24.5700 | 1646 |
| | within | | 1.8266 | 2.3845 | 25.9702 | 13.1148 |
| ln(total asset$_{it}$) | overall | 11.3632 | 1.3964 | 7.1732 | 16.5335 | 21591 |
| | between | | 1.3949 | 7.2403 | 16.4385 | 1647 |
| | within | | 0.2319 | 9.3378 | 13.5677 | 13.1093 |
| ln(leverage$_{it}$) | overall | -0.8218 | 1.6649 | -13.8448 | 6.5481 | 21567 |
| | between | | 1.6244 | -9.8505 | 3.0981 | 1646 |
| | within | | 0.8591 | -10.0882 | 4.8988 | 13.1027 |
| Capital labor ratio$_{it}$ | overall | 45.9013 | 102.578 | 0.4247 | 4966.637 | 21591 |
| | between | | 130.395 | 1.0606 | 4408.206 | 1647 |
| | within | | 56.580 | -941.3434 | 3765.159 | 13.1093 |
| Employer matching contribution$_{it\ (\%)}$ | overall | 6.7949 | 3.6817 | 0 | 100 | 15929 |
| | between | | 3.8641 | 0 | 100 | 1626 |
| | within | | 1.9408 | -20.3480 | 48.1074 | 9.79643 |
| Highest matching contribution among other firms in the same industry$_{it}$ | overall | 21.1719 | 16.855 | 0 | 100 | 15927 |
| | between | | 13.575 | 5 | 100 | 1626 |
| | within | | 13.822 | -53.828 | 97.225 | 9.7952 |
| Average share of stable ownership of other firms in the same industry$_{it}$ | overall | 30.1919 | 9.9934 | 0 | 62.312 | 19031 |
| | between | | 8.0328 | 4.3200 | 55.76 | 1552 |
| | within | | 8.0892 | -14.4362 | 64.7776 | 12.2622 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED

Table 3 The Fixed Effect Estimates of the Productivity Effect of ESO plans on the intensive margin

| VARIABLES | Eq. (1) | Eq. (2) | Eq. (3) | Eq. (1)' | Eq. (2)' | Eq. (3)' |
|---|---|---|---|---|---|---|
| | Fixed Effect Model (1989-2013) | | | FE 2SLS Model (1995-2013 excl. 1999) | | |
| $lnL_{it}$ | 0.959*** | 0.942*** | 0.964*** | 1.119*** | 1.017*** | 1.120*** |
| | (0.156) | (0.156) | (0.157) | (0.190) | (0.380) | (0.189) |
| $lnK_{it}$ | 0.174* | 0.170* | 0.181** | 0.201* | 0.147 | 0.249 |
| | (0.0902) | (0.0902) | (0.0903) | (0.117) | (0.206) | (0.214) |
| $lnL_{it}^2$ | 0.0118 | 0.0128 | 0.0107 | 0.0105 | 0.0196 | 0.00781 |
| | (0.0156) | (0.0154) | (0.0155) | (0.0190) | (0.0332) | (0.0217) |
| $lnK_{it}^2$ | 0.0168* | 0.0176* | 0.0155 | 0.0148 | 0.0240 | 0.00912 |
| | (0.00948) | (0.00947) | (0.00956) | (0.0117) | (0.0307) | (0.0246) |
| $lnK_{it}*lnL_{it}$ | -0.0507** | -0.0519** | -0.0488** | -0.0594** | -0.0714 | -0.0502 |
| | (0.0231) | (0.0229) | (0.0232) | (0.0280) | (0.0439) | (0.0449) |
| $ln(\text{firm age}_{it})$ | 0.412*** | 0.402*** | 0.412*** | 0.723*** | 0.554 | 0.619 |
| | (0.104) | (0.105) | (0.106) | (0.178) | (0.586) | (0.447) |
| Average employee $\text{tenure}_{it}$ | 0.00298 | 0.00370 | 0.00333 | 0.000375 | 0.00327 | 0.00433 |
| | (0.00275) | (0.00274) | (0.00274) | (0.00353) | (0.0100) | (0.0152) |
| $ln(\text{ESO per employee}_{t-1})$ | 0.0945*** | | 0.111*** | 0.369*** | | 0.368*** |
| | (0.00762) | | (0.00831) | (0.0663) | | (0.0680) |
| $ln(\text{ESO per participant}_{t-1})$ | | 0.119*** | | | 0.393*** | |
| | | (0.00895) | | | (0.0951) | |
| $ln(\text{participation rate}_{t-1})$ | | 0.0436*** | | | 0.000633 | |
| | | (0.0114) | | | (1.196) | |
| $ln(\text{ESO share}_{t-1})$ | | | -0.0361*** | | | -0.250 |
| | | | (0.00519) | | | (0.931) |
| Observations | 23,094 | 23,094 | 23,094 | 16,744 | 16,744 | 16,744 |
| Number of id_code | 1,729 | 1,729 | 1,729 | 1,618 | 1,618 | 1,618 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED
Notes: Cluster-Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4 The number of firms that changed their employer contribution matching rates

| Fiscal Year | Number of firms with match rate | | | Total |
|---|---|---|---|---|
| | Reduced | Unchanged | Raised | |
| 1995 | 10 | 1,008 | 16 | 1,034 |
| 1996 | 12 | 1,029 | 19 | 1,060 |
| 1997 | 10 | 1,053 | 33 | 1,096 |
| 2000 | 27 | 833 | 43 | 903 |
| 2001 | 17 | 893 | 40 | 950 |
| 2002 | 25 | 1,135 | 43 | 1,203 |
| 2003 | 17 | 1,173 | 27 | 1,217 |
| 2004 | 10 | 1,234 | 52 | 1,296 |
| 2005 | 14 | 1,228 | 83 | 1,325 |
| 2006 | 39 | 1,257 | 81 | 1,377 |
| 2007 | 10 | 1,232 | 84 | 1,326 |
| 2008 | 28 | 1,317 | 73 | 1,418 |
| 2009 | 41 | 1,565 | 38 | 1,644 |
| 2010 | 28 | 1,522 | 88 | 1,638 |
| 2011 | 17 | 1,496 | 46 | 1,559 |
| 2012 | 16 | 1,564 | 47 | 1,627 |
| 2013 | 11 | 1,744 | 57 | 1,812 |
| Throughout | 115 | 2,365 | 608 | 3,088 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED

Table 5 The Fixed Effect Estimates of the Effect on ROA of ESO plans on the intensive margin

| | Eq. (4) | Eq. (5) | Eq. (6) | Eq. (4)' | Eq. (5)' | Eq. (6)' |
|---|---|---|---|---|---|---|
| VARIABLES | Fixed Effect Model (1989-2013) | | | FE 2SLS Model (1995-2013 excl. 1999) | | |
| ln(total assets$_{it}$) | 0.00226 | 0.00144 | 0.00120 | -0.0114** | 0.00555 | 0.0304 |
| | (0.00239) | (0.00237) | (0.00243) | (0.0054) | (0.0265) | (0.0937) |
| ln(leverage$_{it}$) | -0.00630*** | -0.00615*** | -0.00593*** | -0.00519*** | -0.00657** | 0.00395 |
| | (0.000751) | (0.000748) | (0.000744) | (0.00101) | (0.00278) | (0.0193) |
| Capital Labor Ratio$_{it}$ | -0.000015* | -0.000011 | -0.000017* | -0.000027* | -0.000079 | -0.000120 |
| | (0.000008) | (0.000008) | (0.000009) | (0.000015) | (0.000142) | (0.000201) |
| ln(Firm Age) | -0.00501 | -0.00787 | -0.00561 | 0.0328 | -0.131 | -0.131 |
| | (0.00988) | (0.00988) | (0.00974) | (0.0214) | (0.220) | (0.370) |
| Average Employee Tenure | -0.000476 | -0.000362 | -0.000426 | -0.00091** | 0.00165 | 0.00336 |
| | (0.000299) | (0.000301) | (0.000297) | (0.00041) | (0.00354) | (0.00932) |
| ln(ESO per employee$_{t-1}$) | 0.00963*** | | 0.0117*** | 0.0434*** | | 0.00656 |
| | (0.000797) | | (0.000894) | (0.00898) | | (0.0876) |
| ln(ESO per participant$_{t-1}$) | | 0.0135*** | | | 0.0550*** | |
| | | (0.00102) | | | (0.0176) | |
| ln(participation rate$_{t-1}$) | | 0.00240** | | | -0.178 | |
| | | (0.000974) | | | (0.291) | |
| ln(ESO share$_{t-1}$) | | | -0.00505*** | | | -0.232 |
| | | | (0.000705) | | | (0.488) |
| Observations | 21,260 | 21,260 | 21,260 | 15,113 | 15,113 | 15,113 |
| Number of id_code | 1,617 | 1,617 | 1,617 | 1,476 | 1,476 | 1,476 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED

Notes: Cluster-Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 6 The Fixed Effect Estimates of the Effect on Wages of ESO plans on the intensive margin

| | Eq. (7) | Eq. (8) | Eq. (9) | Eq. (7)' | Eq. (8)' | Eq. (9)' |
|---|---|---|---|---|---|---|
| VARIABLES | Fixed Effect Model (1989-2013) | | | FE 2SLS Model (1995-2013 excl. 1999) | | |
| ln(total assets$_{it}$) | 0.0863*** | 0.0858*** | 0.0839*** | 0.00998 | 0.0153 | 0.0593 |
| | (0.00641) | (0.00641) | (0.00649) | (0.0454) | (0.0565) | (0.560) |
| ln(leverage$_{it}$) | -0.00972*** | -0.00964*** | -0.00884*** | 0.00171 | 0.00120 | -0.0422 |
| | (0.00149) | (0.00150) | (0.00146) | (0.00704) | (0.00775) | (0.478) |
| Capital labor ratio$_{it}$ | 0.000067*** | 0.000069*** | 0.000062** | 0.000589 | 0.000884 | 0.000237 |
| | (0.000025) | (0.000025) | (0.000024) | (0.000474) | (0.000126) | (0.00193) |
| ln(Firm age$_{it}$) | -0.0102 | -0.0117 | -0.00819 | 0.142 | 0.102 | -0.109 |
| | (0.0347) | (0.0347) | (0.0347) | (0.114) | (0.231) | (2.761) |
| Average employee age$_{it}$ | 0.00165 | 0.00165 | 0.00154 | -0.000955 | -0.000550 | -0.00352 |
| | (0.00421) | (0.00422) | (0.00421) | (0.00423) | (0.00474) | (0.0290) |
| Average employee tenure$_{it}$ | 0.0131*** | 0.0132*** | 0.0133*** | 0.0138*** | 0.0139*** | 0.00716 |
| | (0.00348) | (0.00348) | (0.00348) | (0.00348) | (0.00355) | (0.0718) |
| ln(ESO per employee$_{t-1}$) | 0.0209*** | | 0.0258*** | 0.191** | | -0.0123 |
| | (0.00270) | | (0.00281) | (0.0971) | | (2.236) |
| ln(ESO per participant$_{t-1}$) | | 0.0229*** | | | 0.195** | |
| | | (0.00280) | | | (0.0839) | |
| ln(participation rate$_{t-1}$) | | 0.0171*** | | | 0.107 | |
| | | (0.00428) | | | (0.391) | |
| ln(ESO share$_{t-1}$) | | | -0.0118*** | | | 0.629 |
| | | | (0.00219) | | | (6.832) |
| Observations | 21,242 | 21,242 | 21,242 | 14,290 | 14,290 | 14,290 |
| Number of id_code | 1,617 | 1,617 | 1,617 | 1,403 | 1,403 | 1,403 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED

Notes: Cluster-Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 7 The Fixed Effect Estimates of the Effect on Tobin's Q of ESO plans on the intensive margin

| | Eq. (10) | Eq. (11) | Eq. (12) | Eq. (10)' | Eq. (11)' | Eq. (12)' |
|---|---|---|---|---|---|---|
| VARIABLES | Fixed Effect Model (1989-2013) | | | FE 2SLS Model (1995-2013 excl. 1999) | | |
| ln(total assets$_{it}$) | -0.193*** | -0.206*** | -0.213*** | -0.246*** | -0.198* | -0.128 |
| | (0.0325) | (0.0320) | (0.0319) | (0.0600) | (0.110) | (0.294) |
| ln(leverage$_{it}$) | -0.00718 | -0.00480 | -0.000038 | 0.00142 | -0.00247 | 0.0272 |
| | (0.00870) | (0.00854) | (0.00847) | (0.00950) | (0.0124) | (0.0608) |
| Capital labor ratio$_{it}$ | 0.000111 | 0.000168 | 0.000072 | 0.000475 | 0.000345 | -0.000216 |
| | (0.000114) | (0.000114) | (0.000115) | (0.000130) | (0.000533) | (0.000650) |
| ln(firm age$_{it}$) | -0.206 | -0.252* | -0.218 | -0.165 | -0.627 | -0.628 |
| | (0.156) | (0.152) | (0.149) | (0.279) | (0.826) | (1.132) |
| Average employee tenure$_{it}$ | -0.00660** | -0.00480* | -0.00566** | -0.0104*** | -0.00313 | 0.00169 |
| | (0.00289) | (0.00279) | (0.00275) | (0.00342) | (0.0136) | (0.0290) |
| ln(ESO per employee$_{t-1}$) | 0.167*** | | 0.208*** | 0.261*** | | 0.157 |
| | (0.0172) | | (0.0193) | (0.0901) | | (0.276) |
| ln(ESO per participant$_{t-1}$) | | 0.228*** | | | 0.294*** | |
| | | (0.0213) | | | (0.110) | |
| ln(participation rate$_{t-1}$) | | 0.0528*** | | | -0.363 | |
| | | (0.0154) | | | (1.122) | |
| ln(ESO share$_{t-1}$) | | | -0.0964*** | | | -0.654 |
| | | | (0.0104) | | | (1.531) |
| Observations | 21,261 | 21,261 | 21,261 | 15,114 | 15,114 | 15,114 |
| Number of id_code | 1,617 | 1,617 | 1,617 | 1,476 | 1,476 | 1,476 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED

Notes: Cluster-Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 8 Interplays between ESO per employee and Ownership Structure in the productivity effects

| | Fixed Effect Estimates（1989-2013） | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dependent Variables | Value Added$_{it}$ | | Wages$_{it}$ | | ROA$_{it}$ | | Tobin's Q$_{it}$ | |
| Lagged Explanatory Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| ln(ESO per employee$_{t-1}$) | 0.0879*** | 0.0884*** | 0.0204*** | 0.0204*** | 0.00919*** | 0.00917*** | 0.159*** | 0.160*** |
| | (0.0077) | (0.0076) | (0.0027) | (0.0027) | (0.00080) | (0.00080) | (0.018) | (0.018) |
| ln(ESO per employee$_{t-1}$)*institutional investor$_i$ | 0.0350** | | 0.0026* | | 0.00248*** | | 0.0467** | |
| | (0.0157) | | (0.0015) | | (0.00094) | | (0.0147) | |
| ln(ESO per employee)$_{t-1}$*foreign investor$_i$ | | 0.0352** | | 0.0027* | | 0.00277*** | | 0.0455** |
| | | (0.0165) | | (0.0016) | | (0.00095) | | (0.0152) |
| Observations | 23,094 | 23,094 | 21,242 | 21,242 | 21,260 | 21,260 | 21,261 | 21,261 |
| R-squared | 0.510 | 0.510 | 0.681 | 0.681 | 0.214 | 0.214 | 0.317 | 0.317 |
| Number of firms | 1,729 | 1,729 | 1,617 | 1,617 | 1,617 | 1,617 | 1,617 | 1,617 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED
Notes: Cluster-Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 9 The heterogeneous productivity effect of ESO plan

| VARIABLES | (1) Stock Option | (2) Smaller Firms | (3) Younger Firms |
|---|---|---|---|
| $lnL_{it}$ | 0.814*** | 0.962*** | 0.952*** |
| | (0.180) | (0.158) | (0.159) |
| $lnK_{it}$ | 0.245** | 0.169* | 0.193** |
| | (0.103) | (0.0927) | (0.0927) |
| $lnL_{it}^2$ | 0.0131 | 0.00959 | 0.0127 |
| | (0.0165) | (0.0156) | (0.0157) |
| $lnK_{it}^2$ | 0.00944 | 0.0162* | 0.0161* |
| | (0.0104) | (0.00955) | (0.00966) |
| $lnK_{it}$*$lnL_{it}$ | -0.0393 | -0.0477** | -0.0510** |
| | (0.0247) | (0.0232) | (0.0234) |
| ln(firm $age_{it}$) | 0.406*** | 0.419*** | 0.414*** |
| | (0.117) | (0.106) | (0.104) |
| Average employee $tenure_{it}$ | 0.00373 | 0.00315 | 0.00273 |
| | (0.00295) | (0.00274) | (0.00275) |
| Stock $option_{it-1}$ | -0.465*** | | |
| | (0.134) | | |
| ln(ESO per $employee_{it-1}$) | 0.0833*** | 0.0958*** | 0.0951*** |
| | (0.00797) | (0.00775) | (0.00771) |
| ln(ESO per $employee_{t-1}$) | 0.0310*** | 0.0370*** | 0.0250*** |
| *institutional $investor_i$ | (0.0106) | (0.0105) | (0.00958) |
| ln(ESO per $employee_{it-1}$)*Stock $option_{it-1}$ | 0.0356*** | | |
| | (0.0104) | | |
| ln(ESO per $employee_{it-1}$) | | -0.0235*** | |
| * Standardized firm size $measure_i$ | | (0.00746) | |
| ln(ESO per $employee_{it-1}$) | | | -0.00390 |
| * Standardized firm age $measure_i$ | | | (0.00761) |
| Observations | 20,539 | 22,638 | 22,638 |
| R-squared | 0.502 | 0.512 | 0.511 |
| Number of id_code | 1,650 | 1,665 | 1,665 |

Sources: the Survey of Current Status of Employee Stock Ownership (SCSESO) over 1989-2013 and Nikkei NEED

Notes: Cluster-Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.

Figure 1：Changes in Key Attributes of ESO Plans over 1989-2013: Balanced Panel of 572 firms