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Human Capital, Asymmetric Information and Labour-Management

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ABSTRACT. – We consider the employment relation within firms with reference to investment in human capital. Although the firm knows the future value of the worker's human capital to the worker, the worker only finds this out after the training is complete. Both moral hazard and adverse selection problems arise if the specificity of human capital, bestowed on the worker by the firm, is variable. The labour-managed firm is advanced as an institution that may be less prone to these problems. However, the more entrepreneurial the labour-managed firm, the less evident is the comparative advantage in providing training.

Capital humain, information asymétrique et auto-gestion

RÉSUMÉ. – L'auteur s'intéresse à l'apprentissage d'un travailleur à l'intérieur d'une entreprise. Malgré que l'entreprise connaisse la valeur du capital humain du travailleur pour celui-ci, ce dernier ne la découvre qu'à la fin de son apprentissage. Des problèmes de risque moral et de sélection adverse se posent si la spécificité du capital humain, donné au travailleur par l'entreprise, est variable. Il est suggéré que l'entreprise autogérée est une forme d'institution moins sujette à ces problèmes.

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1 Introduction

Equivalence of long-run equilibrium, irrespective of the organizational form of the firm, has often been applied to comparisons of labour-managed (LM) and profit-maximising (PM) firms, see particularly DREZE [1976]. The equivalence holds provided that markets are complete and that production relationships are the same. One well-known departure from equivalence is that of property rights over physical capital. In LM firms these may be limited (FURUBOTN and PEJOVICH, 1970, 1973) since members buy capital, but may only have the right of use of the capital during their time with the firm. A counter argument can be put in terms of the limited property rights of PM firm entrepreneurs in the human capital they donate to their workers by training them. This paper considers this latter scenario. It uses a model adapted from that of ASKILDSEN and IRELAND [1993] to demonstrate the market failure of conventional entrepreneurial systems, in the presence of incomplete contracts, to provide the correct type of training that society needs. In particular, the argument of ASKILDSEN and IRELAND will be extended to consider adverse selection rather than just moral hazard problems of PM firms.

The central thesis we present is that of the need to represent the future costs and benefits of skills in the initial decision as to the kind of training to give to the new entrant worker. We view this as a relationship between the worker and a sequence of employing firms. Note that we will make the assumption that workers generally have a longer working life than firms or technologies exist [1]. The firm offering initial training to the worker might be able to offer a long run contract for the expected life of the firm (although this may be too difficult to design and enforce), but it is unlikely to be able to guarantee the quality of the training in the face of complaints from subsequent employers of the worker. Thus there is a degree of market failure in the provision of human capital investment due to the heavy transaction costs [2] which complete contracts would involve. A key objective of institutional design is that "... investments of idiosyncratic types, which constitute a potential source of monopoly, are undertaken without risk of exploitation" (WILLIAMSON *et al.* [1975], p. 270).

We will argue that the LM firm may be a superior institutional design from the point of view of human capital investment. Our analysis will then broaden in scope to consider a number of parallel problems relating to human capital investment within LM firms. These problems can be divided into two groups: (i) those associated with the heterogeneity of labour and discrimination, and (ii) those arising from variations of the LM firm's constitution. In (i) the use of apprenticeships (Sapir [1980]) as a means of

1. Note that this removes the possibility that contracts can be designed involving pension provision conditional on remaining with the firm: when firms have much shorter lives than workers tied pensions are not worthwhile assets.
2. See WILLIAMSON *et al.* [1975] for a discussion of transaction costs in employment contracts.

discriminating among potential members, and the strategic manipulation of the membership composition (IRELAND [1988], and FURUBOTN [1976]) are shown within the context of the need to train members within the firm [3]. In (ii) we consider the SERTEL [1982] model of the LM firm where workers can sell their shares and membership on a market for membership deeds. We pursue the argument that, just as such a market for membership can be interpreted as reducing inefficiences in investing in physical capital within LM firms, so it also removes much of the advantage of the LM firm for investing in human capital.

2 The Model

Consider the simplest firm: n workers and one machine combining to make one unit of revenue per period. Let the machine cost K and last for two periods; let training cost per worker be t and the wage rate (per period) be denoted w_u for previously untrained workers and $w_t(h)$ for previously trained workers. Workers live for L periods. Workers who were trained in one firm can be employed in another but additional costs must be met according to the kind of training they received. These costs are of amount $ht/2$ per period, $0 \leq h \leq 1$. Thus if training were completely "general" (BECKER [1975]) then $h = 0$ and no additional costs are involved; if training were completely specific, then $h = 1$. Then it is as costly to employ previously trained workers for two periods as to train workers from scratch. That training in firms can be part general and part specific is well accepted, see for instance ODAGIRI's [1992] discussion of the Japanese firm [4]. The going wage for a worker depends on the specificity of his initial training (the value of h), since this determines his value to the employer. For example, very specific initial training may imply a poor understanding of the production process so that mistakes arise, leading to lost time and materials. The value to the employer of an h-type worker for one period is equal to $(2-\mathrm{K})/2\,n - ht/2$, which can be viewed as the average revenue of a worker net of the share of overhead cost K and the h-type-specific additional cost $ht/2$. We will only consider free entry perfect competition within the labour market, so that wage rates will exactly equal the maximum amount that an employer can pay:

$$w_t(h) = (2-\mathrm{K})/2\,n - ht/2 \tag{1}$$

3. Another interesting extension is the possibility of "endogenous entry" (RUBIO [1992]) where firms have to guard against trained members leaving to form their own firm.
4. There is also the question of the balance of in-firm and pre-firm training and education. The National Commission for Education [1992] argues that young workers should be released for part-time study outside the firm, as the employer cannot be relied upon to give the right mix of specific and general training: "Employers' needs are inevitably much shorter term than those of young people with a lifetime of work ahead".

Note that the employer could employ workers of different h-types. The technology we have assumed implies that the firms has n spaces to fill with workers. Equation (1) is an equilibrium condition for any space in any firm.

Rather than employ previously trained labour, an entrepreneur can train new entrants to the labour force. Training takes place at the beginning of the first period of employment and is assumed to be instantaneous for simplicity. The value of a worker, to the firm which has trained him, is $(2-\mathrm{K})/2n$ per period that he remains with the firm: thus "in-house" training involves no loss of productivity while workers remain within the firm. We can think of this as the firm training its workers with the exact same technology as they are to use within the firm so that questions of wider understanding and being able to adapt to new problems and conditions do not arise. The determination of w_u is again taken to be driven by free entry and competition; however additional factors will be the kinds of contracts that can be written and the possibility of asymmetric information in the labour market. These factors will determine the wage cost of keeping the newly-trained worker from leaving before the end of the firm's life. We will consider first that the value of h is fixed and the same for all training firms, and that there are no problems of asymmetric information.

• Two-Period Contracts

If workers can sign contracts for 2 periods then their wages during the contract would depend on whether they were initially trained $(\ _t)$ or untrained $(\ _u)$, and in free entry perfect competition the contract wage rates for periods 1 and 2 for previously untrained workers would in total satisfy:

$$(w_1 + w_2)_u = (2-\mathrm{K})/n - t \tag{2}$$

Then an entrepreneur could recruit n untrained workers, buy the machine for K, train the n workers for cost nt and gain revenue of 2 over the two periods. Competition for untrained workers would then lead to zero profit and to wage payments over two periods given by (2). In the absence of time preference and discount factors, it is only the total wage over the two periods of the contract that is determined. Trained uncontracted workers could also be recruited by firms, and these workers would receive higher wages [given by (1) for each period] unless $h = 1$, when their previous training involves such heavy costs of implementation that they can obtain no greater wage on the labour market than if they had had no previous training.

• E1: Equilibrium with two-period contracts and fixed type of training.

An equilibrium is defined by all new workers receiving training only in the first firm in which they are employed. In this first employment they receive the total wage over the two periods given in (2). Thereafter, one or two period contracts at wage per period of $w_t\,(h)$ [defined by (1)] are taken until the end of the worker's life.

The above description defines an equilibrium because (i) all firms break even; (ii) no firm can make positive profits at the given wage rates; (iii)

no individual worker can make a higher lifetime income by choosing a different set of employers. In particular, a worker cannot gain lifetime income (and will strictly lose if $h < 1$) if he accepts two training contracts since $(w_1 + w_2)_u \leq 2\,w_t\,(h)$.

• One-Period Contracts

If workers can only sign one-period contracts then second period wages within the training firm have to be $w_t\,(h)$ as defined in (1) in order to stop the trained worker from leaving to take an alternative offer. (We assume that h is a known or observable or predictable characteristic of applicants and so the offered wage will reflect the correct productivity parameter). Now in zero profit equilibrium, competition will imply that the single period wage in the training contract is such that the firm will break even over the two periods:

$$(3) \qquad w_u = (2 - \mathrm{K})/n - t - w_t\,(h) = (2 - \mathrm{K} - nt\,(2 - h))/2\,n$$

and then we can state:

• **E2: Equilibrium** with one-period contracts and fixed type of training.

Equations (1) and (3) define the equilibrium wages when contracts can be written only for a single period. Workers remain with the training firm for two periods, the first period with wage w_u defined in (3) and then at wage $w_t\,(h)$. They are then employed at the same wage $w_t\,(h)$ for the rest of their working lives. Again this is an equilibrium since no firm or individual can choose a better action.

So far in this model there are no real effects of limiting contracts to only one period. The only difference is that the distribution of wages over the first two periods of the worker's career is determined by market conditions for trained workers. [The unskilled worker has to take a wage lower than half $(w_1{+}w_2)_u$ in the contract period covering his training, and he is compensated for this by receiving $w_t\,(h)$ one period earlier than if he signed a two-period contract.] There is full information and no scope for either adverse selection or moral hazard problems. It is however straight-forward and natural to vary the model's structure to introduce such phenomena: the variations will also show that even two-period contracts may be socially inefficient.

3 Variable Specificity of Training

Let the value of h be determined by the form of the initial training. In particular let $t + x\,(h)$ be an expenditure per trainee by the training firm to endow h-type training: that is training that will reduce net per period productivity by $ht/2$ (compared to full general training) when the worker is

employed by a new firm or at a new machine. The higher the value of h, the more specific the training, and so the more costly to adapt skills to future needs. The form of $x(h)$ will be assumed to be convex and differentiable with a minimum value of zero when h is h_m. Also, $-x'(0)$ is assumed to be arbitrarily large so that completely general training is always too costly to be economic. In order to consider the extent of market failure it is useful first to review the social optimum for the variable h.

PROPOSITION 1 : The social optimum $\{x(h_0), h_0\}$ pair satisfy:

$$x'(h_0) = -(t/2)(\mathrm{L} - 2)$$

Proof: The social optimum training type (level of h) takes into account lost productivity in *all* future employments of the worker's life. The value of these losses are $h(t/2)(\mathrm{L}-2)$. Thus h_0 minimises the expected sum of training and productivity costs.

COROLLARY 2 : If contracts can be written which specify the value of h, then the social optimum can be achieved.

Proof: First consider two-period contracts. The untrained worker will obtain $-(t/2)dh$ extra expected wages in each period of employment with future employing firms if the training type is changed by dh. The total value of this stream is $-(t/2)(\mathrm{L}-2)dh$, and the worker will be willing to forgo this much extra $(w_1 + w_2)_u$ to fund the better training.

Now consider one-period contracts. Here the worker is willing to reduce w_u by $-(t/2)(\mathrm{L}-1)dh$, but the firm bears an extra cost of $(t/2)dh$ from its second period wage. Thus any dh which reduces the difference (again $-(t/2)(\mathrm{L}-2)dh$) is adopted.

Although it is true therefore that the social optimum could be achieved if contracts could be written to include the value of h (as the workers would be willing to pay for the efficient level of h_0), two problems occur. First, whether such contracts can be written is very doubtful: note that the training firm has completed its life cycle before the workers test the market and discover the actual h-type of their training. This leads to moral hazard problems to be considered below. Second, the need for workers to "pay" for their training by a low (or indeed negative) initial w_u may require the existence of a capital market able to make advances to workers and seek repayment at later periods.

4 Moral Hazard

It is obvious that the firm able to set 2-period contracts with its workers, but unable to write the value of h into the contract would set $h = h_m$. Furthermore in the absence of any contractual value of h, this would be

the type of training specificity expected by joining workers and future employers. Thus

> PROPOSITION 3 : If the value of h cannot be written into the two-period contract, then the training-cost-minimising value h_m is the equilibrium value of h which will be observed for all firms training previously untrained workers.

Proof: Is immediate.

Now let us turn to situations where two-period contracts are not enforceable. If contracts over h are not possible and only one period contracts can be written, an even more socially-inferior outcome occurs. Note that the firm could make the training more specific (denote the firm's choice of h by h^* higher than h_m) by incurring an extra cost $x(h^*)$ per worker. This would be of no direct benefit to the firm and indeed would be an inefficient expenditure never undertaken when contracts last two periods. When contracts can only be written for one period, then such expenditure reduces the trained worker's ability to obtain higher wages outside (and thus inside) the firm at the end of the contract's single period. If the firm cannot commit to a value of h then the only time consistent choice is $h^* > h_m$. Thus we have

> PROPOSITION 4 : If only one-period contracts can be written, and the value of h cannot be contracted, then the equilibrium value h^* is greater than h_0 and satisfies $x'(h^*) = t/2$. Training is even more inefficiently specific than when two-period contracts are possible.

Proof: From (1), the opportunity wage after training is:

$$w_t(h^*) = (2 - \mathrm{K})/2\,n - h^*\,t/2 \tag{4}$$

Now once the contract for training is signed, and if the contract does not specify h, the worker will assume that the firm will select $x > 0$ and $h^* > h_m$ to minimise $x(h) + w_t(h)$ or equivalently $x(h) - ht/2$. Thus $x'(h^*) = t/2 > 0$. The firm will not be able to credibly commit to $x = 0$ and h_m.

The equilibrium wage in the training period in zero-profit perfect competition is

$$w_u = (2 - \mathrm{K} - nt - x(h^*)\,n - nw_t(h^*))/n \tag{5}$$

where $w_t(h^*)$ is given by (4) so that (5) simplifies to

$$w_u = (2 - \mathrm{K} - 2\,x(h^*)\,n - nt\,(2 - h^*))/2n \tag{6}$$

Since in long run equilibrium no profits are earned, the difference in this case, where contracts are for only a single period, is that workers' remuneration is reduced initially by the inefficient x, and then also by the lower productivity (due to the overly specific training), whenever the worker moves on to another firm. This scenario shows that the capitalist system may:

1. Skimp on general training and concentrate on specific training, even if this increases costs of production for the training firm;

2. Imply lower productivity in future jobs due to the lack of basic general skills.

There are two levels of these inefficiencies. First, the absence of contracting over h directly moves the equilibrium h from h_0 up to h_m. Second, the absence of two-period contracts implies that the firm cannot commit even to h_m, but rather to $h^* > h_m$. The basis for these inefficiencies is thus that the worker and firm are assumed unable to write a contract for the life of the firm, and that the generality of training is not enforceable by contract. Neither assumption is difficult to accept. The first reflects the unwillingness of courts to accept the legality of long term labour contracts which might verge on slavery. The second is implied by the fact that tests for reemployment only take place in the middle or end of the firm's life, and failure to attract better offers can be blamed on the worker's own conduct or initial ability. Note that if n is large, there could be a range of abilities within the firm's workforce: then an individual could not claim that retraining costs above average were the "fault" of his training. The above model is simply extended to this case. Suppose that the firm's decision over h is one which relates to the average of the firm's workers, but that individual workers become of type $h + e$, where e is a random variable with zero mean. If only the composite $h + e$ is observed by future prospective employers, wages will depend on this measure of training *output*, rather than on the training *input*, h. Also if failure to obtain better wages outside the firm was a justification for legal redress, moral hazard would arise from the worker taking advantage of the legal guarentee and not applying himself in the workplace or the job market.

5 The Labour-Managed Firm

Now consider a labour-managed (LM) firm of the Ward-Vanek [5] tradition within an economy of capitalist firms. Could it survive or indeed prosper? Suppose n untrained workers borrow the capital and training cost $\mathrm{K} + nt + nx(h)$, for some choice of h, by either individual (personal) or corporate loans. If the loans are to the company they are assumed to be short-term and have to be repaid during the first period. Thus in the first period, members receive (net)

$$y_1 = (1 - \mathrm{K} - nt - nx(h))/n \tag{7}$$

If they stay with the firm in the second period they each then receive $y_2 = 1/n$. They will stay with the firm provided the opportunity wage in the capitalist sector is no more than $1/n$, and since

$$w_t(h) = (2 - \mathrm{K} - nht)/2n < 1/n \tag{8}$$

5. See WARD [1958], VANEK [1970], and discussion in IRELAND and LAW [1982].

this condition always holds. Even if a fairly large proportion (say b) of the capital costs is repaid out of the firm's second period income, so that the firm's debt is longer term, there may still be no need to engage in defensive x.

PROPOSITION 5 : If $b(\mathrm{K}+nt+x(h))$ remains to be paid after the first period then

$$2b < (\mathrm{K}+nht)/(\mathrm{K}+nt+x(h)) \tag{9}$$

is sufficient to make it in the member's interest to remain with the firm during the second period.

Proof: Compare $w_t(h)$ with $1/n - b(\mathrm{K}+nt+x(h))/n$, the net income per member to be earned in the LM firm.

Note however that members must be able to survive the first period: it is the lack of long-term finance that acts as a binding incentive for members to stay with the firm after the first period, in order to reap the final profits, but this very phenomenon may be too great a hurdle for the firm to be created.

If the LM firm can survive without training its workers at too specific a level, then the workers can obtain higher wages throughout their lives whether or not they continue to work for LM or capitalist firms, since they have the benefit of more general skills. Indeed the workers may be willing to pay a greater training cost in order to reduce h below h_m for future employment: in the absence of problems of workers leaving the firm prematurely (condition (9) holding) and given homogeneous treatment of all members, the LM *firm will act in the best interests of its members if it trains workers in the socially optimal way*. Note that LM and capitalist firms would be equivalent organizational forms for workers once the workers' initial training is complete, but that workers originating from LM firms would have higher productivity (and earn higher wages). An exception to this equivalence would be when some LM firm members could exploit a reputation for training and a shortage of LM employment in order to yield an entrepreneurial rent from new untrained recruits. We will return to this possibility in section 7.

6 Adverse Selection

The argument in section 5 shows how LM firms might have a role in providing more efficient training for untrained workers. It relied on the presence of moral hazard for the PM firms when they were unable to write long-term binding contracts or guarantee the nature of training. A similar argument can be made for LM firms as a counter to adverse selection. Here suppose that the initial training has a degree of generality which is not a decision variable (via x) as considered above, but which varies exogenously

among entrepreneurs or machine types; for example some machines are more similar to future machines, and imply higher future productivity of workers trained on them, than others.

Thus take $x = 0$ for all h, but consider the specificity parameter as subject to random variation between firms: denote this as $h + \varepsilon$, where h is fixed and common while ε is random and exogenous with a zero mean. Suppose in addition that, although firms know their own types (their own ε), workers are unaware of the type of training (in terms of its future applicability in other firms, that is the value of ϵ) in any particular firm. All that workers know is the distribution of types, and in particular that the mean loss of productivity per period is $ht/2$. The actual productivity loss will be assumed observable, however, by prospective future employers. Since untrained workers cannot identify firms' types *ex ante*, they will not be willing to accept a lower wage (w_u) during training in one firm than another. Some entrepreneur types will not be able to break-even, and these will be those *offering the most general training*. The reason is that these PM firms would lose their workers prematurely (at the end of the single contract period) or have to pay second period wages which render them loss-making overall. The lowest h-type PM firm that can survive is that with $h + \varepsilon^*$ defined by

$$(2 - \mathrm{K})/n - t - w_u - w_t\,(h + \varepsilon^*)) = 0 \tag{10}$$

and using (1):

$$(2 - \mathrm{K})/2\,n - t - w_u + (h + \varepsilon^*)\,t/2 = 0 \tag{11}$$

so that

$$w_u = (2 - \mathrm{K})/2\,n - (2 - h - \varepsilon^*)\,t/2 \tag{12}$$

Let the number of untrained workers requiring employment in any cohort of new firms be N, then ε^* is such that there are just N/n firms with higher ε. It is important to recognise that it is the top half of the ε-distribution that form firms which undertake training. An immediate implication is that if N increased, the generality of the training would on average increase (average ε declines). Thus if we consider more general training as higher quality training, then training quality is procyclical. The lifetime expected wages of an entrant worker is

$$\mathrm{W} = w_u + w_t\,(h + \varepsilon^{\sim})\,(\mathrm{L} - 1) \tag{13}$$

where $\varepsilon^{\sim}$ is the mean ε greater than ε^*, and using (1) and (12) W simplifies to

$$\mathrm{W} = \mathrm{L}(2 - \mathrm{K})/2\,n - t\,(2 + (\mathrm{L} - 2)\,(h + \varepsilon^{\sim}))/2 \tag{14}$$

Now $d\mathrm{W}/d\varepsilon^{\sim} = -t\,(\mathrm{L} - 2)/2 < 0$, so that a higher N is associated with a lower $\varepsilon^{\sim}$ and in turn a higher W. If the supply of labour into the industry increases with expected lifetime wages, then an unstable environment arises

since the reduction in adverse selection effects leads to lower costs and further entry. This can be countered only by reductions in output price.

There is an argument on efficiency grounds for restricting w_u. If w_u was held below its long-run equilibrium value then training firms lucky enough to find workers would make positive profits. This would mean that the average firm that could survive was one with lower ε than $\varepsilon^{\sim}$, provided that rationing was independent of type of firm. The greater generality of training can lead to higher lifetime wages of workers and the possibility of a social gain. This argument is analogous to a standard Stiglitz-Weiss credit-rationing argument (STIGLITZ and WEISS [1981]).

Finally, note that, in this section, different training qualities are in evidence. It is thus possible that trained workers will be sufficiently disappointed with their training as to decide to retrain. Suppose that they find that their first training has been of specificity level $\varepsilon^{\max}$, the worst outcome, and that they have T periods of working life remaining. If they enter into a new one-period training contract they will expect to receive

$$w_u + (\mathrm{T}-1)\, w_t\, (h + \varepsilon^{\sim})$$

and thus, if they are risk-neutral, they will wish to retrain if

$$w_u + (\mathrm{T}-1)\, w_t\, (h + \varepsilon^{\sim}) > \mathrm{T}\, w_t\, (h + \varepsilon^{\max}) \tag{15}$$

which simplifies to

$$\mathrm{T} > 2(1 - h - \varepsilon^{\sim})/(\varepsilon^{\max} - \varepsilon^{\sim}) \tag{16}$$

Of course (16) does not take account of the possibility of still further periods of retraining. Notice however that if (16) does not hold when $\mathrm{T} = \mathrm{L} - 2$ then no retraining will take place. We will simply note the possibilities of retraining but we will not consider them further: we thus assume that equation (16) does not hold [6].

Now consider the LM firm in the same environment. Profits arising from being a high h-type are not desired. These short-run advantages are outweighed by future lower incomes of the members because of their disadvantage of lower productivity. Thus LM firms of high h-types should not enter the market, and only low h-types should be observed. We can summarise these arguments as

> PROPOSITION 6 : A PM-system will be characterised by firms of high h (low generality of training), while the LM-system will be characterised by firms of low h (high generality of training) when firm types differ and workers cannot observe the type before accepting a training contract.

Proof: Immediate from the above argument.

6. The retraining possibility can be thought to place an upper bound on the cost of poor training; it does not affect the essence of our argument.

Of course, both the moral hazard and the adverse selection arguments for the superiority of the LM form of organization have been heavily biased by our selection of modelling assumptions. In the next sections, we consider a number of difficulties that arise when these assumptions are varied.

7 Heterogeneous Labour

The LM firm is an institution which shares entrepreneurship. When all members are treated equally, they will have a reasonably common purpose. In some situations, however, equal treatment will give way to differences involving discrimination or exploitation. In this section we will consider some ways in which this may arise through the LM firm as a training institution.

The possibility of different generations of members within the LM firm can be built into the model. Here the issue that arises is that if the LM firm starting with untrained labour is profitable in the sense of being in a position to pay higher incomes than other firms over the two-period life of the machine, then the LM firm membership may wish to regenerate itself by replacing the machine. If the membership splits into a number of LM firms these can recruit additional members and train them. This will yield more income for the original membership, if they are able to make additional income from achieving a surplus on the new members. A surplus will exist if the LM firm can credibly commit to (near) full general (h_0) training, since then the efficiency gain can be shared between the new members and the old. The kind of scenario that is likely here is that members (new and original) contribute to the total capital cost out of first period income. If there is a shortage of LM firm opportunities, the opportunity wage for the new recruit, and thus his supply price, would relate to that available within the PM firm. Thus for the new member to participate

$$y_1^n + y_2^n + w_t\,(h')\,(\mathrm{L}-2) > w_u + w_t\,(h^*)\,(\mathrm{L}-1) = \mathrm{W} \tag{17}$$

where y_i^n is the income level paid to new members in period i and h' is the training type in the LM firm. An obvious scenario is where the LM firm can only discriminate between workers in the first period. Suppose that the original members are a proportion δ of the workforce. If these original members can choose first period incomes for new and old workers (y_1^n and y_1^0) subject to the firm's overall first-period budget constraint (per member):

$$(1-\delta)\,y_1^n + \delta\,y_1^0 = (1-\mathrm{K})/n - (\delta\,h' + (1-\delta))\,t \tag{18}$$

then surplus can be shifted to the old members by underpaying new members, even allowing for the extra training involved. In period 2 each worker receives $1/n$. This stops the new member from leaving after period 1, even though $h' < h^*$. The willingness to accept a lower $y_1^n < y_1^0$ in order to

benefit from the better training implies rent for the LM elders. Note that h' at h_m is sufficient to yield a surplus: the new member becomes tied to the firm by his low first period wage as surely as if he had signed a two-period contract. If reputation effects allow an h' less than h_m then a bigger surplus is feasible.

The above discussion reflects the use of apprenticeships and membership application periods by LM firms, and has been analysed by SAPIR [1980] [7]. Obviously other factors such as screening and evaluating new workers may also play a role, or at least be claimed to be important. Sapir points to the role of workers having a period of non-tenure as an "engine for growth" since each generation of workers discriminates against the next. We have shown here how the surplus necessary for the discrimination can be provided by more efficient training.

If uneven training is required to operate the technology, with some workers needing skills and others not, then only some workers in a firm receive training. Conflict may arise in the LM firm between those becoming skilled workers and those remaining unskilled. The analysis of this case can proceed by extending the simple notion of technology that we have been assuming to permit a mix of skill levels of machine attendants, some roles requiring more skill than others. Then one type or coalition of types of worker may become dominant, and indeed majority (share) voting may concentrate the efficiency gain (entrepreneurial rent) on the more skilled workers at the expense of the unskilled (hospitals, law practices, etc. see PAULY and REDISCH [1973], SAPIR [1980]); also the employment of manual labourers, without membership, is often observed (DUBRAVCIC [1970]). The efficiency problem here concerns the strategic use of employment decisions to assure the dominance and profit of a key group of workers (see FURUBOTN [1976]). Some of these issues were discussed in other contexts in IRELAND [1988]. They are also important within the field of industrial training.

To demonstrate the issues involved, suppose that n_1 trained and n_2 untrained workers (where $n_1 + n_2 = n$) are required to operate the machine. The LM firm could train all its members and operate a job rotation scheme (such as in some Israeli Kibbutzim, see BARKAI [1972]), but this is obviously inefficient. On the other hand, if only n_1 members receive training, the surplus over the alternative PM firm lifetime income W might be allocated almost entirely to the trained members since these can better threaten to leave and take their human capital with them. The LM firm may be less keen to adopt a technology which requires a minority of trained members if much of the surplus from the human capital investment can be extracted by the trained minority. Also, within a democratic (one member one vote) LM firm, the ratio of trained to untrained members may be at variance with the technological requirement due to attempts to maintain control by one group or another (IRELAND [1988]). Put simply, internal dissent may remove all the LM firm advantage.

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7. See also De MEZA [1983].

8 Labour Managers' Entrepreneurship

One way in which the LM firm can avoid the problem of limited property rights over capital is for the original members to have membership deeds which can be sold at a market price. In this way the initial members can capitalise on the full value of the income stream from their investment in physical capital whether they remain in the firm or not. This solution to the horizon problem (FURUBOTN and PEJOVICH [1970], [1973]) has been proposed by SERTEL [1982] and others. However, within the context of property rights in human capital, a market for membership reduces the ability of the LM firm to provide socially optimal kinds of training. This is because the trained worker can sell his future profit in the LM-firm, so that there is very little improvement in the property rights structure for human capital compared to the conventional firm. Thus although a market in shares solves most of the problems of property rights for physical capital within the labour-managed form of organization, it fails to retain many of the advantages for human capital property rights, since the replacement of members would involve lost production, not necessarily born by the departing member. An example from our model will make this clear.

Consider an LM firm formed initially from untrained workers, which has repaid all its physical capital and training costs from its first period income. Then each member can look forward to a second period income of $1/n$. Now suppose the workers have been trained to specificity h_0. If an outside worker, with skill specificity characterised by h^*, buys membership from a current member, the price of the membership deed will be $-\gamma\, h^*\, t/2+1/n-w_t\,(h^*)$, on the assumption that the new member has to pay a proportion γ of his productivity loss (remember the initial member has no productivity loss since he was trained within the firm). This leaves the departing member with sale proceeds plus his wage in the next period:

$$
\begin{aligned}
&-\gamma\, h^*\, t/2 + 1/n - w_t\,(h^*) + w_t\,(h_0) \\
&\quad = 1/n + [(1-\gamma)\, h^* - h_0]\, t/2 > 1/n \\
&\quad \text{if} \quad (1-\gamma)\, h^* - h_0 > 0
\end{aligned}
\tag{19}
$$

If the productivity loss gets subsumed within the general costs of the firm, and the new replacement member is given equal income to original members, then $\gamma = 1/n$. Then the departing member, who sells his membership deed, is very likely to be better off from the transaction, leaving his fellow members to bear the extra costs of the new member. The LM firm could counter this threat by either increasing the specificity of its training (h higher than h_0) so that profitable selling of the membership deed is not possible, or by imposing more costs on the replacement (increasing γ). At the limits when h is chosen at h^* or γ at 1 there is no profitable sale of membership deeds.

9 Conclusion

Our conclusions are that the LM firm has similar advantages as an institution for investing in human capital as conventional firms have for investing in physical capital. However, the need to acquire up-front finance may limit the viability of LM firms. Also, internal divisions may arise if workers are treated unequally: these may produce distortions. Finally, a market in memberships may remove much of the difference between LM and conventional firms.

One way of considering all these qualifications to the apparent advantages of labour management as a training mechanism is that the surplus from the extra efficiency in training has to be divided among the membership. Such division leads to similar problems of strategic actions as those involved in the entrepreneur's defence of his profits.

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