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Broad-based Employee Stock Ownership Incentives and Contracting Efficiency

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Abstract: Neoclassical price theory implies that the incentive effects produced by broad-based employee stock ownership compensation plans will be overwhelmed by the problem of free riding. Yet the use of such plans is relatively common. This paper seeks to explain this apparent dichotomy. Using the theories of the firm of Alchian and Demsetz (1972) and Demsetz (1983) and the analytical structure of Jensen and Meckling (1976), I develop a microeconomic rationale for the use of broad-based stock incentives in the presence of a central monitor. I show that the ability of stock to align owner and employee interests is a function of marginal monitoring costs. At the margin, when monitoring costs are large relative to their benefits, the value of shirking to employees is minute. Hence, the small gain promised by stock ownership is sufficient to motivate reduced shirking. The theory rigorously unifies much of the common litany of explanations for the efficacy of such plans: monitoring and information costs, employee self-selection, the small cost of changing behavior, and alignment of employee with employer interests. Two pairs of refutable implications are derived. First, the optimal level of individual employee ownership is negatively related to firm size and positively related to marginal monitoring costs. Second, the change in firm value attributable to employee stock ownership is positively related to both the level of individual employee ownership and marginal monitoring costs.

1. Introduction

Neoclassical price theory implies that the incentive effects produced by broad-based employee stock ownership compensation plans will be overwhelmed by the problem of free riding. When an incentive is divided among n employees, each employee bears the full cost of any additional individual effort but receives only 1/n of its value [e.g., see Bhagat, Brickley, and Lease (1985), FitzRoy and Kraft (1987)]. Hence, "... the idea that joint ownership can do much for incentives when the number of workers is large seems wrong on the face of it" [Kandel and Lazear (1992)].

Nevertheless, directors are advised that stock ownership aligns employee and owner interests and stock-based group incentives are increasingly common [Jones and Kato (1995), Richardson (1995), Rutledge (1996), Wysocki (1995)]. In addition, empirical evidence supports a positive link between profit-sharing and productivity and, to a lesser degree, between employee share ownership and productivity [Beatty (1995), Blasi, Conte, and Kruse (1996), Cahuc and Dormont (1997), Conte and Svejnar (1990), Jones and Kato (1995), Kumbhakar and Dunbar (1993), Kruse (1992), and Weitzman and Kruse (1990)].

A diffuse litany of non-rigorous arguments typically is invoked to explain this apparent contradiction between economic theory and business practice, including peer pressure, mutual monitoring, and monitoring and information costs. This paper develops a theory that subsumes many of these arguments. Within its context, an employee's relative values for pecuniary compensation and shirking are functions of a firm's marginal monitoring costs. As marginal monitoring costs increase, the value of shirking relative to pecuniary compensation decreases and thereby mitigates the free-rider problem. In particular, the theory implies that the optimal level of individual ownership assigned to employees by owner-managers is negatively related to firm size and positively related to marginal monitoring costs; and the change in firm value attributable to employee stock ownership is positively related to both the level of individual employee ownership and marginal monitoring costs.

The paper proceeds as follows. Section 2 reviews pertinent literature. Section 3 considers the change in employee behavior engendered by stock ownership. Section 4 considers the owner-manager's choice of the level of employee ownership, and then derives inferences regarding the effect of employee stock ownership on firm value. Section 5 concludes.

2. Review of current thinking about the incentive effects of employee stock ownership

A wide range of explanations have been proffered for the apparent ability of group incentives to overcome the free-rider problem. These include peer pressure and mutual monitoring, alignment of employee with employer interests, employee self-selection, investment in firm-specific human capital, and monitoring and information costs [Conte and Svejnar (1990), Weitzman and Kruse (1990)].[1] If the behavioral change desired by the firm costs the employee very little, employees are indifferent between the desired behavior, and inaction may be motivated. [Brickley and Hevert (1991), FitzRoy and Kraft (1995), Kandel and Lazear (1992), Nalbantian (1987)]. Further, as owners, employees may have an incentive to monitor, and challenge if necessary, upper management [Scholes (1991)]. But much of the discussion on these points lacks focus and rigor [Lazear (1995)].

Research by FitzRoy and Kraft (1995), Holmstrom (1982), and Cahuc and Dormont (1997) partially fills this void. Holmstrom (1982) demonstrates that a bonus can be an incentive for a team if it is conditional on a production target and administered and financed by an outside party. Extending Holmstrom's model, Cahuc and Dormont (1997) show that effort and labor productivity increase with the size of the bonus. FitzRoy and Kraft (1995) compare the effects of individual versus group incentives on an employee's contribution to firm profit. They demonstrate that group incentives can be effective motivators when the cost of observation is close enough to mean productivity. All three papers assume what a referee for Cahuc and Dormont terms “the most optimistic view of the possibility of team work in a non-cooperative game.”

In tangentially related research, Jackson and Lazear (1991) model stock incentives while comparing the incentive effects of deferred compensation, stock ownership, and option grants. Though they do not explicitly model the relationship between monitoring costs and stock ownership incentives, they draw an implication similar to this research, namely, when monitoring is perfect, monetary compensation is a stronger incentive than stock ownership.

My approach, while incorporating aspects from each of the above studies, differs in several meaningful respects. First, I do not regard the free-rider problem as given. Closer inspection of the free-rider critique suggests at least two reasons why it is too blunt an

[1] Game theory offers another possible explanation. The existence of multiple equilibria in a repeated prisoner’s dilemma game *may* defeat the free-rider problem (Weitzman and Kruse (1990)). Emphasis theirs.

instrument for analyzing the efficacy of group incentive plans. Free-rider analysis compares the economic incentives for workers in a team process when all residual claims are held by a central monitor to the economic incentives when the residual claim is distributed equally across team members. But employee stock ownership programs typically are incremental additions to existing compensation plans, assigning only a small fraction of the firm's residual cash flows to each employee. A central monitor remains active. Further, latent in the free-rider critique is the assumption that the marginal utilities of income and shirking are equal. But Alchian and Demsetz (1972) argue that the marginal utility of income will be greater than that of leisure (shirking) because an individual's realized cost of shirking is less than shirking's true cost.

Next, my theory can accommodate but does not assume the effectiveness of peer pressure and mutual monitoring. It also explicitly recognizes the value of on-the-job consumption to employees and the tradeoffs between wages and on-the-job consumption noted by Alchian and Demsetz (1972) and Demsetz (1983). Finally, my model is structured to yield implications concerning the effect monitoring has on employee preferences for wages and on-the-job consumption, the core contribution of this research.

3. Stock ownership incentives

3.1 Introduction

I develop the theory in three stages, examining the effects of employee stock ownership first on employees' decisions, then on owner-managers' decisions, and finally on firm value. At issue is whether contracts that include employer stock are more efficient than contracts that do not. I use insights from the theories of the firm of Alchian and Demsetz (1972) and Demsetz (1983) and adapt the structure of Jensen and Meckling (1976) to analyze the agency relationship between owner-manager and employee. But where Jensen and Meckling examine the agency problems engendered when an owner-manager sells a partial claim to her firm (i.e., the agent moves from sole to partial ownership), I consider the agency problems resolved by making the employee a partial owner (i.e., the agent moves from zero to partial ownership).

The analysis proceeds as follows. First I state the assumptions and develop the necessary definitions. I then consider an employee's choice between wages and on-the-job consumption, first in a world of costless perfect information, then in a world of costly imperfect information. This leads to a graphical and mathematical depiction of Demsetz's (1983) labor market equilibrium in which employee compensation bundles are comprised of fixed wages and on-the-job consumption. I perturb this equilibrium by substituting employer stock for a portion of the employee's fixed wage. This yields a closed form expression relating the decrease in employee shirking to firm-specific factors known to or controlled by the owner-manager. Using this expression, I then consider the owner-manager's decision concerning the level of individual employee ownership, and ultimately, the effect of employee ownership on firm value.

3.2 Assumptions and Definitions

Two sets of assumptions, one permanent, the other temporary, define the initial world of perfect information.

The permanent assumptions are:

(P.1) Owner-managers are risk neutral and maximize firm value.

(P.2) Workers maximize utility over pecuniary compensation and on-the-job consumption.[2] Marginal utility decreases in both arguments.

(P.3) Total compensation is allocated between pecuniary wages and the cost of on-the-job consumption. Employees in a given quality group receive the same market-determined total compensation but not necessarily the same allocation [Demsetz (1983)].

(P.4) For any given quality group, there exist innumerable owner-managers and employees with diverse monitoring abilities and individual preferences.

(P.5) Neither the supply of nor the demand for labor is perfectly elastic. Still, there exists a sufficient number of market participants such that the actions of any one individual has only a negligible effect on the general labor market equilibrium.

(P.6) All taxes are zero.

(P.7) Owner-managers retain a majority interest in their firms.

(P.8) Production technology exhibits decreasing returns to scale with respect to workers.

The temporary assumptions are:

(T.1) Monitoring is costless and perfect.

(T.2) Workers are risk neutral.

This paper considers the apportionment of employee compensation between pecuniary and nonpecuniary compensation. My employee derives utility from both, the sum of which equals his total compensation.[3] Moving forward requires rigorously defining the cost of on-the-job consumption and a measure of total employee compensation. I adapt the structure of Jensen and Meckling (1976) to this end.

Jensen and Meckling (1976) define a vector $\vec{X} = \{x_1, x_2 \ldots x_k\}$, of on-the-job consumption that includes items under an owner-manager's discretion. Their examples include individual employee attributes and the lushness of office decor. The employee I consider is unlikely to have such discretionary authority. Instead, my $\vec{X}$ contains factors of production over which the employee has some degree of control, such as the lengths of coffee and lunch breaks, the hours spent exerting less than optimal effort, and the personal use of a firm's copy machine, mail, and phone service. Employee utility increases in all elements of $\vec{X}$.

When $\vec{X}$ is combined with a vector $\vec{Z}$ of owner-manager supplied factors of production (e.g., capital, equipment, and raw materials), all productive inputs are present. Let $C(\vec{X},\vec{Z})$ be the cost of supplying $\vec{X}$ and $\vec{Z}$, and $R(\vec{X},\vec{Z})$ be the revenue produced Then, holding $\vec{Z}$ constant, $B(\vec{X},\vec{Z}) = R(\vec{X},\vec{Z}) - C(\vec{X},\vec{Z})$ is the net dollar benefit flow to the firm from an employee's consumption of $\vec{X}$, given $\vec{Z}$. It is the employee's net marginal revenue product. There will exist some vector $\vec{X}$, given $\vec{Z}$, that maximizes this net dollar benefit flow. Let

[2] This implicitly assumes that workers have found the quality group that maximizes their productive capability. Pecuniary compensation includes fixed wages and, later in the analysis, stock received in lieu of wages.

[3] This is analogous to Jensen and Meckling [1976]. Their owner-manager derives utility from the firm's cash flow and consuming on the job. The sum of the dollar values of these two flows is the value of the firm to the owner-manager.

$\vec{X}^*$ be that vector. I call this maximum dollar value the employee's maximum marginal revenue product (*MMRP*), where $MMRP = B\left(\vec{X}^*, \vec{Z}\right)$.[4]

While the employee never consumes less than $\vec{X}^*$, he wants to consume more. Because the cost of his additional on-the-job consumption is greater than the revenue it produces, consuming more reduces the employee's net marginal revenue product. Let $\hat{X}$ be a vector of employee on-the-job consumption, where $\hat{X} > \vec{X}^*$. Then the dollar cost to the firm of the employee's on-the-job consumption is $B\left(\vec{X}^*, \vec{Z}\right) - B\left(\hat{X}, \vec{Z}\right)$. This cost to the owner-manager is a benefit to the employee. I call it nonpecuniary compensation (*NP*). It is analogous to Jensen and Meckling's *F*.

By definition, the employee's maximum marginal revenue product is comprised of the dollar values of two benefit flows: his net marginal revenue product and nonpecuniary compensation. The value of the maximum marginal revenue product is fixed for a given worker and scale of operation. Its allocation between pecuniary and nonpecuniary compensation is the subject of this paper.

Note the distinction between nonpecuniary compensation and on-the-job consumption. On-the-job consumption is the process of using firm assets to increase personal utility and firm product. Nonpecuniary compensation is the net dollar cost of this consumption. On-the-job consumption must exceed the level that maximizes the net dollar benefit flow to the owner-manager $\left(\vec{X}^*\right)$ before nonpecuniary compensation exists (i.e., is positive). All dollar denominated variables are current market values of the period by period cash flows involved, taking into account the probability distributions of these cash flows.

3.3 Equilibrium compensation bundles

3.3.1 The compensation mix in a world of perfect costless information

Assume a market exists that determines the price $\left(CL_p\right)$ for a given quality of labor and that this price is observable by all participants. Further, let the market price of labor reflect both pecuniary and nonpecuniary compensation. Now consider the hiring decision faced by a value-maximizing owner-manager in a world of perfect costless information. Non-negative profits require that an employee's total compensation never exceed his maximum marginal revenue product. If a prospective employee's maximum marginal revenue product is greater than or equal to and his reservation wage less than or equal to the market price of labor, he is engaged.

The employee maximizes his utility by his choice of on-the-job consumption. The owner-manager monitors the employee's on-the-job consumption and pays the difference between its cost and the market price of labor in monetary wages. Because monitoring is perfect and costless wages and the cost of on-the-job consumption are perfectly inversely correlated. Therefore

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[4] As in Jensen and Meckling, $\dfrac{\partial B\left(\vec{X}, \vec{Z}\right)}{\partial x_i} = \dfrac{\partial R\left(\vec{X}^*, \vec{Z}\right)}{\partial \vec{X}} - \dfrac{\partial C\left(\vec{X}^*, \vec{Z}\right)}{\partial \vec{X}} = 0$.

I assume a well-behaved, universally concave production function, where $\dfrac{\partial B\left(\vec{X}, \vec{Z}\right)}{\partial x_i} > 0 \ \forall\, x_i < x_i^*$ and $\dfrac{\partial B\left(\vec{X}, \vec{Z}\right)}{\partial x_i} < 0 \ \forall\, x_i > x_i^*$, $i = 1, 2, \ldots k$.

$$P = CL_p - NP \quad \textbf{(1)}$$

where P denotes pecuniary compensation (wages) and NP denotes nonpecuniary compensation.

Figure 1 depicts these relationships and serves as the base case for the ensuing analysis. In Figure 1a the market supply and demand schedules for labor identify the market-clearing price of labor, CL_p. In Figure 1b the line $\overline{P_p NP_p}$ represents all combinations of pecuniary and nonpecuniary compensation that sum to this market price. I call this line the labor price constraint, LPC_p. An employee with preferences mapped by U_p maximizes his utility by consuming NP_a on the job and receiving P_a in fixed wages.

The employee's choice. After internalizing equation (1) the employee's unconstrained maximization problem is

$$\underset{\{NP\}}{Max}\, U\left(P\left(NP\right),\, NP\right) \quad \textbf{(2)}$$

with first order condition

$$\frac{\partial P}{\partial NP} = -\frac{U_{NP}}{U_P} = -1 \quad \textbf{(3)}$$

where U_{NP} and U_P are the partial derivatives of utility with respect to nonpecuniary and pecuniary compensation. The employee's marginal rate of substitution in consumption equals the owner-manager's marginal rate of substitution in exchange. The employee's equilibrium marginal utilities of on-the-job consumption (nonpecuniary compensation) and wages (pecuniary compensation) are equal.

This scenario is analogous to that described by Jensen and Meckling (1976) when their owner-manager owns 100 percent of her firm's residual claims. Then the cost of her on-the-job consumption and the value of her residual claim are perfectly and inversely correlated. In the case of an employee's choice between on-the-job consumption and wages, perfect costless monitoring ensures a perfect inverse correlation between the cost of on-the-job consumption and wages.

Under the scenario of perfect costless monitoring, workers will be added until the marginal employee's maximum marginal revenue product equals her total compensation $\left(MMRP_{marginal} = LPC_p\right)$. This is not the case when the analysis moves to costly and imperfect monitoring. Under the latter scenario, the supply and demand schedules for labor shift and the marginal employee changes. To facilitate comparisons across the two information regimes, I depict the maximum marginal revenue product of an inframarginal employee ($MMRP_{if}$ in Figure 1b) and hold it constant throughout the analysis.

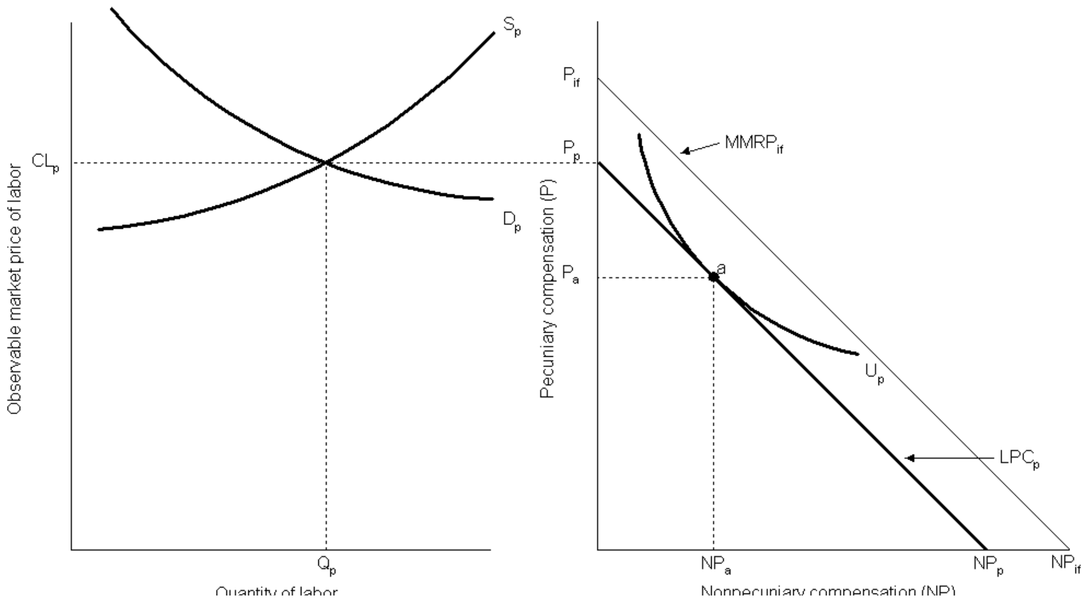

Figure 1a Figure 1b

FIGURE 1a: The market price of labor $\left(CL_pS\right)$ when monitoring is costless and perfect.

FIGURE 1b: The compensation bundle for an employee with preferences U_p when monitoring is costless and perfect. Also shown, the maximum marginal revenue product for an inframarginal worker, $MMRP_{if}$.

3.3.2 The compensation mix when monitoring is costly and imperfect

I now consider the effect of relaxing assumption T.1 (monitoring is costless and perfect). This moves the analysis into a world of imperfect and costly monitoring. In this world, workers shirk. Nonpecuniary compensation thus has two sources: the cost of known or observable on-the-job consumption $\left(OTJ\right)$; and the cost of estimable but unobservable or unattributable on-the-job consumption, or shirking $\left(\varepsilon\right)$ [Alchian and Demsetz (1972), Demsetz (1983)]. The sum of these two costs, $OTJ+\varepsilon$, is the cost to the owner-manager of nonpecuniary compensation.[5]

Overview of the changes induced by shirking. The ability to shirk significantly alters the previous equilibrium solution. Of particular interest, the constraint on employee utility no longer equates the marginal utilities of pecuniary and nonpecuniary compensation. This implies a perfect clientele between workers and employers. Firms with a relative advantage in monitoring will attract workers with preferences for pecuniary compensation; firms with a relative advantage in providing on-the-job consumption will attract workers with preferences for nonpecuniary compensation. In addition, the ability to shirk decreases the market-clearing price of labor, the quantity of labor supplied, employee utility, and total employee compensation.

Shirking. Theories of the firm recognize that incentives to shirk exist in any contractual arrangement when monitoring is costly and imperfect. Because some on-the-job consumption is either prohibitively costly or impossible to observe or assign, employees will increase their

[5] Though nonpecuniary compensation now derives from known on-the-job consumption and shirking, its mathematical definition is unchanged. On-the-job consumption generates a cost when $\hat{X} > \vec{X}^*$ regardless of the observability of $\hat{X}$.

utility by shirking. [Alchian and Demsetz (1972), Demsetz (1983), Jensen and Meckling (1976)]

Nonetheless, utility gains from shirking must be limited. If not, wage-based contracting would be far less common. Shirking occurs within the context of work, limiting the choice of utility-producing elements of consumption. As shirking increases, the employee must select from a decreasing number of increasingly less appealing elements. Further, I assume the likelihood of and penalties from detection increase with shirking. This suggests that employees balance the expected disutility from detection against the utility gained from additional shirking.

To model this process I introduce a shirking deflator, $\lambda(\varepsilon, M)$, where $\lambda(\varepsilon, M) \le 1$. The shirking deflator decreases at an increasing rate as shirking and monitoring (*M*) increase.[6] Shirking enters employee utility functions as the product of the deflator and the dollar cost of shirking, $\lambda((\varepsilon, M))*\varepsilon$. As shirking increases, it first increases, then has no effect upon, and ultimately decreases employee utility.[7]

Individual shirking is by definition either undetectable or unassignable, but it is not unexpected. The owner-manager estimates the amount of shirking that will occur and includes it in the nonpecuniary portion of employee compensation bundles.[8] The estimate must be accurate in the long run. If consistently too low, an employee's total compensation will be worth more than her maximum marginal revenue product and the firm will run inefficiently. If the estimate is too high, the compensation bundle will be worth less than the market price of labor and the owner-manager will be unable to attract qualified workers. Therefore, though the cost of individual shirking is not known ex ante or in the short run, market forces require that it is accurately reflected in compensation packages.

Monitoring. The change to costly imperfect monitoring alters the monitoring calculus for owners. They will balance the gains from monitoring (reduced shirking) against its cost. I define monitoring broadly enough to include both direct monitoring and all properly structured monetary and nonmonetary incentives other than stock ownership.

Examining the marginal effect of stock-ownership requires structuring the relationship between monitoring and shirking. Consider an arbitrary monitoring cost function $NP(M)$, uniquely determined by a firm's organizational structure and production technology. Let $NP(M)$ denote the maximum dollar value an employee can consume on the job when dollars are spent monitoring his activity. As per Jensen and Meckling (1976), spending more decreases nonpecuniary compensation $\frac{\partial NP}{\partial M} < 0$ at a decreasing rate $\left(\frac{\partial^2 MP}{\partial M^2} > 0\right)$.

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[6] Mathematically, $\frac{\partial \lambda(\varepsilon, M)}{\partial \varepsilon} < 0$, $\frac{\partial^2 \lambda(\varepsilon, M)}{\partial \varepsilon^2} < 0$, $\frac{\partial \lambda(\varepsilon, M)}{\partial M} < 0$, and $\frac{\partial^2 \lambda(\varepsilon, M)}{\partial M^2} < 0$

[7] This can be seen by examining the first derivative of $\lambda(\varepsilon)\varepsilon$ with respect to ε. For small levels of ε, $\frac{\partial \lambda(\varepsilon)}{\partial \varepsilon}\varepsilon + \lambda(\varepsilon)$ is positive. Shirking increases utility. When $\frac{\partial \lambda(\varepsilon)}{\partial \varepsilon}\varepsilon = -\lambda(\varepsilon)$, shirking's marginal effect on utility is zero. With additional shirking, $\frac{\partial \lambda(\varepsilon)}{\partial \varepsilon}\varepsilon + \lambda(\varepsilon)$ becomes negative.

[8] Average individual shirking can be estimated ex post by measuring group inputs and outputs (see Demsetz (1983)).

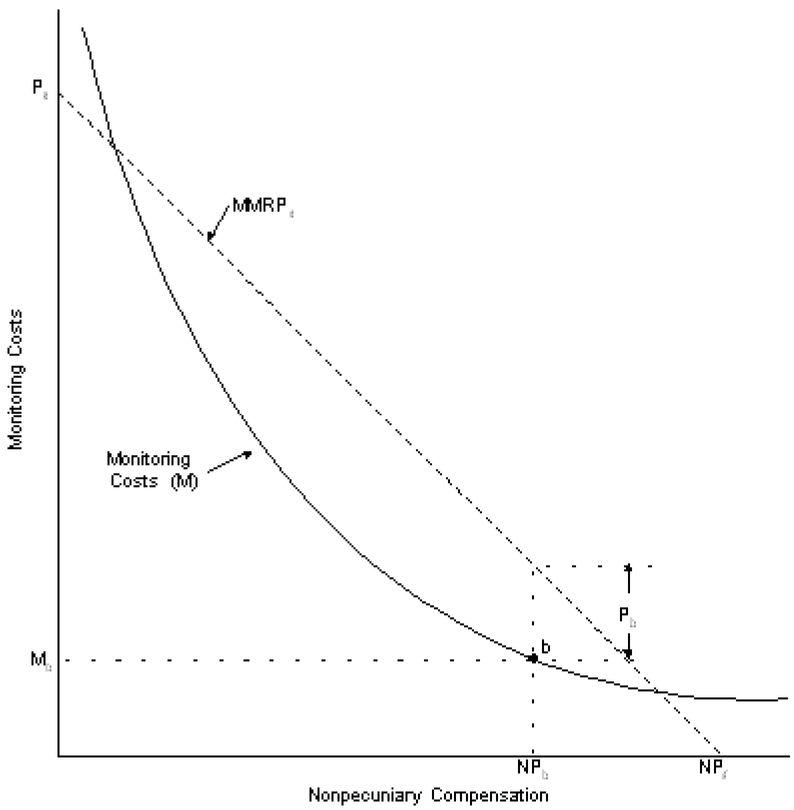

FIGURE 2: One possible monitoring cost function (M) and an inframarginal employee's maximum marginal revenue product $\left(MMRP_{if}\right)$. Spending M_b on monitoring restricts nonpecuniary compensation to NP_b and leaves a maximum of P_b available for pecuniary compensation.

Figure 2 illustrates one possible monitoring cost function and the inframarginal employee's maximum marginal revenue product line. The *y*-axis represents total monitoring costs, the *x*-axis nonpecuniary compensation. If an owner-manager spends nothing to monitor her employee, the employee consumes more on the job than his maximum marginal revenue product. A rational owner-manager therefore will incur monitoring costs to reduce the employee's nonpecuniary compensation. For example, the owner-manager could restrict the cost of the employee's on-the-job consumption to NP_b by incurring monitoring costs of M_b. The amount spent on monitoring determines the amount of on-the-job consumption. Nothing is lost, however, by reversing the direction of causality. An owner-manager may determine how much employee on-the-job consumption she will tolerate and select her monitoring budget accordingly.

Rational limits on monitoring. Rational behavior by the owner-manager constrains the range of monitoring activity. Monitoring costs will be incurred only if monitoring reduces on-the-job consumption, i.e., $\frac{\partial M}{\partial NP}$ is negative. Further, at the margin, value-maximizing owner-managers will not spend more on monitoring than they expect to gain from reduced on-the-job consumption $\left(\left|\Delta M\right| \leq \Delta NP\right)$. This implies a lower limit for $\frac{\partial M}{\partial NP}$ of – 1.

There is also a more subtle constraint on monitoring. When employees view total compensation as the sum of pecuniary and nonpecuniary compensation, $\frac{\partial M}{\partial NP}$ will approach but never equal – 1. This is so because a reduction in on-the-job consumption will be perceived by employees as a reduction of their total compensation. Hence, they will require additional compensation for the decrease in on-the-job consumption (ΔNP) imposed by an increase in monitoring (ΔM). This incremental increase in pecuniary compensation is an implicit cost to owners. Because of this implicit cost it will never be efficient to increase monitoring to the point where $|\Delta M| = \Delta NP$. This latter limit is important to the ensuing analysis.

Net marginal revenue constraint. Non-negative profits require that an employee's total compensation plus monitoring costs not exceed her maximum marginal revenue product. That is,

$$MMPR \geq P + NP + M \qquad \textbf{(4)}$$

Therefore, the maximum pecuniary wage that will be offered is

$$P = MMRP - NP - M \qquad \textbf{(5)}$$

Equation (5) is the vertical difference between an employee's maximum marginal revenue product and the monitoring function (in Figure 2). I call this difference the net marginal revenue constraint $(NMRC)$ and graph it in Figure 3.

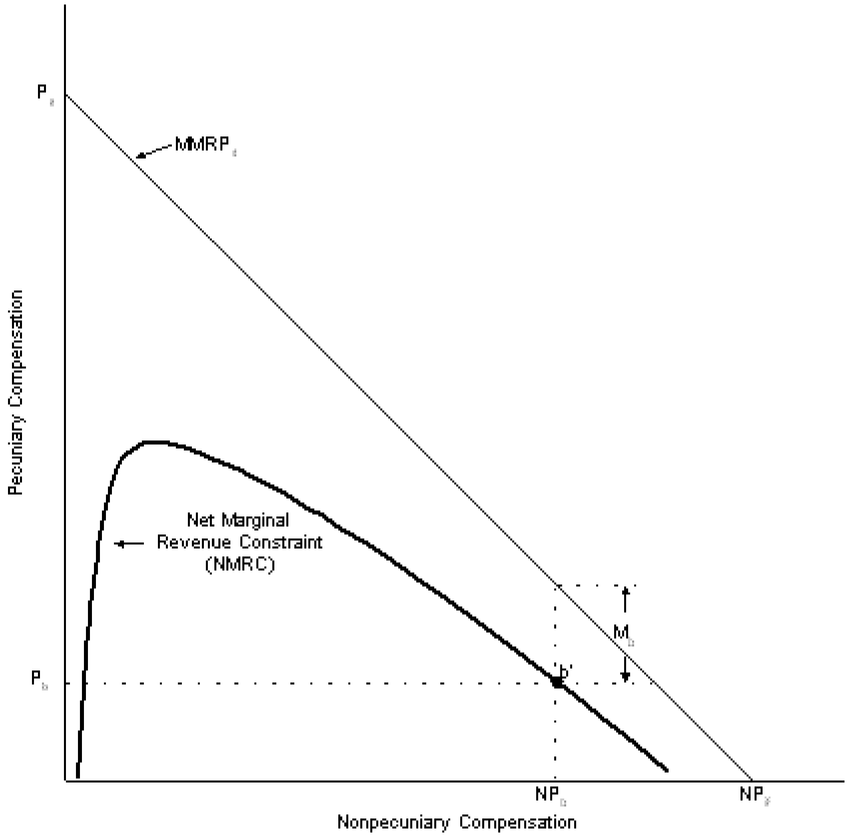

FIGURE 3: The net marginal revenue constraint: $P = MMRP - NP - M$. The net marginal revenue constraint is the zero profit iso-profit line. At point b', monitoring costs (M_b) are the vertical distance between b' and $MMRP_{if}$;

pecuniary compensation is the vertical distance between the origin and point P_b; and nonpecuniary compensation is the horizontal distance between the origin and NP_b.

Figures 2 and 3 convey the same information but in different spaces. For example, at point b in Figure 2, an owner-manager restricts the cost of that employee's on-the-job consumption to nonpecuniary compensation NP_b by spending M_b to monitor her employee. This leaves P_b available for pecuniary compensation. Point b' on the net marginal revenue constraint in Figure 3 also identifies M_b, NP_b, and P_b. But in Figure 3, monitoring costs are the vertical distance between b' and $\overline{P_{if}NP_{if}}$ and pecuniary compensation P_b is the y-coordinate of b'. As before, nonpecuniary compensation is the horizontal distance from the origin.

Nonpecuniary compensation is now the sum of the cost of known on-the-job consumption and the expected cost of shirking, i.e., $NP = OTJ + E(\varepsilon)$. Substituting this expression into equation (), the expression for the net marginal revenue constraint becomes

$$P = MMRP - M - OTJ - E(\varepsilon) \tag{6}$$

where once again equals the maximum amount available for pecuniary compensation.

The net marginal revenue constraint is the zero-profit isoprofit line for compensation bundles. A rational owner-manager will not offer her employee a compensation bundle that lies above it. It therefore becomes the active constraint on employee utility.

Market price of labor. Owner-managers, anticipating monitoring costs and employee shirking, decrease the value of the compensation bundles they offer the labor market. This shifts the demand schedule for labor downward by the sum of the costs of monitoring and anticipated shirking, from D_p to D_{ci} in Figure 4a. Workers, anticipating the value of shirking, reduce the observable portion of their reservation wage. This shifts the supply schedule for labor downward by the value of shirking to employees, from S_p to S_{ci}. But the value of shirking to employees is less than its cost to owner-managers, so the magnitude of the shift in the supply schedule is smaller than that of the demand schedule due to the cost of shirking. Hence, the observable market price of labor (that does not include shirking) decreases by less than the expected cost of monitoring and shirking, from CL_p to CL_{ci}. The quantity of labor supplied decreases from Q_p to Q_{ci}.

Both owner-manager and employee include shirking in the employee's total compensation. Its expected cost, however, is not reflected in the observable market price of labor. Therefore the effective market price of labor is the sum of the observable market price of labor and the expected cost of shirking. The line that represents all bundles that sum to the effective market price of labor, what I call the effective labor price constraint, is depicted as $ELPC_{ci}$ in Figure 4b.

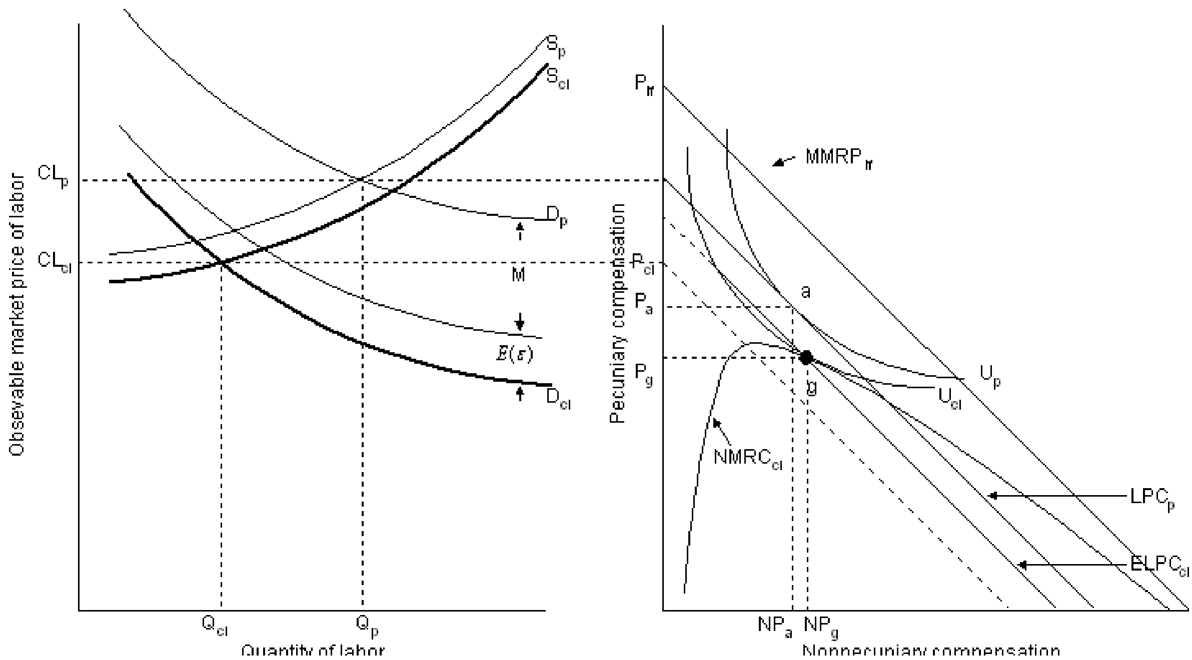

Figure 4a Figure 4b

FIGURE 4a: The market price of labor when monitoring is costly and imperfect. The demand schedule shifts down by the cost of monitoring and the owner-manager's expectation for the cost of shirking, from D_p to D_{ci}. The supply schedule for labor shifts down by the value of shirking to employees, from S_p to D_{ci}.

FIGURE 4b: The compensation bundle when monitoring is costly and imperfect. The effective labor price constraint, $ELPC_{ci}$, reflects both the observable market price of labor and the expected cost of shirking. Employee indifference curve U_{ci} is tangent to the net marginal revenue constraint $\left(NMRC_{ci}\right)$ at point *g*, where $NMRC_{ci}$ intersects $ELPC_{ci}$. The equilibrium compensation bundle is $\left[NP_g, P_g\right]$.

Equilibrium solution. The market price of labor contains two goods, pecuniary and nonpecuniary compensation. The allocation of these goods in the optimal compensation bundle, hence the optimal amount of monitoring, results from an exchange of these two goods between the owner-manager and employee. The exchange is based upon the relative prices placed on the goods by each individual. The ratios of these respective relative prices are the slopes of the owner-manager's net marginal revenue constraint and the employee's indifference curves (their marginal rates of substitution in exchange and consumption). The point at which the employee's indifference curve is tangent to the owner-manager's net marginal revenue constraint maximizes employee utility and equates the marginal rates of substitution in exchange and consumption.[9]

[9] For example, when the slope of the net marginal revenue constraint equals $-\frac{1}{2}$, the owner-manager is indifferent between paying one incremental unit of pecuniary or two incremental units of nonpecuniary compensation. Likewise, when the slope of the worker's indifference curve $\left(-\frac{\partial U_{NP}}{\partial U_P}\right)$ equals $-\frac{1}{2}$, the worker

The employee will not accept compensation less than the effective market price of labor; the owner-manager will not offer more. Workers will be added as long as the point of tangency between employee indifference curves and the net marginal revenue constraint lies above the effective labor price constraint. For each additional worker, the maximum marginal revenue product line and net marginal revenue constraint shift downward, reflecting decreasing returns to scale. Equilibrium is reached and the compensation bundle identified when the point of tangency intersects the effective labor price constraint. The old inframarginal employee from the world of costless perfect information becomes the new marginal employee.

Figure 4b illustrates the new equilibrium solution. Potential employees with preferences mapped by indifference curves $\left(U_{ci}\right)$ tangent to the net marginal revenue constraint $\left(NMRC_{ci}\right)$ at its intersection with the labor price constraint $\left(ELPC_{ci}\right)$, point *g*, will seek employment from and be sought for employment by the owner-manager. Other potential employees will seek employment elsewhere. Innumerable and diverse owner-managers and workers ensure continuous solutions along the labor price constraint.[10]

3.4 Shirking and employee stock ownership

Before the effect of employee stock ownership on firm value can be analyzed, the effect of stock ownership on employee behavior must be considered. This section does that. Section 3.4.1 identifies the equilibrium conditions prior to making the employee a partial owner. Section 3.4.2 perturbs this equilibrium by adding stock to the employee's compensation bundle, then demonstrates that decreased shirking results. Section 3.4.3 relates the amount that shirking decreases (hence the amount that firm value increases) to the level of individual employee stock ownership and marginal monitoring costs. Section 3.4.4 considers the factors that affect how much shirking an employee forgoes when made a partial owner.

3.4.1 Equilibrium conditions prior to employee stock ownership

This section identifies the equilibrium levels of monitoring and employee shirking prior to employee stock ownership. Establishing the level of monitoring is important because monitoring is unchanged by the initiation of stock ownership, at least in the short run. The pre-stock-ownership level of shirking provides a basis for comparison with the changes engendered by stock ownership.

Consider the employee's choice of known on-the-job consumption and shirking. The employee faces the constrained maximization problem

$$\underset{\{OTJ,\,\varepsilon\}}{Max}\; U\left(P\left(E\left[NP\right]\right),\; g\left(NP\right)\right) \qquad \textbf{(7)}$$

subject to

$$P = MMRP - E\left[NP\right] - M\left[E\left[NP\right]\right] \qquad \textbf{(8)}$$

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is indifferent between receiving one incremental unit of pecuniary or two incremental units of nonpecuniary compensation.

[10] The fact that the equilibrium compensation bundle is identified by the point of tangency between an employee's indifference curve and an owner-manager's net marginal revenue constraint offers a simpler way to see that $\frac{\partial M}{\partial NP}$ approaches but never equals – 1. An $\frac{\partial M}{\partial NP}$ equal to –1 implies a slope of 0 for the employee's indifference curve, violating the assumption of increasing employee utility in nonpecuniary compensation.

where the owner-manager's expected cost of all on-the-job consumption, $E\left[NP\right]$, and its value to the worker, , are defined as

$$\begin{gathered} E\left[NP\right] = OTJ + E\left[\varepsilon\right] \text{ and} \\ g\left(NP\right) = OTJ + \lambda\left(\varepsilon\right)\varepsilon \end{gathered} \quad \textbf{(9)}$$

After internalizing the constraint the first order conditions (derived in Appendix A) are

$$\begin{gathered} \frac{\partial U}{\partial P}\left(-1 - \frac{\partial M\left(E\left[NP\right]\right)}{\partial E\left[NP\right]}\right) + \frac{\partial U}{\partial g\left(NP\right)} = 0 \\ \frac{\partial U}{\partial g\left(NP\right)}\left(\frac{\partial \lambda}{\partial \varepsilon}\varepsilon + \lambda\right) = 0 \end{gathered} \quad \textbf{(10)}$$

Employee self-selection ensures these conditions will be satisfied. Consistent with Demsetz (1983), only workers whose preferences balance the owner-manager's relative prices for pecuniary and nonpecuniary compensation will seek employment from this firm. This implies that, in equilibrium, the cost of an employee's shirking equals that expected by the owner-manager, i.e., $\varepsilon^* = E\left[\varepsilon\right]$. Substituting ε^* for $E\left[\varepsilon\right]$ into the first of the definitions (9) formalizes this condition, thus

$$E\left[NP\right] = OTJ^* + \varepsilon^* = NP^* \quad \textbf{(11)}$$

If this condition is not met, the worker chooses another employer, self-employment, or leisure.

Substituting NP^* and ε^* into the first order conditions (10) yields the identities

$$\begin{gathered} \frac{\partial U}{\partial P}\left(-1 - \frac{\partial M}{\partial NP^*}\right) + \frac{\partial U}{\partial g\left(NP^*\right)} \equiv 0 \\ \frac{\partial U}{\partial g\left(NP^*\right)}\left(\frac{\partial \lambda}{\partial \varepsilon^*}\varepsilon^* + \lambda\left(\varepsilon^*\right)\right) \equiv 0 \end{gathered} \quad \textbf{(12)}$$

where $\frac{\partial M}{\partial NP^*} = \frac{\partial M\left(E\left[NP\right]\right)}{\partial E\left[NP\right]}$ (from equation (11)) and $\frac{\partial M}{\partial NP^*}$, $\frac{\partial U}{\partial g\left(NP^*\right)}$, $\frac{\partial \lambda}{\partial \varepsilon^*}$ and $\frac{\partial U}{\partial P^*}$ represent partial derivatives of functions evaluated in the neighborhood of the equilibrium [notation adapted from Chiang (1984)].

These identities capture much of the intuition developed thus far. Because employee utility increases in nonpecuniary compensation $\left(\frac{\partial U}{\partial g\left(NP\right)} > 0\right)$, the second identity will be satisfied only if

$$\frac{\partial \lambda}{\partial \varepsilon^*}\varepsilon^* + \lambda\left(\varepsilon^*\right) \equiv 0 \quad \textbf{(13)}$$

Equation (13) implies that the equilibrium marginal utility of shirking is zero. Rearranging the first condition yields

$$\left(-1-\frac{\partial M}{\partial NP^*}\right)\equiv\frac{\dfrac{\partial U}{\partial g\left(NP^*\right)}}{\dfrac{\partial U}{\partial P^*}} \qquad \textbf{(14)}$$

Equation (14) implies that the marginal utility of nonpecuniary compensation is less than that of pecuniary compensation because $-1<\frac{\partial M}{\partial NP^*}<0$.

The slope of the monitoring cost function, $\frac{\partial M}{\partial NP^*}$, is important to the development that follows, but awkward to label. However, by considering its discrete form, $\frac{\Delta M}{\Delta NP}$, and normalizing the denominator, the ratio is seen to be a simple function of a firm's marginal monitoring costs. As marginal monitoring costs increase relative to their marginal benefits, $\frac{\partial M}{\partial NP}$ approaches –1 and the net marginal gain from monitoring approaches zero; additional monitoring is less effective. When marginal monitoring costs are low relative to their marginal benefits, $\frac{\partial M}{\partial NP}$ is close to zero and the net marginal gain from monitoring is large; additional monitoring is more effective. In the discussions that follow, I use marginal monitoring costs when referring to $\frac{\partial M}{\partial NP}$. For example, the term "large marginal monitoring costs" refers to a partial derivative that approaches a value of –1.

3.4.1a The free-rider problem with costly imperfect monitoring

Note the implications of equation (14) for the free-rider critique. The critique implicitly assumes equal or nearly equal marginal utilities of pecuniary and nonpecuniary compensation. But when monitoring is imperfect the relative values of pecuniary and nonpecuniary compensation are a function of the slope of the monitoring cost function, $\frac{\partial M}{\partial NP}$. As $\frac{\partial M}{\partial NP}$ approaches its rational limit of –1 the marginal utility of nonpecuniary compensation relative to pecuniary compensation decreases substantially. So though the individual pecuniary gain promised by a group incentive is small, it nonetheless can yield positive marginal utility and thereby motivate employees to reduce their shirking.

This motivational effect does not ignore the free-rider problem. Certainly group members who do not reduce their shirking benefit from those who do. But when equilibrium marginal monitoring costs are large, even employees inclined to free ride will be motivated by self-interest to reduce their shirking. Gains in firm value due to positive externalities are in addition to those considered here.

3.4.2 Equilibrium conditions when compensation bundles include employer stock

An employee receiving the equilibrium compensation bundle identified in the previous section (point *g* in Figure 4b) shirks and consumes more on the job than if monitoring were costless and perfect. The employee could reach a preferred position at less cost to the owner-manager by forgoing some shirking in exchange for additional wages (the compensation bundles lying between U_{ci} and $ELPC_{ci}$). But imperfect monitoring makes it impossible for the employee to credibly commit to such a contract. However, when employee behavior affects firm value employee stock ownership can affect such an exchange.

I now consider whether, given an equilibrium in which gains from monitoring have been exhausted, both owner-manager and worker can achieve preferred positions by including employer stock in worker compensation packages. I perturb the previous equilibrium by substituting a fraction (α) of the employing firm's equity $(V(\varepsilon))$ for a portion of the employee's fixed wages (ΔW).[11] The substitution makes pecuniary compensation a function of discretionary employee behavior (shirking ()), thus.

$$P\left(E\left[NP\right],\,\varepsilon\right)=MMRP-E\left[NP\right]-M\left(E\left[NP\right]\right)-\Delta W+\alpha V\left(\varepsilon\right) \qquad \textbf{(15)}$$

Therefore,

$$\frac{\partial P}{\partial \varepsilon}=\alpha\frac{\partial V\left(\varepsilon\right)}{\partial \varepsilon} \qquad \textbf{(16)}$$

By replacing the previous constraint (equation (8)) with the modified constraint (equation (15)), then substituting the new constraint into the worker maximization problem (equation (7)), the first order conditions under stock ownership become

$$\begin{aligned}&\frac{\partial U}{\partial P}\left(-1-\frac{\partial M\left(E\left[NP\right]\right)}{\partial E\left[NP\right]}\right)+\frac{\partial U}{\partial g\left(NP\right)}=0\\&\frac{\partial U}{\partial P}\frac{\alpha\partial V\left(\varepsilon\right)}{\partial \varepsilon}+\frac{\partial U}{\partial g\left(NP\right)}\left(\frac{\partial \lambda}{\partial \varepsilon}\varepsilon+\lambda\right)=0\end{aligned} \qquad \textbf{(17)}$$

Solving () for the optimal values of and yields the identity (derived in Appendix B)

$$\left(\frac{\partial \lambda\left(\varepsilon\right)}{\partial \varepsilon^{s}}\right)\varepsilon^{s}+\lambda\left(\varepsilon^{s}\right)\equiv\frac{\alpha\dfrac{\partial V\left(\varepsilon\right)}{\partial \varepsilon^{s}}}{-1-\dfrac{\partial M}{\partial NP^{*}}} \qquad \textbf{(18)}$$

where ε^{s} is the utility-maximizing amount of shirking when stock is included in an employee's compensation bundle. The right-hand side of equation (18) is positive because $\frac{\partial V(\varepsilon)}{\partial \varepsilon}$ is negative by construction and $\frac{\partial M}{\partial NP^{*}}$ lies between -1 and 0. This can only be the case if shirking decreases from its pre-stock-ownership level, i.e., $\varepsilon^{s}<\varepsilon^{*}$. Hence, within the constraints of this model, equation (18) implies that stock ownership decreases shirking. Intuitively, because the last unit of shirking yields no utility to the employee, a small pecuniary gain is sufficient to motivate decreased shirking.

3.4.3 Shirking forgone

The owner-manager wants to know the amount that shirking decreases, because firm value increases by the cost of the shirking forgone. I now consider how factors under the

[11] While ΔW and $\alpha V(\varepsilon)$ can be chosen such that $\alpha V(\varepsilon)=\Delta W$, they need not be. Chaplinsky, et. al [1998] observe compensation changes at the time of ESOP adoption that range from work-rule changes to large reductions in cash wages. By not restricting the compensation given up by employees to a specific value, the model has the flexibility to address a broad range of exchanges between owner-managers and employees.

control of or known to the owner-manager affect the amount of shirking forgone. Let $\Delta\varepsilon$ be that amount, where $\Delta\varepsilon > 0$. Substituting $\left(\varepsilon^* - \Delta\varepsilon\right)$ for ε^s into identity (18) yields

$$\left(\frac{\partial\lambda\left(\varepsilon^* - \Delta\varepsilon\right)}{\partial\varepsilon^s}\left(\varepsilon^* - \Delta\varepsilon\right) + \lambda\left(\varepsilon^* - \Delta\varepsilon\right)\right) \equiv \frac{\alpha\dfrac{\partial V(\varepsilon)}{\partial\varepsilon^s}}{\left(-1 - \dfrac{\partial M}{\partial NP^*}\right)} \tag{19}$$

After expanding the left-hand side of equation (19) by a first-order Taylor series, the approximate amount of shirking forgone by any given worker (proof in Appendix C) is

$$\Delta\varepsilon \approx \frac{\alpha\dfrac{\partial V(\varepsilon)}{\partial\varepsilon^*}}{\left(1 + \dfrac{\partial M}{\partial NP^*}\right)\left(2\dfrac{\partial\lambda(\varepsilon, M)}{\partial\varepsilon^*} + \dfrac{\partial^2\lambda(\varepsilon, M)}{\partial\varepsilon^{*2}}\right)} \tag{20}$$

Shirking forgone is a function of the fraction of the firm assigned to the employee (α), marginal monitoring costs $\left(\dfrac{\partial M}{\partial NP^*}\right)$, worker preferences (the first and second derivatives of the shirking deflator with respect to shirking), and the effect of the employee's change in behavior on firm value $\left(\dfrac{\partial V(\varepsilon)}{\partial\varepsilon}\right)$.

Figure 5 graphically depicts the equilibrating process when $\Delta W = \alpha V^0$. The relationship between pecuniary compensation and shirking forgone is represented by the ray passing through point *i* with origin at point *g* and slope –α.[12] I call this ray the stock ownership constraint (*SOC*). As the employee forgoes shirking, the value of her stock increases. Utility is maximized at point *i*. The employee forgoes $NP_g - NP_i$ worth of shirking and thereby realizes a $P_i - P_g$ increase in the value of her stock. Her utility increases from U_{ci} to U_i. The total value of the firm's stock increases by $\Delta NP = NP_g - NP_i$, the cost of the shirking forgone.[13]

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[12] For very small levels of individual employee ownership, $\dfrac{\partial M}{\partial NP}$ must be very close to –1 before an incentive effect exists. Allowing positive externalities, such that $\dfrac{\partial V(\varepsilon)}{\partial\varepsilon} < -1$, mitigates this problem.

[13] Because of the linear approximation used to estimate shirking forgone, Figure exaggerates the magnitude of these changes, but not their direction.

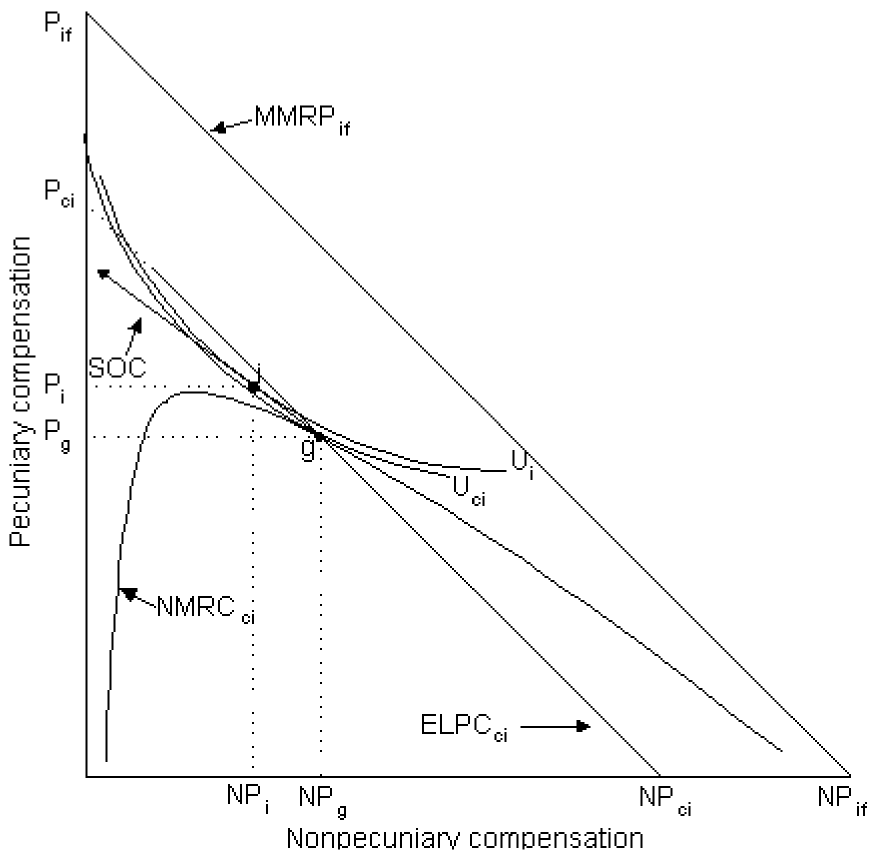

FIGURE 5: The effect of stock ownership on shirking. Ray *SOC* is the stock ownership constraint. After receiving stock in lieu of wages in compensation bundle $[P_g, NP_g]$, the employee foregoes $NP_g - NP_i$ worth of shirking for a gain of $P_i - P_g$ in stock holdings. Utility increases to from U_{ci} to U_i.

3.4.4 Factors that affect shirking

The factors that influence the amount of shirking an employee will forgo are either fixed or exogenous to the employee's decision. The employee's ability to affect firm value $\frac{\partial V}{\partial \varepsilon}$ is fixed by construction, though I do consider the effect of relaxing this constraint. The first and second derivatives of the shirking deflator (λ) are fixed by the Taylor series expansion. Owner-managers control the remaining two factors, marginal monitoring costs $\left(\frac{\partial M}{\partial NP^*}\right)$ and level of partial employee ownership (α). Therefore both are exogenous to the employee's decision.

The decision to make employees partial owners affects neither the level of monitoring nor marginal monitoring costs. Because gains from monitoring are exhausted before the stock ownership decision is made, reducing monitoring after initiating stock ownership would be inefficient (in that some gains from monitoring would be forgone). Further, because marginal monitoring costs are instrumental in matching the firm with its worker clientele, changing the level of monitoring implies replacing the existing work force.[14] I therefore treat stock ownership as a complement to, rather than a substitute for, monitoring.

The following comparative statics consider the partial effects of variables in the owner-manager's information set on employee behavior (the amount of shirking forgone). When interpreting them, it is helpful to recall that employee influence on firm value $\left(\frac{\partial V}{\partial \varepsilon}\right)$ and marginal monitoring costs $\left(\frac{\partial M}{\partial NP}\right)$ are inverse relationships, and that the first and second derivatives of the shirking deflator (λ) with respect to shirking are negative by design. The symbols M_{NP} and V_{ε^s} are used to denote the partial derivatives $\frac{\partial M}{\partial NP^*}$ and $\frac{\partial V(\varepsilon)}{\partial \varepsilon^*}$. The symbol $k(\lambda)$ replaces $\left(2\frac{\partial \lambda(\varepsilon, M)}{\partial \varepsilon^*}+\frac{\partial^2 \lambda(\varepsilon, M)}{\partial \varepsilon^{*2}}\right)$. Differentiating shirking forgone $(\Delta\varepsilon)$ with respect to the variables of interest yields:

$$\frac{\partial \Delta\varepsilon}{\partial \alpha} = \frac{\overset{(-)}{V_{\varepsilon^s}}}{\underset{(+)}{\left(1+M_{NP^*}\right)}\underset{(-)}{k(\lambda)}} > 0 \qquad \textbf{(CS.1)}$$

$$\frac{\partial \Delta\varepsilon}{\partial M_{NP^*}} = -\frac{\alpha \overset{(-)}{V_{\varepsilon^s}}}{\underset{(+)}{\left(1+M_{NP^*}\right)^2}\underset{(-)}{k(\lambda)}} < 0 \qquad \textbf{(CS.2)}$$

$$\frac{\partial \Delta\varepsilon}{\partial V_{\varepsilon^2}} = \frac{\overset{(+)}{\alpha}}{\underset{(+)}{\left(1+M_{NP^*}\right)}\underset{(-)}{k(\lambda)}} < 0 \qquad \textbf{(CS.3)}$$

These equations imply that in the neighborhood of the pre-stock-ownership equilibrium:

(CS.1) Shirking decreases (shirking forgone increases) with the level of individual employee ownership.

(CS.2) Shirking decreases (shirking forgone increases) as marginal monitoring costs increase. Intuitively, as monitoring becomes less effective at the margin (i.e., as the net marginal gain from monitoring approaches zero), the marginal value of shirking approaches zero and the motivational power of stock ownership increases.

(CS.3) Shirking decreases (shirking forgone increases) with the employee's ability to influence firm value.

[14] Changing monitoring effort changes the slope of the net marginal revenue constraint. In turn, this implies a different equilibrium marginal rate of substitution $\left(\frac{\frac{\partial U}{\partial g\left(NP^*\right)}}{\left(\frac{\partial U}{\partial P^*}\right)}\right)$ for employees, hence a different worker clientele.

Comparative static CS.1 does not limit the gains from employee stock ownership. This implies that agency problems can be eliminated by assigning 100 percent ownership to a single individual. Though interesting, this result stems from the linear approximation for shirking forgone. I consider the optimal level of fractional employee ownership in the next section.

The implication of CS.2 is best understood by reconsidering the equilibrium solution depicted in Figure 4b. The constraint on employee utility is the Net Marginal Revenue Constraint (*NMRC*). Its slope at equilibrium determines the employee's relative values for nonpecuniary and pecuniary compensation. As the net marginal gains from monitoring near exhaustion $\left(\text{as } \frac{\partial M}{\partial NP} \rightarrow -1\right)$, the slope of the Net Marginal Revenue Constraint approaches zero, and with it, the employee's relative value of shirking. As the employee's marginal value of shirking decreases, he will forgo more shirking for a given level of stock ownership. Hence, stock incentives are most effective when the gains from monitoring have been exhausted. This suggests that, within the context of this model, stock ownership incentives complement rather than substitute for monitoring.

4. The owner-manager's choice

This section considers the optimal level of individual employee ownership. Holding the level of monitoring constant, the level of employee ownership is the only decision variable available to the owner-manager. After examining the owner-manager's problem, I consider the total effects of individual employee ownership and marginal monitoring costs on firm value. Firm scale remains constant throughout, consistent with the model's initial assumptions.

4.1 The owner-manager's decision when monitoring costs are fixed

The owner-manager chooses the level of employee ownership that maximizes the value of her remaining shares. For *N* workers, the owner-manager's problem is

$$\underset{\{\alpha\}}{Max}\ \left(1 - N\alpha\right)\left(V^0 + \sum_{i=1}^{N} \Delta\varepsilon_i\right) + N\Delta W \qquad \textbf{(21)}$$

where

α = the level of individual employee ownership,

N = the number of employees that are made partial owners,

V^0 = the value of the firm prior to employee ownership,

$$\Delta\varepsilon_i = \frac{\alpha \frac{\partial V(\varepsilon)}{\partial \varepsilon}}{\left(1 + \frac{\partial M}{\partial NP^*}\right)\left(2\frac{\partial \lambda_i(\varepsilon)}{\partial \varepsilon} + \frac{\partial^2 \lambda_i(\varepsilon)}{\partial \varepsilon^2}\right)},\ \forall i = 1,\ldots,N \text{, and}$$

ΔW = the value of the compensation forgone by each worker.

Solving the first order condition for the optimal level of individual employee ownership (derived in Appendix D) yields

$$\alpha^s = \frac{1}{2N} - \frac{V^0\left(1+\dfrac{\partial M}{\partial NP^*}\right)}{2N\dfrac{\partial V(\varepsilon)}{\partial \varepsilon}\bar{k}} \tag{22}$$

where

$$\bar{k} = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{\left(2\dfrac{\partial \lambda_i(\varepsilon, M)}{\partial \varepsilon_i^*} + \dfrac{\partial^2 \lambda_i(\varepsilon, M)}{\partial \varepsilon_i^{*2}}\right)}$$

Optimal fractional ownership is a function solely of firm attributes evaluated in the neighborhood of their pre-stock-ownership equilibrium values. This makes sense, since these attributes comprise the information set upon which owner and employee base their decisions. I treat these factors as exogenous independent variables when analyzing their cross-sectional effects on the optimal choice of fractional employee ownership. As before, M_{NP^*} and V_ε denote the partial derivatives $\frac{\partial M}{\partial NP^*}$ and $\frac{\partial V(\varepsilon)}{\partial \varepsilon^*}$; both are negative. By construction, $\bar{k}$ is negative. The comparative statics follow.

$$\frac{\partial \alpha^s}{\partial M_{NP^*}} = -\frac{\overset{(+)}{V^0}}{\underset{(+)}{2NV_\varepsilon \bar{k}}} < 0 \tag{CS.4}$$

$$\frac{\partial \alpha^s}{\partial V^0} = -\frac{\overset{(+)}{\left(1+M_{NP^*}\right)}}{\underset{(+)}{2NV_\varepsilon \bar{k}}} < 0 \tag{CS.5}$$

$$\frac{\partial \alpha^s}{\partial V_\varepsilon} = -\frac{\overset{(+)}{V^0}\overset{(+)}{\left(1+M_{NP^*}\right)}}{\underset{(-)}{2NV_\varepsilon^2 \bar{k}}} < 0 \tag{CS.6}$$

(CS.4) Optimal fractional employee ownership is larger the greater are marginal monitoring costs. At the margin, less effective monitoring leads to greater employee ownership.

(CS.5) Optimal fractional employee ownership is smaller the greater a firm's pre-stock ownership equilibrium value. Because the value of a given share is larger, it costs the owner-manager more.

(CS.6) Optimal fractional employee ownership is larger the greater the employee's ability to affect firm value.

4.2 The owner-manager's decision when monitoring costs are variable

The ability to change production technology over the long term makes the level of monitoring another choice variable. For completeness, comparative static relationships that treat monitoring costs as another choice variable have been derived. The implications are ambiguous but can be signed by making several reasonable assumptions. The resulting implications are unchanged from those reported in section 4.1. Details are available upon request.

4.3 Factors that affect firm value

Having determined the interaction between the level of employee ownership and monitoring in the owner-manager's problem, the total effects of employee ownership and marginal monitoring costs on the value of the owner-manager's remaining share can now be examined. I first consider the effects of a fair exchange of stock for wages $\left(\alpha V^0 = \Delta W\right)$, then those of an unfair exchange $\left(\alpha V^0 > \Delta W\right)$.

Firm value prior to the exchange of stock for wages is V^0. The owner-manager exchanges $N\alpha V^0$ for $N\Delta W$ and gains $\left(1 - N\alpha\right)\Sigma\Delta\varepsilon_i$ from reduced shirking. This makes the post-exchange value of her remaining share

$$\begin{aligned} FV_{\text{fair}} &= V^0 - N\alpha V^0 + N\Delta W + \left(1 - N\alpha\right)\Sigma\Delta\varepsilon_i \\ &= V^0 + \left(1 - N\alpha\right)\Sigma\Delta\varepsilon_i \end{aligned}$$

The total effects of the level of employee ownership and marginal monitoring costs on the owner-manager's claim are

$$\frac{d\left(FV_{\text{fair}}\right)}{d\alpha} = \left(1 - 2N\alpha\right)\frac{\overset{(+)}{NV_\varepsilon \bar{k}}}{\underset{(+)}{\left(1 + M_{NP^*}\right)}} + -\left(1 - N\alpha\right)\frac{\overset{(+)}{N\alpha V_\varepsilon \bar{k}}}{\underset{(+)}{\left(1 + M_{NP^*}\right)^2}}\frac{\partial M_{NP^*}}{\underset{(-)}{\partial\alpha}} > 0 \qquad \textbf{(CS.7)}$$

$$\frac{d\left(FV_{\text{fair}}\right)}{dM_{NP^*}} = \left(1 - 2N\alpha\right)\frac{\overset{(+)}{NV_\varepsilon \bar{k}}}{\underset{(+)}{\left(1 + M_{NP^*}\right)}}\frac{\partial\alpha}{\underset{(-)}{\partial M_{NP^*}}} + -\left(1 - N\alpha\right)\frac{\overset{(+)}{N\alpha V_\varepsilon \bar{k}}}{\underset{(+)}{\left(1 + M_{NP^*}\right)^2}} < 0 \qquad \textbf{(CS.8)}$$

Subject to the qualifications imposed on $\Delta\varepsilon$ by the Taylor series approximation,

(CS.7) Firm value increases with the level of fractional ownership; and

(CS.8) The increase in firm value is greater the greater are a firm's marginal monitoring costs.

But what if the exchange is not fair? Let δ be a discount factor, where $0 \le \delta < 1$ and $\Delta W = \delta\alpha V^0$. The post-exchange value of the owner-manager's share becomes

$$\begin{aligned} FV_{\text{unfair}} &= V^0 - N\alpha V^0 + N\delta\Delta W + \left(1 - N\alpha\right)\Sigma\Delta\varepsilon_i \\ &= V^0 - N\alpha V^0\left(1 - \delta\right) + \left(1 - N\alpha\right)\Sigma\Delta\varepsilon_i \end{aligned}$$

Differentiating with respect to the level of employee ownership and marginal monitoring costs yields the revised comparative statics

$$\frac{d\left(FV_{\text{unfair}}\right)}{d\alpha}=\underset{(-)}{\left[-NV^{0}\left(1-\delta\right)\right]}+\left(1-2N\alpha\right)\frac{\overset{(+)}{NV_{\varepsilon}\overline{k}}}{\underset{(+)}{\left(1+M_{NP^{*}}\right)}}$$

$$+\underset{(-)}{\left[-\left(1-N\alpha\right)\right]}\frac{\overset{(+)}{N\alpha V_{\varepsilon}\overline{k}}}{\underset{(+)}{\left(1+M_{NP^{*}}\right)^{2}}}\underset{(-)}{\frac{\partial M_{NP^{*}}}{\partial\alpha}}\gtrless 0 \qquad \textbf{(CS.9)}$$

$$\frac{d\left(FV_{\text{fair}}\right)}{dM_{NP^{*}}}=\underset{(-)}{\left[-NV^{0}\left(1-\delta\right)\right]}\underset{(-)}{\frac{\partial\alpha}{\partial M_{NP^{*}}}}+\left(1-2N\alpha\right)\frac{\overset{(+)}{NV_{\varepsilon}\overline{k}}}{\underset{(+)}{\left(1+M_{NP^{*}}\right)}}\underset{(-)}{\frac{\partial\alpha}{\partial M_{NP^{*}}}}$$

$$+\underset{(-)}{\left[-\left(1-N\alpha\right)\right]}\frac{\overset{(+)}{N\alpha V_{\varepsilon}\overline{k}}}{\underset{(+)}{\left(1+M_{NP^{*}}\right)^{2}}}\gtrless 0 \qquad \textbf{(CS.10)}$$

For relatively fair exchanges, δ is close to 1 and the signs of the relationships are unchanged. As δ decreases, the exchange becomes increasingly unfair and the directions of the above relationships reverse. Stock ownership then decreases firm value. Such a scenario, however, violates the assumption of value-maximizing owner-managers.

4.4 Capturing employee surplus

Given the model's current structure, an employee receives a supplier surplus equal to the vertical distance between U_i and U_{ci} in Figure 5. Competitive labor markets enable the owner-manager to capture most of this surplus by reducing the employee's fixed wages until the employee's utility with stock ownership is incrementally greater than her utility without. The comparative static relationships are not affected.

4.5 Employee stock ownership when employees are risk averse

Relaxing the assumption of risk-neutral employees (T.2) adds another layer of mathematical complexity to the owner-manager's decision. Risk-averse employees require a premium to bear the risk associated with stock ownership. After deriving an expression for this premium, I formally considered the relationships between the level of employee ownership and the risk premium, the firm's value prior to employee stock ownership, and the firm's marginal monitoring costs. The signs of the relationships between the level of employee ownership to firm value prior to employee ownership and to the risk premium are ambiguous; but the relationship between the level of individual employee ownership and marginal monitoring costs is unchanged by the addition of risk. The optimal level of employee ownership increases with marginal monitoring costs. The derivations are available upon request.

5. Summary

This research attempts to explain the apparent dichotomy between an increasingly common business practice and microeconomic theory. Broad-based stock ownership programs are being adopted even though the free-rider critique argues that such incentives will be ineffective. While many explanations for this dichotomy have been proffered, no rigorous theory exists that unifies these explanations or suggests a specific empirical approach to the problem.

Using neoclassical price theory I develop a model that unifies many of the existing explanations for the efficacy of employee stock ownership plans—monitoring and information costs, employee self-selection, and alignment of employer and employee interests. Production technology and organizational structure uniquely determine each firm's monitoring and information costs. In turn, monitoring and information costs determine the relative prices for pecuniary and nonpecuniary compensation. Employees self-select firms whose relative prices for pecuniary wages and shirking match the employees' preferences, at which point the marginal value of shirking is zero. Employees who then become partial owners find it in their self-interest to reduce their shirking. Employer and employee interests are aligned and firm value increased.

The theory yields two pairs of refutable implications. First, the optimal level of individual employee ownership increases with marginal monitoring costs and decreases with firm size. Second, the change in firm value attributable to employee stock ownership incentives increases with marginal monitoring costs and the level of individual employee ownership.

Employee Stock Ownership Plans, universal stock options, employee stock purchase plans, and employee 401(k) plans that include employer stock offer avenues for testing, refining, and improving our understanding of broad-based stock incentive plans. Finally, because this model examines changes in individual behavior, its implications also are applicable to executive compensation that includes stock ownership.

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