INVESTMENT AND SUPPLY EFFECTS
OF INDUSTRY-INDEXED BONDS:
THE LABOR MANAGED FIRM

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In this paper we introduce and analyze a financial instrument, termed industry-average performance bonds (IAPB), that we show offers two important advantages for labor-managed firms (LMF): reduced underinvestment, and diminished "Illyrian" supply effects. These instruments commit the LMF to pay a contractual share of value added in its industry, or otherwise index liabilities to a measure of industry conditions; we show that certain incentive compatibility problems associated with the simple firm performance bonds examined in the LMF literature to date are thereby overcome. Privately optimal use of such instruments is also shown to induce LMFs to rationally adopt a positively-sloped supply function in contrast to the classic Ward effect. Finally, it is shown that IAPBs have an effect on joint choice of investment and LMF membership similar but not identical to an exogenous reduction in risk. The bonds are also of interest to employee-owned, producer-coop, family-run and other risk-averse businesses that wish to retain managerial or internal control. (JEL P13, G32, J49)

1. Introduction

In recent years there has been an enormous expansion of partial or full employee ownership of firms in many countries.[1] Employee ownership is growing dramatically in Central and Eastern Europe, where privatization to employees are common. Almost all transition economies, and many other developing countries, provide special incentives to encourage employees to purchase state-owned firms in which they work [e.g., Lee (1991); Im, Jalali and Saghir (1993);

[1] For the US case, see Blasi and Kruse (1991).

Smith (1994)]. Explicit employee share ownership is emerging as a central feature of China's township and village enterprise property rights reform [Smith (1995)]. But some economists have concerns about the wisdom of including privatization to employees as a component of economic reform [e.g., Lipton and Sachs (1990)]. Such firms might exhibit enough of the potentially negative features of the labor-managed firm (LMF) to offset possible gains in production efficiency.[2]

First, employees in LMFs (where nonmember labor or discrimination in income shares are prevented) will have an incentive to decrease output and employment when output price rises, and exhibit related 'perverse' responses to changes in costs and taxes. This 'Ward effect' may occur when owner-employees must share rents generated by market price increases with new employees who would receive claims on net income irrespective of the point at which they joined the firm. Under standard production function specifications, if labor is the only variable factor and if a coalition of LMF members are able to lay off some other members after a price rise, remaining members' incomes will normally be maximized by doing so. Layoffs (or at least incentives to reduce membership through attrition) will also be the most likely response to a price increase under generalizations such as variable capital.[3] Although few current employee ownership regulations would prohibit nonmember labor or share discrimination,[4] a mild version of the Ward effect might in principle apply to East European privatized firms and other employee ownership arrangements.[5]

Moreover, if employee control follows from majority (or even minority) employee ownership, outside investors will presumably be willing to bear any part of the firm's risk only at a high premium. Without control over management directly or through the threat of takeovers, investors might fear that employees will take profits in pay raises and avoid paying an adequate return on shares. This makes the analysis of alternative debt instruments in the LMF framework an important issue for transition economies, even while it remains one of the most unexamined issues in LMF theory.

Currently, fully employee owned firms have only a few options for raising capital, each of which distorts investment and employment choices. They might invest out of their own income, foregoing outside funding and keeping the full stream of value added. This requires a high rate of saving, especially for capital intensive firms. The need to buy shares discourages liquidity-constrained (e.g., unemployed) workers from joining. Alternatively, current workers could give shares to new workers. This would discourage investment, shorten the planning horizon, and reduce employment. These represent additional disincentives for

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[2] For reviews of these widely reported gains for various Western economies, see Blinder (1990) and Bonin, Jones and Putterman (1993).

[3] See Ireland and Law (1982) for an introduction.

[4] For an excellent discussion of institutional ownership arrangements under certainty in which Ward effects do or do not apply see Meade (1986).

[5] See e.g. Nuti (1995).

LMFs to hire new workers when the value of the workers' share in the firm is positive [Vanek (1970)]. LMFs can also issue bonds, keeping only a part of value added but bearing all of the risk. This does not directly require high saving, but the uneven income stream would require high personal saving as an insurance device; and the value of such a risky job might be less than that of an ordinary job.

Proposed alternative approaches to funding LMFs are designed to make it possible for investors to share the risk, without either giving workers incentives to cheat investors or 'compromising the essential character' of the LMF. The leading proposal is the issue of performance bonds, or 'risk participation bonds'. Vanek (1977, pp. 226–288) proposes that such bonds pay a fixed share of value added by the firm. This is a valuable suggestion, but it has limitations that suggest that such bonds could usefully be combined with complementary types of financing. For example, Vanek's system could be subject to the well known inefficient labor effort problems of sharecropping first pointed out by Marshall.[6] McCain (1977) and Major (1996) have proposed similar arrangements in which capital memberships paying an amount proportional to employee shares are issued in exchange for (a market-determined amount of) investment. These systems are analogous to the labor-capital partnerships of Meade (1972, 1986). The LMF could employ new workers without requiring them to pay for their share(s) in advance. Retired workers could keep their shares or sell them back to the firm, or, where permitted, to investors, to avoid bearing new risk. With such a system, a more efficient level of employment and investment may obtain.

However, there is an incentive compatibility problem with performance bond financing, that suggests that LMFs can do better by supplementing such bonds with other instruments. Workers have an incentive to make investments which do not increase value added but which do increase workers' utilities, for example 'gold-plated' purchases to make their jobs more pleasant, such as fancy offices, luxury furniture in factories, and elegant restaurants, or simply to supply less effort than they would if they did not share value added with investors. Moreover, in the presence of asymmetric information about financial performance, the LMF has an incentive to under-report sales (Wolfstetter, Brown and Meran, 1984), or over-report costs. All these problems are present in conventional firms to some degree, but can be limited by shareholders' legal authority, and especially by the threat of takeovers. To avoid such problems, it is necessary to design an asset which bears some of the risk which is out of the control of workers, but makes payments which they cannot affect.

In this paper we present an approach to asset design inspired by the principal/agent and utility regulation literatures, in which it is often efficient to base bond payments on the performance of other firms in the same industry [Holmstrom (1979, 1982); Green and Stokey (1983); Lazear and Rosen (1981)]. For

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[6] The inefficiency problems were pointed out a century ago by Marshall. However, like sharecropping, such a contract could in principle be understood as a compromise between different types of risk [for a discussion see Ray (1998, pp. 420–444)].

example Gibbons and Murphy (1989) have analyzed managerial evaluations based on the performance of other managers in the principal agent framework [see also Antle and Smith (1986)]. Shleifer (1985) considered the electric utility regulation problem that marginal cost pricing will damage the company's incentive to innovate; and proposes that prices be set equal to average marginal costs across a basket of utilities as an alternative. Although one does receive a return from the 'gold-plating' of other utilities, one does not receive a return from one's own gold-plating, so no firm has the incentive to gold-plate (so long as collusion is excluded). We develop a general solution, an asset we call Industry-average performance bonds (IAPBs). Each bond would pay a fixed share or other function of value added by other firms in the same industry. It would be bought at the market rate, which would include where relevant a default premium. These bonds have very favorable properties for improving the economic performance of LMFs.

In section 2 we provide further details on the design and intended effects of industry performance bonds, and introduce them in a model of the LMF under certainty. In section 3, we examine the behavior of the LMF with industry-indexed bonds to substantiate our claims that they would induce higher investment under conditions of industry-specific uncertainty. In section 4, we show that the use of IAPBs have an effect on joint choice of investment and membership similar but not identical to an exogenous reduction in risk, when both are chosen before the uncertainty is resolved. In section 5, we show how the use of these bonds also mitigates or reverses the classic Ward effect, in which LMFs find it optimal to decrease employment and output when price rises. Unlike various regulatory schemes proposed in the literature, this is a solution to the Ward effect that firms would adopt voluntarily. In effect, IAPBs may be used to take advantage of the fact that the LMF wants to expand membership when exogenous nonlabor costs rise to make it in the LMF's interests to expand output and employment when price rises. Finally, in section 6, we offer general concluding observations.

2. Industry-average performance bonds

Industry-average performance bonds (IAPBs) would pay a fixed share or other function of the value added of other firms in the same industry.[7] Since the

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[7] An alternative form of the asset would depend on the average of dividends paid by publicly traded firms in the same industry. A limitation of this approach is that it depends on the presence of a sufficiently large number of publicly traded conventional firms in the relevant industry to provide a benchmark. In fact it would only work if the amount of the dividend-based asset issued by LMFs were low. If a substantial value of such assets were issued, conventional firms would have an incentive to increase the dividends paid on their shares. If their shareholders also held the new assets this would be an additional way of serving their shareholders' interests. In any case defunding competitors is always tempting. The dividend-based asset can at most be used so long as the needs of LMFs for capital

payment would depend only on the value added by other firms in the same industry, workers in an LMF issuing such shares would have no interest in reducing their liability by reducing value added, through either gold plating or income under-reporting.

To introduce the model we briefly examine performance bonds in an environment of price certainty. Assume the LMF is controlled by founding members with 'property rights' to their job; in other words they cannot be laid off involuntarily.[8] Assume a continuum of LMFs indexed by i which ranges from 0 to 1. Each produces the same good with the same production function given by (1), where Q_i is the output of firm i, L_i is (homogeneous) employment in firm i, K_i is the capital used by firm i, and p is the price of output.

$$pQ_i = pF(L_i, K_i). \tag{1}$$

Variables without subscripts refer to industry totals. The price of the good is normalized to 1. The model has two periods. Workers have alternative utility of value w.[9] Firm i issues an asset which pays a share D_i of value added in the industry. Investors require an expected return of r, so the asset issued by firm i sells for $D_i pQ/(1+r)$. The term pQ has no subscript and refers to industry value added. The firm invests the proceeds; so,

$$K_i = D_i pQ/(1+r). \tag{2}$$

The workers divide the remainder, so each worker receives a share given by:

$$s_i = (pF(L_i, K_i) - D_i pF(L, K))/L_i \tag{3}$$

plugging (2) into (3) gives

$$s_i = (pF(L_i, D_i pF(L, K)/(1+r)) - D_i pF(L, K))/L_i. \tag{4}$$

The LMF is assumed to choose D_i and L_i to maximize s_i, subject to the constraint that s_i is greater than or equal to w. Note that since firms pay a return on bonds that depends on industry rather than firm performance, members have no incentive to prefer to remunerate themselves with in-kind rather than monetary income; shares s_i may be modeled as incorporating in-kind 'gold-plating' income without affecting any results.

The maximization in (4) is undertaken by a manager, some number of initial members or some other agent, in period 0, but assuming that the return, s_i, is equal for all homogeneous employees. This equal shares assumption is

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and risk arbitrage are low. Note also that the assumption that firms are small in the public regulation literature is not inconsistent with natural monopoly, because the comparison group is a regional or national set of firms.

[8] This assumption corresponds roughly to that in Bonin (1981) and Brewer and Browning (1982).

[9] For example, employment opportunities in conventional firms paying wage w.

maintained not only for simplicity, but also to make the efficiency problem for the firm more difficult: it is well-known that labor-managed firms choose employment levels efficiently when allowed to vary the dividend share for otherwise equally-skilled workers, depending only on how late they arrived in the (established) LMF [Meade (1986)].

It is clear that the LMF will chose D_i to fund the efficient capital stock without requiring any additional saving from their members. The first order condition for D_i is

$$0 = pF_K(L_i, K_i)F(L, K)/(1 + r) - pF(L, K).\qquad(5)$$

So with industry performance bonds under certainty, $F_K = (1 + r)$. An LMF using IAPBs would invest the same amount as an LMF with conventional external bond financing. This establishes a benchmark result that will be useful in interpreting results under uncertainty.[10]

In the next sections, we extend the model of IAPBs in LMFs to the case of uncertainty.

3. IAPBs and the underinvestment effect: Risk resolved after membership size is fixed

A major advantage of IAPBs over ordinary bonds is that they enable LMFs to avoid bearing firm non-specific risk. This is clearly desirable if there are any investors who are willing to bear some of the risk, and in particular if the risk is industry-specific and diversifiable.[11] For simplicity we will assume that there is a risk neutral investor, or equivalently that the risk is completely industry specific and diversifiable.[12]

Workers maximize a mean-variance utility function of income[13] of the form in (6):

$$V_i = E(s_i) - \text{var}(s_i)g.\qquad(6)$$

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[10] Note that for this benchmark result to imply equal levels of capital investment with a profit maximizing 'twin' firm as well, we would need to make additional assumptions of perfect competition in the long run, with no differences across firms other than in the objective function.

[11] The presence of firm non-specific risk is a major source of the well-known underinvestment incentive first described by Vanek (1970, 1977).

[12] In general, the optimal set of assets for risk averse investors with possibly diverse expectations must include different bonds indexed to the price of every good [Fischer (1975)]. This means that we suppress an investor-side advantage of indexed bonds, making the efficiency case for LMFs that much more difficult.

[13] As is well known, the mean-variance formulation may be derived as a Taylor-series approximation to expected utility; the approximate equivalence between the two approaches will hold for small variance of income, $\text{var}(s_i)$, or equivalently if price shocks are sufficiently small, which we assume throughout section 3.

The LMF could face risk in output price, productivity or input costs. An advantage of value added bonds is that they hedge against any of these shocks. For simplicity, we consider only price risk due to shocks to demand.

Price risk is assumed to include a firm specific (e_i) and a firm non-specific (u) component; the expected price is now normalized to 1. Equation (7) replaces equation (1):

$$p_i Q_i = (1 + e_i + u) F(L_i, K_i). \tag{7}$$

We assume that LMFs face infinitely elastic demand at $p_i = 1 + e_i + u$. Moreover, we assume that e_i and u have mean zero, the variance of e_i is σ_e^2, the variance of u is σ_u^2, and, for simplicity, that each firm's price has an equal covariance with the average price in the industry.[14]

Within a constant returns to scale range, the level of labor demanded by the LMF is not determined in partial equilibrium. The only variable which can be calculated is the capital-labor ratio. If there is a risk neutral investor, the socially efficient capital labor ratio gives $F_K(L_i, K_i) = (1 + r)$. If employee owned firms finance investment by selling conventional bonds then s_i is given by (8):

$$s_i = (1 + e_i + u)\frac{Q_i}{L_i} - (1 + r)\frac{K_i}{L_i}, \tag{8}$$

so V_i is given by equation (9),

$$V_i = \frac{Q_i}{L_i}(1 + r)\frac{K_i}{L_i} - g(\sigma_e^2 + \sigma_u^2)\frac{Q_i^2}{L_i^2}. \tag{9}$$

V_i is maximized when the first order condition (10) holds :

$$F_K(L_i, K_i) = (1 + r)/\left[1 - 2g(\sigma_e^2 + \sigma_u^2)\frac{Q_i}{L_i}\right] > 1 + r, \tag{10}$$

which implies a level of investment that is lower than that of the risk-neutral profit-maximizing firm (PMF), or that would prevail under risk-averse PMFs if risk is diversifiable.

Investors face some risk of optimal (for the workers) liquidation of a solvent LMF and/or of bankruptcy in purchasing indexed bonds, just as in purchasing conventional bonds. Thus, the risk that investors will lose income due to the complete shutdown of a firm, rather than simply to price fluctuations in the industry, cannot be eliminated with our approach. In general, both bankruptcy risk and liquidation risk are increased by moral hazard,[15] as highly indebted

[14] Clearly, as a special case, the covariance of p_i and p may equal zero. If $p_i = \beta_i u + e_i$, then the amount of the performance bond which the LMF must sell to hedge industry risks is proportional to β_i. If β_i is known to the LMF, this merely complicates notation; otherwise this creates a problem in optimal hedging which is outside the scope of the paper.

[15] We do not explicitly model moral hazard. For a simple approach to modeling moral hazard with conventional performance bonds that can be used in the case of our IAPBs, see McCain (1977, pp. 377–381).

firms (whether LMFs or PMFs) have an incentive to take on high-risk investments since they have the option to declare bankruptcy. Note, however, that this incentive is lower when IAPBs are issued, since repayment depends on industry conditions. It is optimal for the firm (LMF) to declare bankruptcy when its value to its shareholders (members) falls to zero. Therefore, to minimize agency costs, it is efficient to design debt instruments which prevent (as long as possible) the decline to zero of the value of the firm (LMF) to its shareholders (members). This is an argument for indexed bonds unrelated to the argument which we present [Mello and Parsons (1989, 1992)].

The fact that IAPBs reduce bankruptcy risk does not imply that, whenever an LMF financed by IAPBs enters bankruptcy, it would have been bankrupt if it had been financed with conventional bonds. It is possible that high value added growth in the industry would bankrupt an LMF financed with IAPBs even if the LMF could have met conventional bond payments. The assumptions which we make rule this possibility out, but, in general, each LMF will find it optimal to use a variety of debt instruments.

Define the expected bond payment as B_i; the risk neutral investor(s) are willing to pay $B_i/(1+r)$ for this asset. The LMF invests K_i in physical capital, and invests the remainder in risk-free bonds, in order to hedge against value added risk.[16] s_i is given by equation (11):

$$s_i = (1 + e_i + u)\frac{Q_i}{L_i} - (1+u)\frac{B_i}{L_i} + \frac{B_i}{L_i} - (1+r)\frac{K_i}{L_i}, \qquad (11)$$

which is the future value of output revenue less contractual bond obligations plus net proceeds from the risk-free bond investments, and which is easily simplified to equation (12):

$$s_i = (1 + e_i)\frac{Q_i}{L_i} - (1+r)\frac{K_i}{L_i} + \left(\frac{Q_i}{L_i} - \frac{B_i}{L_i}\right)u. \qquad (12)$$

Since the LMF bears only firm specific risk it will invest more than it would if it were financed with conventional bonds. But since the LMF must bear some risk, it will still invest less than the risk neutral PMF. More formally, V_i is given by equation (13):

$$V_i = \frac{Q_i}{L_i} - (1+r)\frac{K_i}{L_i} - g\left(\frac{Q_i}{L_i}\right)^2 \sigma_e^2 - g\left(\frac{Q_i}{L_i} - \frac{B_i}{L_i}\right)^2 \sigma_u^2, \qquad (13)$$

which is maximized when first order conditions (14) and (15) hold

$$F_K(L_i, K_i) = (1+r) / \left[1 - 2g\sigma_e^2\left(\frac{F_K(L_i, K_i)Q_i}{L_i^2}\right)\right] \qquad (14)$$

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[16] The formulation that the LMF borrows more than the amount of internally invested capital and invests the rest in risk-free bonds is a simple way of representing the purchase of an efficient insurance contract in this model.

$$\frac{B_i}{L_i} = \frac{Q_i}{L_i}. \tag{15}$$

Thus, it is optimal for LMFs to sell enough industry performance bonds to hedge against all firm non-specific risk. If all risk is firm-nonspecific, industry average performance bonds will guarantee LMF members a riskless income and efficient investment levels will obtain, indicating that these bonds are optimal debt/insurance instruments.

This result contrasts with the results of classic papers on implicit contracts which do not consider indexation to exogenous information (industry average value added in our case). For example, Azariadis (1983) demonstrates that the first best contract is only incentive compatible if the well informed party—in our case the LMF, and in his case the firm—is risk neutral. Since we allow investors to observe industry average value added, Azariadis' result does not apply.

If employee owned firms are constrained to sell no more industry performance bonds than needed to finance their investment, they will have to bear some of the non-firm-specific risk as well as firm specific risk. This will cause them to invest less than if not restricted, but more than if they financed investment with conventional bonds. Of course, there may be other available means to insure against additional non-firm-specific risk.

Selling some simple performance bonds would also reduce the risk members bear and increase the LMF's efficient level of investment. But there are important limits on the use of simple firm-level performance bonds. If LMFs sold such bonds, they would avoid bearing some of the firm specific risk; and we may expect even risk neutral investors to take into account the resulting incentives for inefficient effort and other moral hazard problems. The members of the firm would have to bear the cost of this inefficiency. In the extreme, if the firm sold enough simple performance bonds to avoid all firm-specific risk, members would have no incentive to work at all. Clearly, then, the required expected interest on ordinary performance bonds will be increasing in the amount of such bonds issued, placing more immediate practical limits on their use. We may conclude that LMFs must bear at least some firm specific risk.

In sum, industry performance bonds enable LMFs to avoid bearing firm non-specific risk, increasing the level of capital the LMF is willing to invest. But because of moral hazard, LMFs must bear some firm specific risk. This may cause some underinvestment and reduce the desirability of membership in the firm. Efficiency advantages of LMFs, including non-pecuniary amenities, might outweigh this cost in some industries and not in others.[17] The balance of benefits will depend on the degree of risk, the efficient capitalization per worker,

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[17] If the efficiency gains of LMFs outweigh the cost of bearing firm specific risk membership in LMFs would be valuable. This could distort membership decisions, although it would not do so if the efficiency gains were proportional to membership. In any case, the magnitude of rents to be capitalized is much lower than the quasi-rents of an internally financed LMF, so a "membership market" [Sertel (1987)] might become practical.

the efficient labor force size, the extent of any LMF productivity gains, and any other worker utility benefits deriving from the employee owned environment.

4. IAPBs and risk: Investment and membership both chosen before uncertainty is resolved

In this section, we consider effects of IAPBs on investment and membership when both are chosen before the price uncertainty is resolved. In this scenario, the additional effects of IAPBs are similar to an exogenous reduction in risk [Hey (1981)].

Assume that the LMF and all firms in the industry choose L and K before p and p_i are revealed. In this section we generalize the LMF utility function, assuming that it maximizes $U(s_i)$ for some concave U. This means that industry value added, pQ, is proportional to p. The LMF sells performance bonds such that its liabilities are $B_i p$ in period 2 when uncertainty is resolved. This implies that s_i is given by equation (16):

$$
\begin{aligned}
s_i &= s(B_i, K_i, L_i, p_i, p) \\
&= [1 + u + e_i)Q_i - B_i(1+u) + (B_i - (1+r)K_i)]/L_i \qquad (16) \\
&= (Q_i(1+e_i) - (1+r)K_i)/L_i + (Q_i - B_i)u.
\end{aligned}
$$

It is clear that $B_i = Q_i$, since any other value of B_i (say B_i') would give $s(B_i', K_i, L_i, p_i, p)$—a mean preserving increased spread of efficient $s(Q_i, K_i, L_i, p_i, p)$, which reduces expected utility for any concave U. Thus, s_i is given by equation (17):

$$
s_i = (Q_i(1+e_i) - (1+r)K_i)/L_i. \qquad (17)
$$

Equation (17) implies first order conditions (18) and (19),[18]

$$
\partial(E(U(s_i))/\partial(K_i) = 0 = [Q_K(1 + \text{cov}(U'(s_i), e_i)) - (1+r)]/L_i \qquad (18)
$$

$$
\partial(E(U(s_i))/\partial L_i = 0 = (L_i Q_L - Q_i)(1 + \text{cov}(U'(s_i), e_i)) + (1+r)K_i/L_i^2. \,(19)
$$

In (19), $E()$ is the expected value operator, and partial derivatives are evaluated at (L_i, K_i). Equations (18) and (19) imply that the LMF chooses L_i and K_i so that returns to scale are locally constant, since these conditions imply that,

$$
Q_i = L_i Q_L + K_i Q_K. \qquad (20)
$$

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[18] Note that this equation follows for a general utility function. The formulation closely follows that of Hey (1981). If, instead of the general term $U'(s)$ there had been a linear function of s we would revert to the earlier mean variance formulation.

From (18) we also have that,

$$Q_K = (1+r)/(1 + \text{cov}(U'(s_i), e_i)). \tag{21}$$

Equation (21) implies that the marginal product of capital is higher when firm-specific risk is present: s increases in e_i; thus $U'(s_i)$ decreases in e_i; and $\text{cov}(U'(s_i), e_i)$ is negative. This indicates that firm specific risk causes the LMF to choose a point on the constant returns to scale (CRS) locus [Vanek (1970)] with a higher marginal product of capital. If the production function exhibited CRS throughout, this would simply imply the choice of a lower capital-labor ratio.

Notice that if the LMF used conventional bonds, s_i would be given by (22),

$$s_i = (Q_i(1 + u + e_i) - (1+r)K_i)/L_i. \tag{22}$$

Thus, the introduction of IAPBs is equivalent to a reduction of risk. With the privately efficient use of IAPBs, Q_L and Q_K are closer to those which would be chosen in the absence of risk, or by a risk neutral profit maximizing firm, compared to what would prevail in the absence of IAPBs. Since we have assumed that risk is diversifiable, or that there are risk neutral investors, this means that industry average performance bonds move the investment and membership choices of the LMF simultaneously closer to the standard efficiency conditions–and exactly to these conditions if there is no firm specific risk.

5. IAPBs and the Ward effect in the short run: Risk resolved before employment set

In this section, we consider an alternative scenario in which capital is chosen in advance, but the labor force size is fully flexible and chosen to maximize income per head given the price level; this corresponds to the original "Illyrian" model of Ward (1958). We argue that the perverse response to price (the Ward effect) will be mitigated to the extent that industry-average performance bonds are used, and risk is primarily industry risk. This is because unanticipated pure profits and losses due to conditions affecting the industry are absorbed to that extent by IAPB holders. Thus, these windfall gains and losses do not give LMFs incentives for backward-bending supply behavior.

It is worth noting that there is no econometric evidence to suggest that the Ward effect, or any other perverse LMF response, has ever been encountered in practice [for a survey see Bonin, Jones and Putterman (1993)], and in this sense might be considered only a theoretical curiosity. However, because there do exist material incentives for perverse responses, strategies for mitigation of these incentives remain a worthy topic for economic analysis, because such incentives may cause a sluggish response of supply to price changes; and because,

if incentives for an economic behavior exist, there are grounds for concern that we may see the behavior in practice at some point in the future.

It is easy to see that LMFs will choose to hedge at least some risk, and that this will reduce the Ward effect under very general conditions. By construction, before the LMF can use IAPBs, members are not able to optimize over their level of bond payments [B in equation (13)]. Thus, they must make do with a constrained optimum, paying the same rate of return in each of the two states. When we allow the LMF to use IAPBs, members can effectively pay a different rate of return in each state. For example, letting prob(p_j) be the probability that state j occurs, R_j be the effective return under state j, and considering a two state case for simplicity, prob(p_1)R_1 + prob(p_2)R_2 = R, the exogenous expected return. Since the LMF is risk averse, the possibility of using IAPBs provides an extra degree of freedom to maximize utility. Thus, some IAPBs will be used; and by adopting *any* positive amount of IAPBs, the LMF will effect a change in fixed costs with the same sign as price changes; this will induce a Wardian fixed cost effect opposite in sign to that of the Ward price effect.[19] Thus, the Ward effect must be at least mitigated. Then, if the differential between returns across states is sufficiently great, the Ward effect will be reversed.

Expressed somewhat differently, if the LMF insures all risk (as it can when there is no firm specific risk for general prices not just two states) then the first order conditions for optimal membership equalizes the value of the marginal product of labor to the constant share s. Thus the response to price changes would be just the same as the response of a profit maximizing firm which pays a constant wage. The matter is more complicated when the funding strategy is chosen by founders in their own self interest, but the result still holds, as we demonstrate in this section.

Our results allow for general production specifications, and general risk-averse utility specifications; but we will work with specific structures of price risk. In the model, p is revealed in period one; it is the same for all firms in the industry. Then, L is chosen, and goods are produced and sold at p; indexed bonds are redeemed for the contract payment; and conventional bonds are redeemed for their face value. Investors are assumed to be risk neutral; or equivalently it is assumed that risk in the indexed bond is industry specific and completely diversifiable. After risk has been resolved, LMFs maximize net revenues per member, s.

To illustrate, assume a special case in which uncertainty about output price takes either of two values, p_1 or p_2, with equal probability; let $p_1 > p_2$. For ease of exposition we assume that the IAPBs are indexed to these output prices. This is, first of all, consistent with the type of assets assumed in the previous sections, because we assume that production functions are not stochastic, and

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[19] In the Wardian model of the LMF, an increase in fixed costs induces an expansion of membership to spread these costs; with IAPBs this 'perverse' result works to offset the perverse price effect.

so the relevant uncertainty is risk in demand (price). Moreover, as we consider a case with only two states, we can concentrate on a single issue of financing, which is what the bond pays in these two states. Note that as long as industry average value added is different in the two states, some combination of IAPBs and conventional bonds can generate any given payment in each state. Thus, in a two state world, general price indexed bonds and industry average value added bonds (and conventional bonds) allow exactly the same set of financing strategies.

In period 1, the LMF issues bonds which pay $b(p)$ in period 2, where $b(p_1) \equiv b_1$, and $b(p_2) \equiv b_2$. With the bond proceeds, the LMF buys capital, K. After investment commitments have been made, the price is revealed, and the LMF determines income-per-head-maximizing membership. Finally, output $Q = F(L_j, K)$ is produced and sold; the LMF pays investors and distributes equal shares to members,

$$s_i = (p_j F(L_j, K) - b_j)/L_j. \tag{23}$$

The indexed bond, which then pays b_1 or b_2, is sold to a risk neutral investor,[20] giving us

$$K = (b_1 + b_2)/(2(1 + r)). \tag{24}$$

Values of b_1, b_2 and L_1, and L_2 are chosen to maximize $E(U(s))$ for some utility function U with $U' > 0$, $U'' < 0$. Then, as we will demonstrate, employment is higher in the high-price state, the opposite of the Ward effect.

To demonstrate by contradiction that if b_j is optimal, then $L_1 > L_2$, we will show that, if not, it is possible to find a feasible change in b_j which increases $E(U(s))$. Accordingly, assume that b_1 and b_2 are efficient and $L_1 \leq L_2$: we seek a b_1' and b_2' which provide higher utility than b_1 and b_2. First, we assume that $L_1 < L_2$ and derive a contradiction showing that $L_1 \geq L_2$. To do this we demonstrate that, if $L_1 < L_2$, then different bond payments and membership levels give higher $E(U(s))$ and the same expected bond payments, contradicting the assumptions that b_1, b_2, L_1 and L_2 were efficient and that $L_1 < L_2$. With this proof strategy, we do not need to show that these new bond payments (b_1' and b_2') membership ($\hat{L}_1$ and $\hat{L}_2$) and shares ($\hat{s}_1$ and $\hat{s}_2$) are efficient, so we will choose them to make comparison easy. First, set

$$\hat{s}_2 = s_1, \quad \hat{L}_1 = L_2, \quad \hat{L}_2 = L_1, \tag{25}$$

then choose $\hat{s}_1$ so that expected income accruing to bond holders is the same— $(b_1' + b_2')/2 = (b_1 + b_2)/2$. That is,

$$b_2' = p_2 F(\hat{L}_2, K) - \hat{L}_2 \hat{s}_2 = p_2 F(L_1, K) - L_1 s_1, \tag{26}$$

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[20] Since investors are risk neutral (or alternatively the risk is diversifiable), the required expected return on K is $1 + r$, since capital only lasts for one period.

and

$$b_1' = b_1 + b_2 - b_2' \qquad (27)$$

This will give $\hat{s}_1 > s_2$ and an increase in $E(U(s))$. To see this note that $E(\hat{s}_j \hat{L}_j) = (\hat{s}_1 L_2 + s_1 L_1)/2$, so, if $\hat{s}_1 \leq s_2$, then $E(E(\hat{s}_j \hat{L}_j)) \leq E(s_j L_j)$. On the other hand, $E(p_j F(\hat{L}_j, K)) > E(p_j(L_j, K))$, since output is increased by $F(L_2, K) - F(L_1, K)$ when the price is p_1 (high) and decreased by the same amount when the price is p_2 (low). This means that if $\hat{s}_1$ is less than or equal to s_2, then b_1' would be greater than $b_1 + b_2 - b_2'$. Therefore, for $b_1' = b_1 + b_2 - b_2'$, $\hat{s}_1 > s_2$ so $E(U(\hat{s}_j)) > E(U(s_j))$. This contradicts the assumption that b_1, b_2, L_1, and L_2 were chosen to maximize $E(U(s))$ and proves by contradiction that the hypothesis that $L_1 < L_2$ is false so $L_1 \geq L_2$.

Note that $\hat{L}_1$ and $\hat{L}_2$ are not efficient given b_1' and b_2'. If share maximizing membership (say L_1' and L_2') were chosen given p_1, p_2, b_1' and b_2', then the resulting $E(U(s'))$ would be still higher, and *a fortiori* higher than $E(U(s))$. We consider $\hat{L}_1$ and $\hat{L}_2$ simply to make comparison with the original expected utility of members simple. The fact that $E(U(s))$ is lower than some other feasible $E(U(\hat{s}))$ contradicts the assumption that the original plan was efficient, since $E(U(s))$ must then be lower than the maximal expected utility of members.

Similarly, we derive a contradiction from the assumption that, for efficient b_1 and b_2, membership is constant with $L_1 = L_2 = L$. It is clear that $b_1 > b_2$ and $s_1 > s_2$, since $p_1 > p_2$. Choose $b_1' = p_1 F(L, K) - s_2 L$ and $b_2' = p_2 F(L, K) - s_1 L$. The expected value of b_j' is equal to the expected value of b_j, so investors supply exactly K. If the LMF chooses $\hat{L}_1 = \hat{L}_2 = L$, then members would obtain $\hat{s}_1 = s_2$ and $\hat{s}_2 = s_1$; so $E(U(\hat{s}_j)) = E(U(s_j))$. Now b_1' does not equal b_1; so L is not the efficient membership given b_1', p_1 and K. This means that if the LMF chooses efficient membership L_1', given b_1', p_1 and K; and efficient L_2', given b_2', p_2 and K, the LMF is strictly better off. In turn, this means if $L_1 \leq L_2$, then b_1, and/or b_2, is not efficient. Therefore, for efficient b_1 and b_2, $L_1 > L_2$, which completes the proof.[21]

It is instructive to examine efficient b_j in greater detail. Given the assumption that p is equally likely to be either p_1 or p_2, and that for any K the LMF is free to choose b_j such that $b_1 + b_2 = 2K/(1 + r)$, then if b_j is efficient,

$$dU(s(K, L(b_1, p_1, k), b_1))/db_1 = dU(s(K, L(b_2, p_2, k), b_2))/db_2. \qquad (28)$$

By the envelope theorem, (28) holds for $\partial s_j / \partial b_j$; so,

$$U'(s_1)/L_1 = U'(s_2)/L_2, \qquad (29)$$

since $L_1 > L_2$, $U'(s_1) > U'(s_2)$, so $s_1 < s_2$. This means that the LMF overinsures, so that the share is lower when the price is higher. This in turn means

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[21] Note that there are no restrictions on utility or technology, except that, given K, p and b, there is an efficient L; and this efficient L changes if b changes.

that the LMF over-reacts to price changes, that is, its supply curve slopes up more steeply than that of a profit maximizing firm.

To derive the efficient capital stock, we hold $\beta_1 = b_j/K$ and $\beta_2 = b_2/K$ fixed, so as to satisfy investors. This gives:

$$0 = U'(s_1)(pF_K(L_1, K) - \beta_1)/L_1 + U'(s_2)(p_2F_K(L_2, K) - \beta_2)/L_2.$$

Equation (22) indicates that

$$0 = p_1 F_K(L_1, K) + p_2 F_2(L, K,) - (\beta_1 + \beta_2), \quad \text{while}$$

$$(\beta_1 + \beta_2) = 2(1 + r) \quad \text{to satisfy investors, so}$$

$$1 + r = 0.5(p_1 F_K(L_1, K) + p_2 F_K(L_2, K)) = E(p_i F_K(L_j, K)). \tag{29'}$$

It may be shown that essentially the same results can be derived from this proof strategy using a uniform price distribution.[22] Moreover, with a related proof strategy, it is shown in Appendix A that similar results obtain in a more general case in which price p has a given mean and any probability density function which is symmetric about that mean.

Since we have assumed that all firms in the industry have the same production function and face the same prices, all conventional firms in the industry would produce the same value added (as a multiple of their capital). This means that a bond indexed to the average value added by all conventional firms in the industry could equally be used by LMFs to hedge their risk.

The direct price indexing approach that we have used in this example has the advantage that it can be used to hedge risk even if all firms are LMFs. If there are conventional firms which face the same price and have the same production function as the LMFs, an alternative approach would be to index

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[22] In particular, assume price is uniformly distributed from p_L to p_H. Other assumptions are the same as before. Then for any $p_L < p_1 < p_1 + b < p_2 < p_H - b$, for any $b > 0$, $E(y(p)|_{p_1 < p < p_1+b}) < E(y(p)|_{p_2 < p < p_2+b})$. The proof proceeds by contradiction as before. Define $X \equiv E(y(p)|_{p_2 < p < p_2+b}) - E(y(p)|_{p_1 < p < p_1+b})$ so the claim is that $X > 0$. Consider:

$$\hat{L}(p) = L(p + p_2 - p_1) \quad \text{if} \quad p_1 < p < p_1 + b;$$
$$\hat{L}(p) = L(p + p_1 - p_2) \quad \text{if} \quad p_2 < p < p_2 + b;$$
$$\hat{L}(p) = L(p) \quad \text{otherwise.}$$

Moreover, let:

$$\hat{s}(p) = s(p + p_2 - p_1) - (p_2 - p_1 - b)X/2 \quad \text{if} \quad p_1 < p < p_1 + b;$$
$$\hat{s}(p) = s(p + p_1 - p_2) - (p_2 - p_1 - b)X/2 \quad \text{if} \quad p_2 < p < p_2 + b;$$
$$\hat{s}(p) = s(p) \quad \text{otherwise;}$$

and $\hat{b}(p)$ is the bondholders' residual. If $X < 0$, then both investors and founders of the LMF are better off, even given $\hat{L}(p)$, which is not efficient given $\hat{b}(p)$. If $X = 0$ then both investors and founders of the LMF are indifferent between $b(p)$ and $\hat{b}(p)$ given $\hat{L}(p)$, but $\hat{L}(p)$ is not efficient; so if the LMF admits members $L'(p)$, efficient given p and $\hat{b}(p)$, they are better off. Therefore X is greater than 0 as claimed.

bonds to average value added among conventional firms. Note that this is effective if the conventional firms face prices highly correlated with those faced by the LMF, and if they have similar production functions. It is not necessary for the firms used in the index to be competitors of the LMF.

While we have reported special cases, the finding is a consistent one; the results we present illustrate that consistent set of findings for the most general utility and production function specifications.[23] Note that in our results the expected value of $\hat{s}(p)\hat{L}(p)$ does not depend on the production function. It is only required that the LMF is in a competitive market and p is exogenous.[24]

The strategy of using IAPBs to reverse the Ward effect incentive may be interpreted as 'taking advantage of one Ward effect to counteract the ill effects of another.' That is, we take advantage of the fact the LMF wants to expand membership when exogenous lump-sum costs rise to find a strategy to make it in the LMF's interests to expand output and employment when price rises.

In this section, we have assumed that hiring decisions are made to maximize the members' share *ex post*. In this we follow the assumptions in Ward (1958), and differ from research influenced by the implicit contracts literature [Miyazaki and Neary (1983); Wolfstetter, Brown and Meran (1984); McCain (1985)]. In the latter approach, it is assumed that decisions are made to influence *ex ante* utilities of members who face an equal layoff probability. In contrast, we consider the case in which the firm is governed by a small core of founding members who personally face no layoff risk. Our results imply expansion of membership in response to a sufficiently large price increase.[25]

In sum, the results described above are in striking contrast to those obtained for LMFs which finance investment from their members' resources or by conventional fixed interest bonds or loans. Share-maximizing LMFs financed by conventional means will have an incentive to respond to an increase in the price of the good they produce by reducing employment and output. At best, current members of share maximizing LMFs have no incentive to share rents with outsiders. But if risk-averse LMFs can sell industry-indexed bonds, and with them the rights to such rents to outside investors, this 'Illyrian' problem can be avoided. Moreover, it is rational for risk-averse LMFs to voluntarily

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[23] For example, in an earlier working paper available from the authors, we examined the case of constant returns to scale throughout, solving for the ratios of B, D, Q and L, to K. Using this assumption, and assuming that IAPB payments take the form $B = \Theta p^{\gamma}$, we showed normal price responsiveness under a range of conditions. For example, in the constant returns Cobb-Douglas case, where a is labor output elasticity, for $\gamma = 1/(1-a)$, the LMF supply response is identical to that of the conventional firm, and the share s_i equals the wage paid by conventional firms. As the risk aversion of the LMF goes to infinity, this γ becomes privately efficient.

[24] It should be noted that the finding that the covariance of price and output are positive does not demonstrate that output is monotonically increasing in price.

[25] We have considered just two periods; however, given that capital can be freely adjusted, while employees have no membership rights and permanent layoffs are not prohibited (there are no links between periods), the results equally apply in an n-period model.

follow this strategy.[26] Thus, unlike various regulatory schemes proposed in the literature, mere availability of IAPBs offers a partial solution to the Ward effect that firms would adopt voluntarily.

6. Concluding remarks

In this paper, we have shown that the use of industry performance bonds can raise investment in labor-managed firms, while mitigating the incentive for Ward effects. These instruments commit the LMF to pay a contractual share of value added in its industry, or otherwise index liabilities to a measure of industry conditions. We have shown that certain moral hazard problems are overcome with the use of industry performance bonds. Privately efficient use of such instruments were then shown to induce LMFs to rationally adopt a positively-sloped supply function. The use of indexed bonds to hedge risk were shown to ameliorate the perverse response problem of LMFs, which is ultimately caused by the presence of rents. A number of regulatory and taxation schemes have been proposed that would have the effect of compelling or inducing LMFs to respond efficiently to market signals.[27] The approach of this paper is unique in that the (risk averse) LMF would in theory voluntarily adopt the scheme; and no knowledge of technology or other conditions would be required on the part of government. If not adopted in practice, regulation could still be utilized to require the use of IAPBs.

IAPBs are also of interest to employee-owned, producer-coop, family-run and other risk-averse businesses that wish to retain managerial or internal control.

Clearly, there are several economic issues to resolve before such bonds are implemented, but there is no reason to anticipate that these should be insurmountable. There are numerous possibilities for indexes on which to base IAPBs, including indexes based on product prices, value added, dividends or other profit measures, stock or bond prices, (inverse) commodity input costs, or combinations, such as weighted averages of prices; or perhaps weighted averages across categories, such as value added and profits. In general, the 'best' index or weighted index will vary across firms and industries, depending on company strategy and market conditions.

Some employee owned firms and cooperatives produce or market products in several industries, and this complicates the construction of indexes. In such cases, a weighted index of data could be used, for example across several SIC

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[26] While it may be privately optimal to renege on a contract *ex post*, we assume conventionally that contracts are legally enforceable.

[27] For example, Vanek, Pienkos and Steinherr (1977), and Guesnerie and Laffont (1984), which consider perfect competition in the short run as well as imperfect competition. See also Ireland and Law (1982).

codes. A limitation is that proportions of activity across SIC codes for a firm change over years. To some degree switches across products are predictable, for example response to price or input cost changes. The index may be weighted according to prices of products actually produced in a given period. Some shifts will occur in other predictable ways such as over a business cycle. Of course, a firm may switch to a product group in which it has not previously produced when it accidentally discovers a new product or process. In this case the appropriate index may not have been agreed upon in advance. Some contingency for such situations may have to be agreed.

Owner-operated firms, most obviously entrepreneurial start ups, may move from product to product, and indeed investors may wish to 'invest in the entrepreneur' or group of entrepreneurs and their perceived abilities, rather than in the future of a product (or service) or groups of products *per se*. In such cases alternative indexes, such as those of fast growing privately held firms, might be appropriate. Many firms do not produce 'pure commodities', that is, undifferentiated products sold by many sellers; but rather have specialties that may be hard to match with other firms in producing an index. In some cases, the problem is that the product produced is narrower than standard price indexes, rather than broader, such as a firm that produces in high quality specialty niches, such as at least partly hand-crafted products. This type of specialization is common in fully employee owned and managed firms. In such cases a relevant standard industry index may be unavailable; it may be better to create such an index across standard industries. For example, in the hand-crafted products category, an index might be created that drew on firms across ceramics, glassware, wood products, and other fields normally considered different industries (but in Italy populated by organizationally similar cooperatives).

It may be objected that IAPBs are of little practical significance, because capital costs are a small part of total costs, especially for LMFs and employee owned firms. However, low capital use may be an endogenous outcome of low available finance. Moreover, there is selection bias, in that the only employee ownerships observed today are among workers who have such special characteristics as low risk aversion, low opportunity costs (e.g., due to plant closings), or have substantial collateral or otherwise low bankruptcy risk and so can get fixed term financing. LMFs might be more common if investments by such firms were facilitated through such instruments.

In introducing a new type of financial instrument, or any innovation in economic organization, the question inevitably arises: "if this is so good, why doesn't it already exist?" In other words, though the defect is not apparent, the fact that the instrument is not in use 'reveals' that there must be a hidden flaw. But new forms of financial instrument are in fact frequently introduced; as economic conditions change, new types of economic organization become suitable. In this case, it is worth recalling that employee ownership has only recently become a large factor in economies with highly developed financial

markets.[28] The dearth of employee owned firms in the past has limited the potential profitability of innovations aimed at that market. There are frequently increasing returns to scale in the financial sector. Sometimes, one would hope, economic analysis can itself lead to innovations of value to the economy. Perhaps this paper will encourage securities firms to introduce such instruments in the not-too-distant future.

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[28] There has been some *de facto* employee ownership or labor management in socialist economies, but no real financial markets, even in former Yugoslavia.

Appendix A

Assume that price p has mean A and p.d.f., f, which is symmetric about A, so that,

$$p \sim f(p) \quad \text{and} \quad f(p) = f(2A - p).$$

Suppose bond payments are indexed to price. (Note again that price and industry value added indexed bonds are very similar in nature. In particular, if there is no firm specific risk, there is a single industry price, and there are no supply shocks, then a bond that pays a function of industry value added pays the same amount as a bond that pays according to the state of the world.) As before, in period 1 the LMF issues bonds which pay $b(p)$ in period 2; with the proceeds it buys capital K. This type of price-indexed bond (or other bonds that pay some function of the 'state of world') yields an identical payment as one indexed to value added provided that there is no firm specific risk, there is only one industry price (as would be the case if all firms made identical goods), and industry value added is a function of this price (that is there are no supply shocks as applies throughout the paper). Then the price is revealed and the LMF admits total members $L(p)$, produces $Q(p) = F(L(p), K)$ shares, $s(p) = (pF(L(p), K) - b(p))/L(p)$.

The indexed bond, which pays $b(p)$, is sold to a risk neutral investor, so $K = E(b(p))/(1 + r)$; $b(p)$ and $L(p)$ are chosen to maximize $E(U(s))$ for some utility function U with $U' > 0$, $U'' < 0$. Then, $\text{cov}(Q(p), p) > 0$. That is, the covariance between the LMF's output and the price of its output are positive, so on average the LMF's supply curve slopes up; and—at least on average—the Ward effect is reversed. The proof is analogous to the earlier special case. If the proposition does not hold it is possible to find a change in $b(p)$ which increases $E(U(s(p)))$. For if $b(p)$ is efficient, then $\text{cov}(Q(p), p) > 0$. Assume that $b(p)$ is efficient and $\text{cov}(Q(p), p) \leq 0$. We will derive a contradiction by finding a $\hat{b}(p)$ which produces higher utility than $b(p)$.

To prove by contradiction that $\text{cov}(Q(p), p) > 0$ assume that $\text{cov}(Q(p), p) \leq 0$, and consider modified membership $\hat{L}(p)$, shares $\hat{s}(p)$, and payments on the bond $\hat{b}(p)$:

$$\hat{L}(p) = L(2A - p);$$

$$\hat{s}(p) = s(2A - p) - 2\text{cov}(Q(p), p)/E(L(p));$$

$$\hat{b}(p) = pF(\hat{L}(p), K) - \hat{s}(p)\hat{L}(p).$$

$\hat{L}(p)$ is not efficient as will be shown below. Investors are equally willing to pay K for $b(p)$ or for $\hat{b}(p)$. As they are risk neutral (or can diversify risk) they are concerned only with the expected value of $b(p)$, or $\hat{b}(p)$, which are equal. $\text{Cov}(Q(p), p)$ can not be negative. If it were negative, $b(p)$ could not be efficient since $\hat{s}(p)$ would be preferable to $s(p)$ for any utility function U which is increasing in s, even if the cooperative admitted $\hat{L}(p)$ members. If the

cooperative admitted the efficient number of members given $\hat{b}(p)$ they would be still better off than if they admitted $\hat{L}(p)$ members. Therefore, $\text{cov}(Q(p), p) \geq 0$.

The covariance of $Q(p)$ and p is not zero. If $\text{cov}(Q(p), p) = 0$, then by symmetry $\hat{s}(p)$ would have the same distribution as $s(p)$. However, $\hat{L}(p)$ is not the efficient membership given $\hat{b}(p)$. If the cooperative admits efficient $L'(p)$ members given $\hat{b}(p)$, then it is strictly better off paying $\hat{b}(p)$ than paying $b(p)$. Therefore, if $b(p)$ is efficient, $\text{cov}(Q(p), p) > 0$.

References

Antle, Rick, and Abbie Smith, "An empirical investigation of the relative performance evaluation of corporate executives", *Journal of Accounting Research, 24*, 1, 1986, pp. 1–39.

Azariadis, Costas, "Employment with asymmetric information", *Quarterly Journal of Economics, 98*, Supplement, 1983, pp. 157–172.

Ben-Ner, Avner, and Derek C. Jones, "Employee ownership: An overview of its growing incidence around the world", *Industrial Relations Research Association Proceedings*, 1990, pp. 374–384.

Blasi, Joseph, and Douglas Kruse, *The New Owners*, New York, Harper Collins, 1991.

Blinder, Alan (ed.), *Paying for Productivity*, Washington, DC, Brookings, 1990.

Bonin, John P., "The theory of the labor-managed firm from the membership's perspective with implications for Marshallian industry supply", *Journal of Comparative Economics, 5*, 4, 1981, pp. 337–351.

Bonin, John, Derek Jones, and Louis Putterman, "Theoretical and empirical research on the labor managed firm: Will the twain ever meet?", *Journal of Economic Literature, 31*, 3, Fall 1993, pp. 1290–1320.

Brewer, Anthony A., and Martin J. Browning, "On the 'employment' decision of a labour-managed firm", *Economica, 49*, 194, March 1982, pp. 141–146.

Estrin, Saul, Derek Jones, and Jan Svejnar, "The productivity effects of worker participation: Producer cooperatives in western economies", *Journal of Comparative Economics, 11*, 1, March 1987, pp. 40–61.

Fischer, Stanley, "The demand for index bonds", *Journal of Political Economy, 83*, 3, June 1975, pp. 509–534.

General Accounting Office (GAO), *Employee Stock Ownership Plans: Benefits and Costs of ESOP Tax Incentives for Broadening Stock Ownership*, Washington, DC, 1987.

Gibbons, Robert, and Kevin J. Murphy, "Relative performance evaluation of chief executive officers", NBER working paper, 2944, National Bureau of Economic Research, Cambridge, MA, April 1984.

Green, Jerry R., and Nancy L. Stokey, "A comparison of tournaments and contracts", *Journal of Political Economy, 91*, 3, 1983, pp. 349–364.

Guesnerie, Roger, and Jean-Jacques Laffont, "Indirect public control of self-managed monopolies", *Journal of Comparative Economics, 8*, 2, June 1984, pp. 139–158.

Hey, John D., "A unified theory of the behavior of profit-maximizing, labor-managed and joint-stock firms operating under uncertainty", *Economic Journal, 91*, 2, June 1981, pp. 364–374.

Holmstrom, Bengt, "Moral hazard and observability", *Bell Journal of Economics, 10*, 1, 1979, pp. 324–340.

Holmstrom, Bengt, "Moral hazard in teams", *Bell Journal of Economics, 13*, 2, 1982, pp. 234–340.

Im, Sco J., Robert Jalali, and Jamal Saghir, *Privatization in the Republics of the Former Soviet Union*, Washington, DC, World Bank, 1993.

Ireland, Norman J., and Peter J. Law, *The Economics of Labor-Managed Enterprises*, New York, St. Martin's Press, 1982.

Jones, Derek, and Jan Svejnar, "Participation, profit sharing, worker ownership and efficiency in Italian producer cooperatives", *Economica, 52*, 28, November 1985, pp. 449–466.

Lazear, Edward, and Rosen Sherwin, "Rank-order tournaments as optimum labor contracts", *Journal of Political Economy, 89*, 5, October 1981, pp. 841–864.

Lee, Barbara, "Should employee participation be part of privatization?", PRD working paper, 664, World Bank, Washington, DC, 1991.

Lipton, David, and Jeffrey Sachs, "Privatization in Eastern Europe: The case of Poland", *Brookings Papers on Economic Activity*, 2, 1990, pp. 293–341.

Major, Guy, "Solving the underinvestment and degeneration problems of workers' cooperatives: Non-voting and vote-weighted value-added residual shares (NOVARRS and VOWVARRS)", *Annals of Public and Cooperative Economics, 6*, 4, December 1996, pp. 545–601.

McCain, Roger, "On the optimum financial environment for worker cooperatives", *Zeitschrift für Nationalökonomie, 37*, 3–4, 1977, pp. 355–384.

McCain, Roger, "The economics of a labor-managed enterprise in the short run: An implicit contracts approach", in: Jones, Derek, and Jan Svejnar (eds.), *Advances in the Economic Analysis of Participatory and Labor-Managed Firms*, volume 1, London, JAI Press, 1985, pp. 41–54.

Meade, James, *Alternative Systems of Business Organization and of Workers' Remuneration*, London, Allen and Unwin, 1986.

Mello, Antonio S., and John E. Parsons, "A commodity linked bond as an optimal debt instrument in the presence of moral hazard", Alfred P. Sloan School of Management working paper, 3035-89-EFA, MIT, Cambridge, MA, 1989.

Mello, Antonio S., and John E. Parsons, "Measuring the agency cost of debt", *Journal of Finance, 47*, 5, December 1992, pp. 1887–1904.

Miyazaki, Hajime, and Hugh Neary, "The Illyrian firm revisited", *Bell Journal of Economics, 14*, 1, Spring 1983 pp. 259–270.

Mork, Randall, Andrei Shleifer, and Robert Vishny, "Alternative mechanisms for corporate control", NBER working paper, 2532, National Bureau of Economic Research, Cambridge, MA, 1988.

Nuti, Mario, "Corporate governance and employee share ownership in transitional economics", mimeo, London Business School, London, 1995.

Paroush, Jacob, and Nava Kahana, "Price uncertainty and the cooperative firm", *American Economic Review, 70,* 1, March 1980, pp. 212–216.

Ray, Debraj, *Development Economics*, Princeton, Princeton University Press, 1998.

Shleifer, Andrei, "A theory of yardstick competition", *Rand Journal of Economics, 16,* 3, Autumn 1985, pp. 319–327.

Scholes, Myron S., and Mark A. Wolfson, "Employee stock ownership plans and corporate restructuring", *Financial Management,* Spring 1990, pp. 12–28.

Sertel, Murat R., "Workers' enterprises are not perverse", *European Economic Review, 31,* 8, 1987, pp. 1619–1626.

Smith, Stephen C., "On the law and economics of employee ownership in privatization in developing and transition economies", *Annals of Public and Cooperative Economics, 65,* 3, December 1994, pp. 437–468.

Smith, Stephen C., "Employee participation in China's township and village enterprises", *China Economic Review, 6,* 1, Spring 1995, pp. 157–167.

Vanek, Jaroslav, *The General Theory of Labor-Managed Market Economies*, Ithaca, Cornell University Press, 1970.

Vanek, Jaroslav, *The Labor-Managed Economy: Essays*, Ithaca, Cornell University Press, 1977.

Vanek, Jaroslav, Andrew Pienkos, and Alfred Steinherr, "Labor managed firms and imperfect competition", in: Vanek, Jaroslav (ed.), *The Labor-Managed Economy: Essays*, Ithaca, Cornell University Press, 1977, pp. 256–269.

Ward, Benjamin, "The firm in Illyria: Market syndicalism", *American Economic Review, 48,* 4, 1958, pp. 566–589.

Wolfstetter, Elmar, Murray Brown, and Georg Meran, "Optimal employment and risk sharing in Illyria: The labor managed firm reconsidered", *Zeitschrift für die Gesamte Staatswissenschaft: Journal of Institutional and Theoretical Economics, 140,* 4, December 1984, pp. 655–668.

Zusammenfassung

Dieser Beitrag präsentiert und analysiert ein neues Finanzierungsinstrument, "industry-average performance bonds" (IAPB). Es wird gezeigt, daß dieses Instrument zwei wichtige Vorteile für selbstverwaltete Betriebe (labor-managed firms, LMF) hat: das suboptimale Investitionsvolumen wird erhöht, und die "Illyrischen" Angebotseffekte werden gemindert. Dieses Instrument verpflichtet die LMF, einen vertraglich festgelegten Teil der gesamten Wertschöpfung des relevanten Industriezweigs zu zahlen, oder die Verpflichtung anderweitig an ein Maß des Gesamtzustands des Industriezweigs zu indexieren; wir zeigen, daß dadurch bestimmte, in der LMF-Literatur diskutierte Anreizprobleme, die normalerweise mit einfachen Unternehmens-Performance Bonds verknüpft sind, überwunden werden können. Der optimale Einsatz dieses Instruments induziert die LMF darüber hinaus, eine ansteigende Angebotskurve zu realisieren, im Gegensatz zum klassischen Ward-Effekt. Zudem wird gezeigt, daß IAPBs die gleichzeitige Wahl von Investition und LMF-Mitgliedschaft beeinflussen, und zwar ähnlich – wenn auch nicht identisch – wie eine exogene Risikominderung. Diese Bonds sind auch interessant für Firmen im Mitarbeitereigentum, Produzentengenossenschaften, Familienbetriebe u.a. risiko-averse Unternehmen, die interne Kontrolle und Management beibehalten wollen.