General Training Under Asymmetric Information

Eliakim Katz
and
Adrian Ziderman

Firms are unlikely to provide their employees with general
training that makes them more desirable to competing firms.
They are more likely to provide such training if it is difficult for
other firms to measure the value of the training.
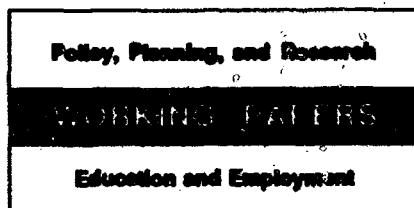
One widely accepted conclusion in the human capital literature on training is that firms will finance only firm-specific training because it is non-transferable to other firms. Firms will not be willing to finance training in general (transferable) skills.

In this paper it is argued that a recruiting firm will possess only limited knowledge of the training level in general skills acquired by workers in other firms. Hence a worker with transferable skills who changes employer can expect to suffer a cut in wages for a transition period while his level of productivity is being evaluated and recognized. Such a worker has no incentive to move as long as the present value of the loss in earnings during the probationary period is greater than the present value of the

loss incurred in remaining with the training firm at a wage below the market-level for his skill. In such cases this constraint on worker mobility will make it feasible for firms to assume a share in investment in the general-skills training of their workers — a result that qualifies the traditional theory of on-the-job training as developed by Becker.

This result may have some important implications for policy in countering the deleterious effects of such market imperfections as minimum wage legislation and a restricted capital market, on the supply of trained labor with general skills. It also suggests that training certification, in facilitating interfirm mobility, discourages on-the-job training by firms.

This paper is a product of the Education and Employment Division, Population and Human Resources Department. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Cynthia Cristobal, room S6-035, extension 33640.

Produced at the PPR Dissemination Center

General Training Under Asymmetric Information

by

Eliakim Katz
and
Adrian Ziderman

Table of Contents

Eliakim Katz, Consultant to the Bank, is Professor of Economics at York
University, Toronto, Canada.

Adrian Ziderman is Senior Economist at the Bank, on leave from Bar Ilan
University, Israel.

I. Introduction

Becker's seminal work regarding on-the-job training, with his famous distinction between 'general' and 'specific' training, has led to the emergence of a whole new field of research into the economics of training within the firm (Becker 1975). Working with a model of a perfectly competitive firm, Becker defined as completely specific those forms of training which increase the productivity of a trainee in the firm providing the training, but which do not at all raise the worker's productivity in other firms. General training, on the other hand, was defined as raising the worker's productivity in both the training firm and other firms.

The upshot of Becker's model is that firms have no incentive to invest in general training. Being embodied in the trained workers and of potential value to other firms, such training will tend to cause workers to move to other firms after being trained if they do not receive a wage equal to their enhanced marginal product. Hence, the training firm cannot hold on to this form of investment if it is to be profitable and will not undertake it.

One major implication of this result (which goes a long way in explaining a wide variety of labor market phenomena) is that general training will, in general, have to be paid for by the trainees themselves. Since such workers may be poor or illiquid and have little access to the capital market, the payment to the firm for this training will often take the form of reduced earnings during the training period.[1] Only to the extent that training is specific will the firm be prepared to bear the burden of at least part of the training expenses.

Becker argued that a unity of interests between the training firm and the worker would, in practice, lead to a sharing between the two parties of both the costs of specific training and the returns stemming therefrom.

The view of firm-specific on-the-job training as a shared investment between worker and employer is now generally accepted as a central element in the human capital model.[2/] However, for general training, no such sharing arrangement is viewed as feasible, other than in such special market circumstances such as monopsony. This absence of a mutually beneficial agreement occurs because the costless potential mobility of generally trained workers means that the training firm cannot ensure that the worker will remain with the firm beyond his training period, if he is paid less than his marginal product. Hence the firm cannot recoup any potential investments in general training. Only where there is some degree of immobility of labor may firms be able to collect part of the extra product of general training (see Eckaus, 1963).[3/]

On the other hand, since an agreement will in general emerge for specific training, such training has lent itself to being applied to a wide range of issues in labor economics theory, particularly in relation to the micro economics of the firm.[4/] In contrast, application of the concept of general training to the theory of the firm has been more limited.[5/] This is presumably due to the unlikely achievement of a general training agreement between the firm and its workers.

In this paper, we take a view that leads to a different conclusion. We assume that potential recruiting firms have less information regarding a worker's training than the firm providing the training. This asymmetry of information concerning the general training received by workers negates one of the central assumptions of the Becker model, i.e. that the transferability of generally trained workers between firms is costless to the worker. Once such a transfer is seen as costly to trained workers we are led to the result that

training firms <u>will</u> assume an active role in the investment in general
training. This in turn endows the general training concept with a central
role (potentially no less significant than that of specific training) in the
theory of the firm.

In Section II we present our basic model regarding the behavior of a
recruiting firm in the face of imperfect information. In Section III the
behavior of the training firm is examined. In Section IV some extensions and
complications are considered, including the issue of natural ability.

II. Asymmetric Training Information and the Recruiting Firm

Unlike formal schooling, on-the-job training is essentially heterogeneous and typically difficult to define. Indeed, on-the-job training tends to be informal and hard to measure, is often tailor-made for individual workers, not readily leading to certification on completion. While also relevant to job entry-level training, there characteristics are particularly applicable to the whole complex of continuous training and skill development measures that firms provide for their workers, including training for performance upgrading, skills renewal and career development. As a result of these characteristics, and particularly a lack of training certification, outsiders to a firm which provides such training will find it difficult and costly to determine the extent and coverage of the on-the-job training, particularly continuous training, provided by such a firm to its workers.[6] The type and extent of the training on-the-job given by the firm to any one of its workers will be unknown to other firms.

In contrast, the firm actually providing the training will, of course, possess relatively full information regarding the training given to its own individual workers. Should a trained worker change his employment, his new firm will have considerably less information than the training firm about the on-the-job general training the worker possesses. Indeed, the central tenet upon which this paper is based is that there exists this asymmetric information about workers between the training firm and a recruiting firm.

Given this informational asymmetry, let us consider the circumstances under which this asymmetry may be relevant to the issue of general training by firms. Two major factors are of importance. First, the

extent to which it is possible for a new firm to assess, quickly and cheaply, a new worker's individual marginal product. Second, the speed with which the recruiting firm can discover an individual worker's level of training. We consider these two factors in detail, since our analysis crucially depends on them.

Clearly, the asymmetry of information between firms is irrelevant if the worker's marginal product is easily and quickly determined, because the information about a worker's level of training is, in effect, only a proxy for knowledge of his marginal product. If the actual marginal product is easily discovered, other information is of no importance. Since our paper is based on the assumption that informational asymmetry plays a crucial role in the provision of general training, our analysis holds only in cases where a new worker's marginal product is neither cheaply nor rapidly determined.

This, however, would not seem to be a major restriction on the validity of the analysis. Since most wage rates in the economy are not based on actual output or a visible marginal product, our assumption that training and other indirect information is of importance is plausible for most jobs. Indeed, most jobs involve complex and different roles, the marginal product of which cannot be measured directly. Furthermore, a given worker's contribution to a firm's profits may depend on his interaction with others as well as on the marginal product of others. This dependence of a worker's product on both horizontal and vertical factors makes any direct or rapid measurement of his product well nigh impossible.

Consider now the speed with which a recruiting firm can discover a new worker's training level. Clearly, if it is both rapid and cheap to discover a worker's on-the-job training level, then the asymmetry of

information between firms is of little consequence.[7/] Thus, our analysis
implies that we assume on-the-job training information to be costly and/or
slow to obtain. This seems a plausible assumption given that the fastest
method of determining a worker's training level is probably discovering his
marginal product. In addition, most labor contracts are fairly long,
suggesting that employers may not benefit from shorter ones, and this in turn
implies a long discovery period. As above, therefore, finding out training
information will encounter obstacles, such as job complexity, interaction
with other workers and so on.

One more point should be noted. In the foregoing analysis we assume
that the length of employment is exogenous. Thus we exclude dismissals,
probation periods and other devices through which a firm might cut its losses
if it has made a mistake in hiring as a result of asymmetric information. The
availability of such devices might be viewed as enabling the firm to hire and
pay workers what it perceives as their true marginal product and then demote
or dismiss them if it had overestimated their skill.

However, there are two reasons why such devices might not work.
First, as suggested, there may be a long discovery period. Second, a
recruiting firm is likely to pay a worker a little less than his actual
marginal product, until the end of the discovery process. During that time
the wage will be well less than his maximal marginal product. Hence the firm
need not cut its losses, since it makes none. This works as follows:

Giving the worker a task that might be beyond his level of training
will be costly to the recruiting firm in terms of the worker's errors of
judgement, wasted materials and so on. Hence, the firm will tend to put a new
worker into a "least damaging" position, which will tend to be in a position

required minimal skill and yielding a wage W_u. This implies that en route to his ultimate (training-based) position, the individual will be given lower level assignments and be producing less than his maximal marginal product.

As more information on this will be revealed to the recruiting firm over time, the wage of a worker can be expected to rise as information about his training becomes available to the firm. This process will continue until the worker's wage reaches W_T, when the worker will both be producing and seen to be producing at his maximal marginal product, MP_T.

Since a new worker's marginal product is likely to be less than his maximum, the recruiting firm does not necessarily expropriate (very much of)[8] the difference between the wage actually paid to the worker, W_p, and the wage, W_T, which is equal to his maximum marginal product. A new recruit will in general[9] provide a smaller output to the recruiting firm than he did in the training firm. From this, it follows that, when a worker changes a place of employment, a social dead-weight loss will tend to occur. This social loss can be viewed as the cost of the informational asymmetry

A typical productivity perception path of the trained worker within the recruiting firm is shown in Figure 1. In accordance with the above discussion the worker is depicted as being initially viewed by the recruiting firm as untrained and put into a position requiring no training. This enables him to produce only a little more than a marginal product of MP_u, for which he obtains a wage W_u. Then, as his skills are discovered by the firm through observation, he is moved up through the firm, producing and receiving an increasing marginal product and wage respectively, until he ultimately produces MP_T and earns W_T. As suggested above, such a process might take a considerable time to complete.

Thus, given asymmetric information, Becker's assumption of the possibility of an immediate and costless transfer of workers from the training firm to other firms does not hold. A worker, on moving, will tend to suffer a wage loss due to the recruiting firm's lack of knowledge of his background. The present value of this loss when the interest rate is zero is given by the shaded area in Figure 1. Given a positive market interest rate, this loss, L^P, may be written as:

$$L^P = \int_o^n (W_T - W^P(t))e^{-it} \, dt \,, \qquad (1)$$

where n is the complete discovery period of the worker in the recruiting firm, W_T is the wage corresponding to the worker's true skill, $W^P(t)$ is the discovered skill based wage payable to the worker after he has been in employment with the recruiting firm for t periods and i is the market rate of interest. Using our earlier assumption, $W^P(0) = W_u$, equation (1), measuring worker's loss on changing employment, is thus seen to constitute a more general formulation of the implicit case dealt with by Becker. Since the Becker model assumes the worker incurs no earnings loss on moving to the new firm, it implies that $W_T = W^P(t)$ for all t, or, in terms of Figure 1, that the productivity perception path coincides with the ordinate between W_u and W_T.
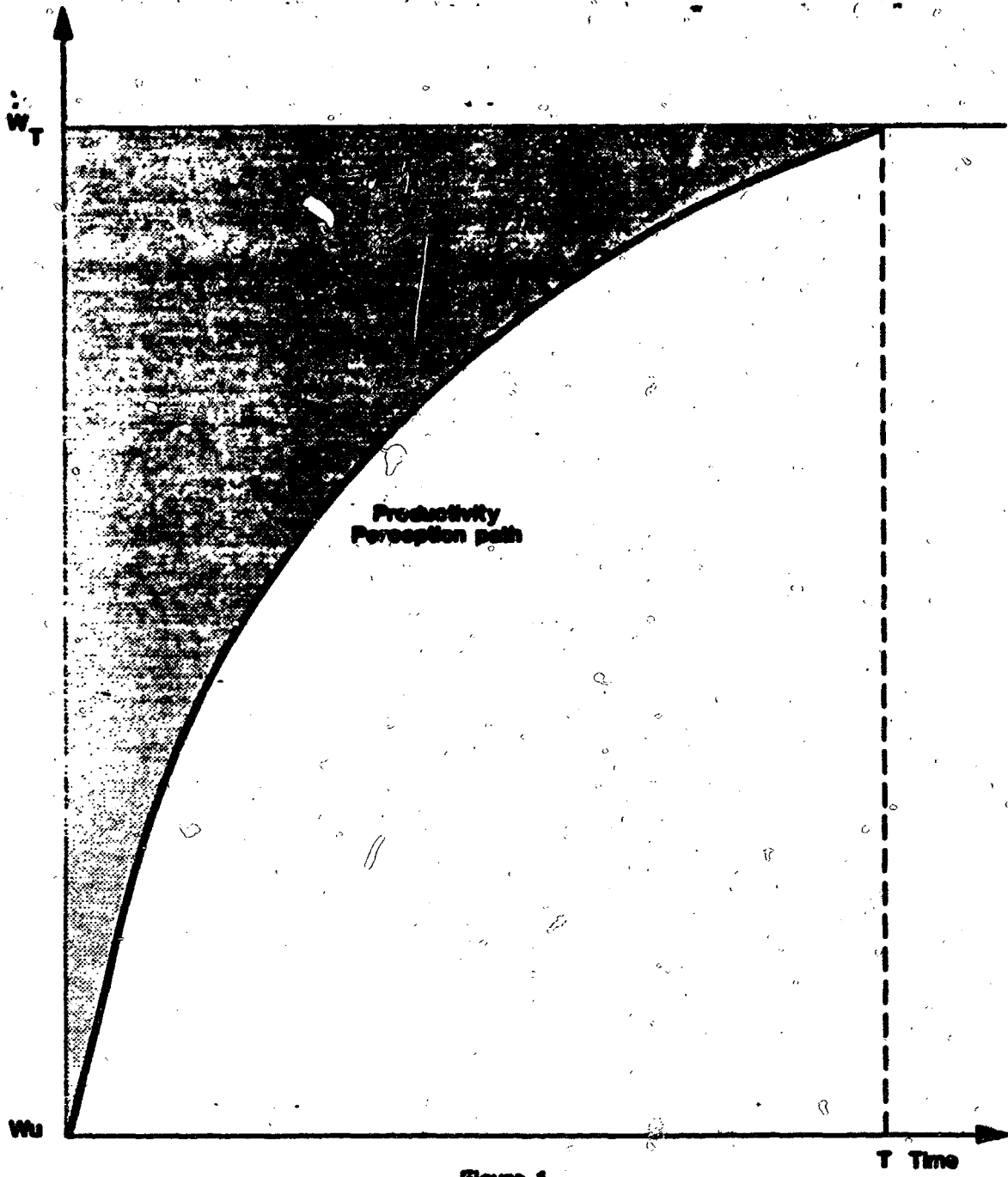
Figure 1

III. The Training Firm and Sharing the Benefits of Training

So much for the behavior of the recruiting firm. But how might training firms be expected to act in view of all this? Assuming profit maximization, as long as the rate of return, r, on training investments sufficiently exceeds the market rate of interest, i, training firms will have an incentive to invest in on-the-job training.

In the case of both general training and absence of asymmetric information, however, firms will be constrained from taking advantage of this type of investment opportunity because of the need to pay a generally trained worker a wage equal to his enhanced marginal product to prevent leaving for another firm. Thus, the training-investment opportunities are passed on to the worker who, to the extent that he is able to raise finance for his training, both pays for, and reaps the earnings benefits of, this investment.

The presence of asymmetric information and the potential worker loss of L^P on moving, however, render the investment in general training by the firm feasible, and indeed, results in the sharing of the general training investment and benefits between worker and firm. In this case the firm is able to invest in general training and then, after the completion of the training both recoup its investment and earn a return by paying the trained worker a wage lower than his marginal product, W_T, without necessarily motivating the worker to move to another firm. As long as the present value of the firm's investment plus return is lower than L^P, the firm will find it both profitable and feasible to invest in general training since this wage difference will not cause the worker to leave and the firm's investment in the worker will be secure. L^P both gives scope for, and acts as a constraint on, the training firm's ability to invest in general training.

The constraint emerges because we can define the firm's general training investment as being L^O - this being that part of the investment in general training that the worker "loses". Clearly, L^O cannot exceed L^P (the loss the worker would incur on moving) or else the worker would have a strong incentive to move to a new firm. Thus, L^P yields the upper limit on the firm's contribution to the costs of a worker's general training. With symmetric information, the firm's ability to invest in a worker's general training is zero whereas when the information is asymmetric, L^P is strictly positive and at least some general training by the firm is feasible.

In addition, the worker is unlikely to pay for all his general training (even if he can finance it and it carries a high return). This is so for two reasons. First: given asymmetric information, it is only a partially transferrable asset and should he choose, or be obliged, to change firms for any exogenous reason he will lose up to L^P. Second: given that the firm has money, which it has still not recovered, invested in the worker, he is more likely to be kept on in the event of a downturn in business or other exogenously caused declines in the firm's labor demand. Asymmetric information therefore can enhance the interest of both workers and training firms in agreeing to share training costs, though, of course, there is no a priori reason to believe that their interests will coincide in terms of the proportions of training to be owned by each party.

Since, the present value of the benefits from training the marginal worker must equal the costs, the training firm will not pay more than L^P for the individual's general training. From this it follows that:

$$L^O - T_F \leq L^P \qquad\qquad (2)$$

where T_F represents that part of total investment in general training that is borne by the firm.

If the ratio of firm's investment in general training (T_F) to total general training investment is given by a, then L^O is measured by

$$L^O = a\int_o^m (W_T - W_u)e^{-it} \qquad (3)$$

where m is the expected number of years of service of the worker in the firm and the worker receives a post-training wage W_A, equal to $W_T - a(W_T - W_u)$.[10]

As noted above, L^O can never exceed L^P or the trained worker will leave, and the training firm will forfeit the remaining part of the return on its share of the training investment. This loss by the firm will apply from the time the worker leaves until period m. The worker, on moving to a new firm, will also lose, but the loss will be the whole of L^P regardless of how much time has elapsed since he received his general training. In addition, given an intention to move, the worker will have lost that part of L^O already paid back to the training firm between training and moving. Thus, if it is at all profitable for the worker to move, he would do so immediately after training, and to avoid this possibility the firm must ensure that $L^O \leq L^P$ especially at time 0.

We conclude that under conditions of asymmetric training information, worker and firm may share in the investment in general training. The firm's investment will be bounded above by L^P so that the maximum proportion of training costs contributed by the firm is L^P/T. In fact, given

the firm's desire to exploit all profitable training investment possibilities, it will invest all it can in general training (up to L^P), so that in practice L^P will tend to T_F and A will tend to L^P/T.

There is an additional consideration that may encourage firms under conditions of asymmetric information to invest in general training: the wage it pays to the worker may, in itself, act as a partial indicator of training received, since it will usually reflect worker productivity. Thus in the absence of general training sharing, a worker earning his trained wage in the training firm and switching firms may be able to claim an equivalent wage or at least a large proportion of such a wage and not suffer the full loss of L^P. In order to maintain the effect of asymmetric information and conceal training information from recruiting firms, the training firm will be encouraged to lower the actual wage paid to its trained workers below W_T. This is, of course, precisely what happens when the firm takes on part of general training investments and thus buttresses the process of training sharing.

Indeed, the foregoing discussion produces an example of the multi-dimensional tension between the interests of firms and their trainees. The trainee clearly prefers a training which makes him visible, provides him with a certificate and generally identifies him outside the training firm as well trained.[11] This desire to achieve potential mobility may in fact lead the worker to select a form of training (or training in a part of the firm) which is capable of yielding these signals. The firm, on the other hand, has an interest in keeping information regarding the worker's training level low, by avoiding training visibility, certification and so on. Thus the type of training offered by firms and chosen by workers may be varied, subject to the

constraint of available courses and methods of training, and will in turn influence the degree of firm sharing in training, since clearly, the more "mobile" is the worker's skills acquired through training, the lower will be the scope for the firm's sharing in the training investment and vice-versa.[12/]

IV. Some Extensions and Further Issues

The role of natural ability:

In addition to there being asymmetric information between firms vis-a-vis training, there is likely to be a difference in the information available to firms regarding individual worker's natural ability. Training firms are obviously likely to have better information regarding natural ability, and this adds another dimension of informational asymmetry to the asymmetry due to training. How does the introduction of natural ability affect our results?

It seems likely that information asymmetry concerning natural ability, will tend to strengthen our results. As argued earlier, lack of knowledge about a worker implies that a recruiting firm is likely to start him off at an unskilled level. When natural ability is added to the issue, the recruiting firm could be twice wrong. This is because the training firm will possess two different pieces of information about the worker, whereas the recruiting firm will possess none. This will reduce even further the desire of a trained worker of any given natural ability level to move to the recruiting firm, since he will be losing on both counts.

In addition, the issue of natural ability, by making the identification of an individual worker's traits more difficult, is likely to reduce the value of information the recruiting firm is able to glean from the training firm. For example, if workers were homogeneous the wage structure and its relation to training would soon be learnt by a recruiter. Since workers are, however, heterogeneous in natural ability, both their training costs and/or the post-training marginal costs are likely to vary from worker to worker, thus bringing about different wages to each worker and making the

relation between marginal product and wages very difficult to discern. (Note that workers pay for their training with reduced wages and that the reduction of wages of any one worker depends on his speed of learning and other natural traits).

Asymmetric information and minimum wage legislation:

The presence of asymmetric information does more than lead to a sharing of general training investment by worker and firm; it may also negate factors which lead to market failure in the form of under-investment in general training. For example, in the model with symmetric information the worker must pay for all his training costs in the form of lower wages <u>during the relatively short training period</u>, since presumably he will leave the firm if he has to pay for any training after his training is concluded. The need to pay for his training over this short period will make his payments high (and his net wages low). Minimum wage legislation may act as a constraint on worker-financed general training if the minimum wage is set at a level exceeding that of the net wage to be received by the worker during the training period (Hashimoto, 1975). This is because the undertaking by workers of a sizeable amount of training costs, to be paid back over a short time, might bring their net wage - namely the wage minus the payment for training - below the minimum wage, thus legally constraining the employers from allowing workers to undertake (and pay for) so much investment. The slack investment would not, given symmetric information, be undertaken by the training firm and this leads to a "training gap" which may imply socially suboptimal general training and a welfare loss.

However, the sharing of the training investment between the firm and the worker which is made possible by asymmetric information, implies a lower

investment by workers. This in turn means smaller payments by workers and higher wages. Those higher wages are less likely to contravene minimum wage regulations. Hence, paradoxically, training investment by the firm may permit training investment by workers.[13]

Exogenous leaving:

The possibility that a worker may leave the training firm for exogenous reasons, i.e. those unrelated to the income in the training firm as compared with a new firm, has implications for our model. Such exogenous reasons could include a change in marital status, health, a move to another city and so on. Clearly, when investment in training is shared, both the worker and the training firm lose out. The worker loses since he must now start from scratch and suffer the loss of at least L^p; the firm loses because it does not recoup all of its training investment, T_F. Thus both parties have an incentive to minimize the likelihood of exogenous leaving of a firm by a worker.[14]

Alternatively the firm and the worker can depart from a linear sharing arrangement as in (3), towards a sharing agreement in which the share of the training firm in the worker's training based wage is, in the early post-training periods, in excess of &, i.e., the firm will tend to get more of its investment plus return early on. Hence, defining $W^o(t)$ as the wage at time t, this agreement would involve, for low values of t, $W^o(t) < W_A$ where, as defined above, W_A is the wage representing the constant sharing of benefits arrangement underlying (3). Subsequently, $W^o(t)$ will exceed W_A.

Thus, the present value of the "loss" to the worker from this arrangement is given by L^o where

$$L^0 = \int_0^P (W_T - W^0(t))e^{-it}. \tag{4}$$

This is a general form of (3), and here the wage, $(W^0(t))$, and duration of the sharing agreement, (P), are chosen by negotiation.

Finally, we consider a further implication of the possibility that the worker may leave for exogenous reasons. The firm may reduce this risk by making the payment to the worker partly non-transferable and non-usable until he has been employed for some years. A generous pension plan might do the trick here. Indeed, as we have suggested elsewhere (Katz and Ziderman, 1987), a pension plan, a housing loan, school subsidies, may all be seen as methods of causing those workers self selecting to apply to the firm, to be more risk averse individuals. This reduces their mobility to new firms about which they have less information than their current one, and thus helps safeguard the firm's training investment.

Effects of changing interest rates:

A further issue emerges when interest rates change: a change in the rate of interest will at times affect L^P differently from L^0 and thus alter their ratio. Interest rates rising fairly soon after training may cause L^P to fall by a relatively large amount whilst the remainder of L^0 may decline by a relatively small amount. This might then cause the remainder of L^0 to exceed L^P, forcing the firm to raise wages and incurring a loss on its general training investment, T_F.[15/] A paradoxical phenomenon might then occur where an increase in interest rate raises the wages of certain parts of the labor force. This problem may be solved if, at least at the early stages of the post training period, L^0 is made to follow as closely as possible the time path of L^P or in any event, the financial arrangements of the early post

training period are rendered less sensitive to interest rates, perhaps by methods which have been developed in the finance literature (see Weston and Copeland, 1983 pp. 434-437).

Capital market imperfections:

The inability of workers to finance their training because of a lack of funds or a lack of access to capital markets may be circumvented if asymmetric training information is present. Since firms share in general training investments, a smaller burden of the finance of training falls on the worker, enabling him to train. This factor is especially important in developing countries where capital markets may be partial or missing altogether. In the absence of asymmetric information on the other hand training may not take place because of the worker's lack of suitable collateral and the firm's inability to provide a training loan to the worker because of the difficulty of ensuring loan repayments. Asymmetric information may thus solve the problem of market failure in the investment in general training.

Training sharing vs. loan agreements:

The consideration of capital market constraints introduces a new element into our discussion of training sharing. Whereas asymmetric information will do nothing to ease worker access to external loan markets, it does make possible the offering of a loan to the worker by the firm to finance the general training of the worker, as an alternative to sharing the benefits of training. Firms, and especially large ones which possess good credit worthiness and sufficient collateral, as well as possibly having implicit or explicit government guarantees against default, are likely to be able to obtain such funds.[16/]

Finally, consider the perception of L^P and the possible tensions between the training firm and the trainee in regard to this. It transpires that the way in which the worker will want the firm to view L^P may crucially depend on whether the worker and the firm are partners in paying for, and reaping the rewards of, the worker's training or whether the worker, as is the case just considered, essentially borrows the money for training from his firm.[17] If training is essentially an investment sharing procedure which, following most of the literature, is the assumption adopted in this paper, the worker will wish to own as large a share as possible in the training investment subject to his desire that some of the risks of training alluded to above are borne by the firm. To do this he will attempt to dissuade the firm from participating in the training investment by painting L^P to be as small as possible. This he can do by emphasizing to his training firm those factors that might serve as a training signal to a recruiting firm. Such signals may include visibility in his job, formal scholastic and training certificates he might be able to obtain in his spare time, and word of mouth information from firm to firm. In addition, the worker might try to convince the firm that the exogenous probability of his leaving is not insignificant, to further motivate the firm to reduce its investment share.

However, once the worker has been trained, he would like to squeeze the training firm still further by pointing out that L^P is even smaller than previously described, so that the training firm would have to raise his wage to avoid his leaving. Thus, both prior to and after his training he may have an incentive to reduce the training firm's perception of L^P as well as to increase its perception of the probability of his exogenous leaving.[18]

Contrast the above with the case in which the worker receives a loan from the firm for the purposes of financing his training, rather than entering into a sharing agreement with the firm. In this case his motivation is to maximize the loan by increasing the training firm's perception of L^P before he is trained, but to press the firm for higher wages by reducing the firm's perception of his L^P after he has been hired.

Thus, whereas the sharing agreement leads to a similar behavior pattern of the worker both before and after training, a loan from the firm to finance the worker's training leads the worker to alter his behavior after training.

V. Conclusions

In this paper we show that firms will assume a role in financing the general training of their workers, if training information is asymmetric between training and recruiting firms. Thus, in contrast to the classic Becker result that firms will finance only specific training because it is non-transferable to other firms, the inability of recruiting firms to immediately recognize the general training level of a new worker makes general training only partially transferable (or only transferable in the longer run) and thus gives training firms motivation to invest in it.

The main implication of this result is that the general training issue becomes, given asymmetric information, a central decision variable of the firm. The extent of the firm's participation in the finance of general training, the type of general training financed, the choice of lending workers money to train as opposed to being partners in the training investment, the interaction of training risk (in workers of unknown quality) with other risks and indeed the long run wage profile of a worker with general training as a function f the firm's extent and type of investment in his training, all become, given our analysis, part of the micro-economic theory of the firm and its legitimate realm of study.

References

Azariadis, C. "Implicit Contracts and Underemployment Equilibria",
Journal of Political Economy, December 1975.

Becker, G. Human Capital, 2nd ed., New York: National Bureau of Economic
Research, 1975.

Doeringer, P.B. and M. Poire. Internal Labor Markets and Manpower Analysis,
Lexington, Mass: D.C. Heath, 1971.

Donaldson, D. and B.C. Eaton. "Firm-Specific Human Capital: A Shared
Investment or Optimal Entrapment?" Canadian Journal of Economics,
August 1976.

Eckaus, R.S. "Investment in Human Beings: A Comment", Journal of Political
Economy, October 1968.

Fleisher, B.W. and T.J. Knieser. Labor Economics: Theory and Evidence,
3rd Edition, Englewood Cliffs, New Jersey: Prentice Hall, 1984.

Haltiwanger, J.C. "Asymmetric Information, Multiperiod Labor Contracts, and
Inefficient Job Separations", Southern Economic Journal, July 1983.

Hashimoto, M. "Wage Reduction, Unemployment and Specific Human Capital",
Economic Inquiry, December 1975.

Hashimoto, M. "Firm-Specific Human Capital as Shared Investment", American
Economic Review, June 1981.

Katz, E. and A. Ziderman. "Towards on Theory of Incremental Wage Scales",
Applied Economics, October 1986.

Marshall, A. Principles of Economics, 8th Edition, London: Macmillan, 1949.

Milgrom, P. and S. Oster. "Job Discrimination, Market Forces, and the
Invisibility Problem", Quarterly Journal of Economics, August 1987.

Mincer, J. "On the Job Training: Costs, Returns and Some Implications",
Journal of Political Economy, Supplement, October 1962.

Mincer, J. Schooling Experience and Earnings, New York: National Bureau of
Economic Research, 1974.

Mortensen, D.T. "Specific Capital and Labor Turnover", Bell Journal of
Economics, Autumn 1978.

Parsons, D.O. "Specific Human Capital: An Application to Quit Rates and
Layoff Rates" Journal of Political Economy, Nov.-Dec. 1972.

Penceval, J.H. "Wages, Specific Training and Labor Turnover in US Manufacturing Industries", *International Economic Review*, February 1972.

Rosen, S. "Learning and Experience in the Labor Market", *Journal of Human Resources*, Summer 1972.

Taylor, J. *Unemployment and Wage Inflation*, London: Longmans, 1974.

Weston, T.E. and J.F. Copeland. *Financial Theory and Corporate Policy*, Reading, Massachusetts, Addison Wesley, 1983.

Ziderman, A. "Costs and Benefits of Adult Retraining in the United Kingdom", *Economica*, November 1969.

Ziderman, A. *Manpower Training: Theory and Policy*, London: Macmillan, 1978.

Notes

1. Of course, the cost of the training may exceed earnings during the training period. Alternatively, the reduction of earnings by the cost of training may contravene minimum wage laws. In both these cases general training may not be feasible even if it is to be financed by the worker. A fuller discussion of this issue is given in Section IV; the traditional Beckerian theory of training, and applications, are outlined in Ziderman (1978).

2. There are, however, some dissenting voice : see Donaldson and Eaton, 1976 and Mortensen, 1978. A formal analysis of the specific training cost sharing model is provided by Hashimoto, 1981.

3. This is particularly relevant for cases where the pay back period on training investment is very short so that training costs may be recouped within a relatively short period following training (for some evidence on this see Ziderman, 1969).

4. Internal labor markets (Doeringer and Poire 1971), implicit contract theory (Azariadis 1975, Hashimoto 1975), labor hoarding (Taylor 1974), turnover and quit rates (Parsons 1972, Pencavel 1972, Haltiwanger 1983) to list but a few of these areas in which the specific training concept plays a central role.

5. See, however Rosen's 1972 paper, viewing the general training process in terms of an implicit market for training and learning opportunities that is dual to the market for jobs. That paper constitutes one of the notable developments of the theory of general training.

6. This difficulty of obtaining information about, and measuring the extent of, on-the-job training in firms is also reflected in the amount of data about this, which remain, at best, sparse. In addition, attempts by economists at measuring global costs of such training have had to be indirect and approximate, reflecting once again the difficulties outsiders have in assessing on-the-job training programs (See, for example, the classic studies of Mincer 1962, 1974).

7. The case of a worker's marginal product being easily determined is clearly a special case of general information about workers, being quickly and cheaply discovered.

8. Since the worker is better than the job he is doing, he will be producing a little more than the typical worker at that level. This surplus, which is a signal that he is better trained than his job and should be promoted, is profit to the firm.

9.   Note that the shaded area measures the social loss of the worker's
        move. Of course, it might be argued that based upon its long-term
        experience, the recruiting firm may be aware that newly recruited
        workers do, on average, arrive with _some_ amount of training and
        natural ability and hence, that it might pay such a worker a
        somewhat higher wage than W_u which takes into account the
        possibility that the new worker may have received general training.
        This means that a new and (unknown) worker would be paid somewhere
        in between W_T and W_u until his training level is ascertained. Note
        however, that this practice is unlikely to occur: paying unknown
        workers above W_u will have negative self selection effects as well
        as cause resentment amongst the firm's original, untrained
        employees. In addition, this practice might cause firms major
        longer run problems. Given that (nominal) wages are downward
        sticky, a recruiting firm may have difficulty in reducing the wage
        of the untrained worker to W_u once he is discovered to be untrained.
        Inflation, which erodes the real wage value of nominal wages, may be
        one solution to this problem, though not necessarily a reliable or
        timely one. Starting all workers, however briefly, at W_u, may
        therefore still be a better practice, especially given the
        mismatching problem.

10.   For convenience, we have assumed that training is instantaneous so
        that the relevant time span for the worker's productive years in the
        training firm is 0 to m. Other assumptions which allows training to
        take some time need not alter the essence of our results.

11.   For an interesting application of the concept of worker visibility,
        in another context, see Milgrom and Oster (1987).

12.   One solution to this problem of visibility and certification may be
        an implicit agreement between the training firm and its employees:
        once the firm has recovered its investment in general training the
        worker will be employed more visibly (sent to conferences, employed
        in demonstrating the firm's products etc.). Furthermore at this
        time the worker may be given certificates and other evidence of
        excellence at his job.

13.   The issue may, nonetheless, not be completely solved by the firm's
        ability to share in training costs. This is because the firm faces
        another constraint on its investment sharing, namely L^P, as
        discussed above. Hence, the firm's maximal investment $T_F(=L^F)$ _plus_
        the worker's legally permissible investment (i.e. that which would
        bring him down to the minimum legal wage) may still fall short of
        the amount required to pay for the full training desired. Thus,
        whilst given minimum wage legislation under asymmetric information
        as compared with symmetric information, will always reduce the
        training gap some part of this training gap may nonetheless persist.

14.   In addition the firm may protect itself by reducing L^P through
        choosing a higher discount rate to take account of the exogenous
        leaving risk. This, of course, will reduce the amount of a worker's

general training invested in by the firm.

15.   If interest rates fall, the training firm could, conceivably, reduce wages and still keep the worker. Given the downward stickiness of wages, however, this seems unlikely to occur. Hence, immunization against interest rate changes will increase the firm's profitability.

16.   Clearly those firms that are capable of financing the training of their workers by acting as financial intermediaries are likely to be large rather than small or intermediate in size. The trainers of workers are, therefore, going to be sizable, well established firms whereas the firms mainly recruiting trained workers are likely to be small, with relatively little in the way of financial assets. This process will be reinforced if there are economies of scale in the training of workers, a factor that will offer a cost advantage to larger firms in the training of workers.

17.   In the literature it is generally assumed that training loans by firms and investment in training by the firm are equivalent: see, for example, Fleisher and Knieser, 1984, pp. 334-6.

18.   Note, however, that this will not be labored or the worker may not get the job or training at all, on the grounds of the firm's hiring and firing costs.

Title	Author	Date	Contact
WPS149 Reflections on Perestroyka and the Foreign Economic Ties of the USSR	Bela Balassa	January 1989	N. Campbell 33769
WPS150 Improving the Currency Composition of External Debt: Applications in Indonesia and Turkey	Ken Kroner Stijn Claessens	January 1989	L. Chavarria 33730
WPS151 U.S. Trade Policy Towards Developing Countries	Bela Balassa	January 1989	N. Campbell 33769
WPS152 Subsidies and Countervailing Measures: Economic Considerations	Bela Balassa	January 1989	N. Campbell 33769
WPS153 An Analysis of Debt Reduction Schemes Initiated by Debtor Countries	Ishac Diwan Stijn Claessens	March 1989	L. Chavaria 33730
WPS154 Forecasting, Uncertainty and Public Project Appraisal	Jock R. Anderson	February 1989	A. Kitson-Walters 33712
WPS155 Measuring Adult Mortality in Developing Countries: A Review and Assessment of Methods	Ian Timaeus Wendy Graham	April 1989	S. Ainsworth 31091
WPS156 Credit Cooperatives in Israeli Agriculture	Yoav Kislev Zvi Lerman Pinhas Zusman	March 1989	C. Spooner 37570
WPS157 A Policy Model for Tunisia with Real and Financial Flows	Martha de Melo Marc Leduc Setareh Razmara	January 1989	A. Bhalla 60359
WPS158 Labor Redundancy in the Transport Sector	Alice Galenson	February 1989	W. Wright 33744
WPS159 Current International Gas Trades and Prices	Kay McKeough	March 1989	M. Fernandez 33637

	Title	Author	Date	Contact
WPS160	Evaluating the Performance of Public Enterprises in Pakistan	Mary M. Shirley	March 1989	R. Malcolm 61706
WPS161	Commodity-indexed Debt in International Lending	Timothy Besley Andrew Powell	March 1989	J. Raulin 33715
WPS162	Ups and Downs in Inflation: Argentina Since the Austral Plan	Miguel A. Kiguel		
WPS163	The Impact of Infrastructure and Financial Institutions on Agricultural Output and Investment in India	Hans P. Binswanger Shahidur R. Khandker Mark R. Rosenzweig	March 1989	J. Arevalo 30745
WPS164	Intersectoral Financial Flows in Developing Countries	Patrick Honohan Izak Atiyas	March 1989	W. Pitayatonakarn 60353
WPS165	Developing Countries' Exports of Manufactures: Past and Future Implications of Shifting Patterns of Comparative Advantage	Alexander J. Yeats		
WPS166	Achieving and Sustaining Universal Primary Education: International Experience Relevant to India	Nat J. Colletta Margaret Sutton	March 1989	M. Philiph 75366
WPS167	Wage Determination in Rural Bangladesh: The Welfare Implications	Martin Ravallion		
WPS168	Technological Change from Inside: A Review of Breakthroughs!	Ashoka Mody	March 1989	W. Young 33618
WPS169	Financial Sector Reforms in Adjustment Programs	Alan Gelb Patrick Honohan		
WPS170	General Training Under Asymmetric Information	Eliakim Katz Adrian Ziderman	April 1989	C. Cristobal 33640