Personnel training:
a theoretical and empirical review

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by

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26 May, 2004

Summary

This report provides an introduction to personnel training (on-the-job training) literature in the economics field. Theoretical models dealing with the initiation of training programmes and their effects on pay at the individual level are discussed, and empirical research on wage effects is reported. In addition, there is an overview of sources of data and the extent of personnel training in the EU and the United States.

Keywords: Training, human capital, investment, wage effect
JEL-codes: J24, J31

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1   Introduction

The development of skills, know-how and expertise (competences) in working life has attracted increasing attention in the labour-market research field. This area covers everything from leave of absence for study or organized in-company training programmes to personal experience and informal contacts with colleagues and fellow workers. This review of the literature in this field focuses on skills development in the "employment" context which is wholly or partially financed by the employer. In the following, the term *personnel training*, or simply *training*, is used to cover this.

The purpose of this review is to examine the theoretical and empirical research on the effects of personnel training at the individual level, and it is confined to personnel training in industrialized western countries. There is a special focus on the situation in Sweden, and this is compared with that in other countries. The empirical results concentrate on the impact of training on the employee's pay at the individual level. The impact on employee productivity and the company's performance is not analysed in detail in this study[1].

This review starts with an analysis of the factors that distinguish personnel training from other activities performed on a daily basis by employers and employees. This is followed by an account of traditional human capital theory and its predictions about the effects of personnel training at the individual level. The manner in which institutional factors in the labour market can affect training is discussed in this connection, and in particular the part played by trade unions. The next stage is presentation and discussion of the data on which many of the empirical studies are based. The extent of personnel training and the factors involved are described. Finally, a picture of how personnel training appears to affect the employee's pay levels is presented, based on theoretical predictions and the empirical data.

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[1] See Hansson, Johansson & Leitner (2003) for an overview of the impact on company performance. See Bartel (2000) for an overview of employee productivity.

2   Theoretical starting points

2.1   Special characteristics of personnel training

Pigou (1912) presents one of the first economic analyses of training and skills development in working life. He noted that, if the employee changed jobs and moved elsewhere, the employee's improved expertise would be transferred to other employers thus benefiting other employers but not the employer who had financed the training.

"Under a free economy … since workpeople are liable to change employers, and so to deprive investing [employers] of the fruits of their investment, the private net product is apt to fall considerably short of the social net product. Hence, socially profitable expenditure by employers in the training of their workpeople … does not carry a corresponding private profit." (Pigou, 1912, p 153)

Thus, personnel training gives rise to a positive external effect, since the employer's private return is less that the value of the training investment to society as a whole.

The construction of a new hydroelectric plant is a classic textbook example of a positive external effect because it benefits production in existing power facilities downstream. Hence, a positive (negative) external effect occurs if a company's production or the benefits for individual citizens increase (decline) due to activities undertaken by other companies or individuals, providing that such activities are not bought or sold in a market. There is an essential difference, however, between the hydroelectric plant example and personnel training. The power facility's positive external effect on power stations downstream does not reduce the power company's willingness to invest, providing the power company does not want to avoid benefiting a competitor for strategic reasons. In contrast, the employer's willingness to invest in personnel training is inhibited by the advantages that other employers may obtain from the programme. This is clearly because the value of the power company's investment in the power facility is not diminished by the positive

external effects, while this is clearly the case if there is no return on the employer's investment in personnel training[2].

Hence, the reason that the positive external effects of training inhibit the willingness to invest is because employees hold *ownership rights* over their expertise. Marshall (1920) noted that, in contrast with *physical* capital, an employer cannot own the employee's skills:

" *… whoever may incur the expense of investing capital in developing the abilities of the workman, those abilities will be the property of the workman himself: and thus the virtue of those who have aided him must remain for the greater part its own reward."* (Marshall, 1920, p 565)

The possibility that other employers can benefit from investment in personnel training made by another employer is referred to as a poaching externality[3]. This means that the employer's investment in personnel training is inhibited on the grounds of the employee's ownership of his or her skills, and the possibility that other employers may utilize the employee's recently acquired skills and know-how by recruiting the employee after completion of training programme.

In other words, ownership of the employee's skills and know-how cannot be bought or sold in a market, since a market of this type would involve serfdom and slavery. The employee's know-how capital is dependent on premises, equipment, trademarks and customer relationships which are the property of the employer. Without these tangible and intangible assets, the investment in human capital will often be of little economic value. The mutual dependence of the employee's and the employer's assets mean that personnel training is integrated with pay issues and other conditions of employment. Studies of personnel training inevitably involve studies of contractual conditions of employment.

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[2] Pigou added that the positive external effects are reduced in cases where production calls for a specialized labour force whose skills cannot be used by other employers. As a result, according to Pigou, employers' investment in training should be more common in workplaces of this nature.

[3] Cf poaching game or fish.

A further factor that distinguishes investment in personnel training from tangible or physical investment is that the labour market's evaluation of the employee's know-how may differ from the value placed on it by the parties responsible for an investment in training. In other words, the investment is *relation-specific*. Physical investments may sometimes also be relation-specific, for example investments in various stages of production in the manufacturing process. In this case, however, ownership rights can be reallocated as a result of mergers and takeovers, and the company's profit potential can be assessed on the stock market. On the other hand, the labour market's evaluation of the employee's know-how capital is inevitably based on the employee's switch from the original environment in which the investment took place. The labour market's evaluation of the investment will only comply with the value set on it in the workplace concerned if the personnel training programme is of a totally general nature, with universal application.

An additional factor, which follows from the two previous conditions, is that the training programme must be financed by the employee and/or the employee's current employer. Restrictions on the ownership of the employee's know-how makes it impossible to pledge this asset as collateral with a credit institute. Furthermore, the market value of the investment is subject to inadequate information about the employee's skills in the labour market.

As a result, these factors mean that personnel training is a complex investment, affecting the employee's pay structure, productivity, security of employment and other terms of employment. The literature in the economics field discusses how training affects conditions of employment and how conditions of employment affect incentives for training.

2.2 Human capital theory

2.2.1 The basic model: general and specific investment

Recent research in the personnel training field usually takes Becker's (1962, 1964) pioneering work on *human capital investments*[4] as its starting point. Becker's definition of Human capital investment is that investment in human

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[4] See also Schultz (1961), Mincer (1962) and Oi (1962).

capital consists of activities that affect future real income as a result of the acquisition of personal resources by human beings. As a result, it should be noted that training is only one of several possible activities which may have an impact on the individual's human capital. These activities range from school education to physical training and a healthy diet, which promote good health. Becker's analysis focused on training (*on-the-job training*) because this activity indicated particularly clearly how investments in human capital affect incomes, productivity, forms of employment and other economic variables.

Becker made a key distinction between *general* and *specific* training. General training may be applied by all employers who may decide to recruit the employee concerned, while specific training only enhances the employee's productivity in the workplace concerned[5]. This distinction had a major impact on subsequent literature in the field, and is still debated. Different consequences are predicted for future income and security of employment, depending on whether the training programme is general or specific.

2.2.2   Impact on pay

The basic assumption in Becker's analysis is a labour market subject to *perfect competition*. Neither the employer nor the employee has sufficient influence in the labour market to affect the employee's market wage or salary. All parties concerned are risk-neutral and have access to identical information about the employee's productivity. In a model in which personnel training is excluded, equilibrium occurs when the employee's wage rate is equal to the value of employee's marginal product in the workplace. If the employer establishes a level of wage rate which is less than the employee's marginal product, a competitor may offer higher wage rate and thus succeed in recruiting the employee. If, on the other hand, the employee demands higher pay than his or her marginal product, other employees would be prepared to work for lower

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[5] However, the distinction between general ability and specialized ability was already noted by Marshal (1920), p 207: "We may then use the term general ability to denote those facilities and general knowledge and intelligence which are in varying degrees the common property of all grades of industry: while that manual dexterity and that acquaintance with particular materials and processes which are required for the special purposes of individual trades may be classed as specialized ability".

pay. Parity between the employee's marginal value and the employee's wage rate means that the employer cannot make a profit.

Personnel training affects this equilibrium since it introduces an *investment cost* and *expectations about future revenues*. The investment cost consists of reduced production while the employee is involved in training activities instead of performing normal work assignments (*indirect costs*), and also expenditure for travel, course materials and course fees, etc. (*direct costs*). Expected future revenues consist of improved productivity in the workplace as a result of the investment in training. Once again, perfect competition in the labour market means that the employer cannot profit. In an equilibrium situation, over time the employer's total marginal revenues resulting from personnel training will be equal to the employer's total marginal costs, taking into account a given discount rate. However, in contrast with the previous situation, the employer's marginal revenue may differ from wage costs in specific time periods. This deviation of marginal revenue depends on whether the personnel training programme is general or specific.

According to Becker, a rational employer will not provide general personnel training unless the employee personally defrays the cost. Since general abilities have the same value, both in the outside world and in current employment, the market rate of pay and the employer's remuneration costs will increase after conclusion of the training programme. As a result, only the employee will be prepared to pay for general personnel training. This may be stated as follows:

General personnel training leads to lower initial wages and a more rapid rate of pay increase compared with similar work with no personnel-training element.

Hence, Pigou's theory under which the positive external effects of personnel training lead to inefficient training programmes in working life is contradicted by Becker's model, under which the employee makes an efficient investment since he/she receives the full return on the investment as a result of an improved market wage. Thus, according to Becker, the fact that the employer cannot own the employee's general human capital does not give rise to any form of inefficiency.

The outcome is different in the case of specific training, since the employee's productivity only increases in the workplace in question. This means that the employer and the employee expose themselves to a risk - if

employment is terminated after the training programme, there will be no return. The employer and the employee share this risk by sharing the cost of training and future revenues. Becker's intuitive explanation is that it could be initially assumed that the employer pays the entire cost of training and receives the entire return on the training investment. But if the employee changes jobs after completion of training, the employer's return is zero. In order to increase the employee's incentive to continue in his employ after completion of training, the employee will pay part of the training cost but will also receive part of the return. If, on the other hand, the employee pays the entire training cost and receives the entire return, the employee would run the risk of losing the return as a result of dismissal after completion of training. The parties' propensity to continue the employment relationship is maximized if investment costs and revenues are shared. The formal proof underlying this conclusion is presented by Hashimoto (1981). We would claim that:

Specific personnel training results in lower pay initially and a more rapid rate of pay increases compared with equivalent tasks with no training, although to a lesser degree than would be the case for general training (assuming the same improvement in productivity), and only in the current employment situation.

2.2.3   Why should employers finance general personnel training?

Fundamental human capital theory assumes that the employer will defray all costs relating to *general* training, but will also receive all the financial benefits generated by skills-training in the form of increased pay. This establishes the prerequisites for a utility-maximizing individual to choose the efficient volume of personnel training, in which the employee selects general training that ensures that the marginal investment cost is equivalent to the marginal expected future revenue. In the case of specific training, the employer and the employee will instead maximize the expected return by sharing the investment cost and the expected revenues.

But, in practice, the employer normally pays part of the cost for general personnel training, despite the fact that the return is controlled by the employee. What is the explanation for inefficient personnel training of this nature?[6]

Perhaps the most obvious reason for payment of general training by the employer is that the employee has limited opportunities to finance his/her share of the training costs. No doubt, the employee could apply for a bank loan, but in this case the bank would require collateral in the form of a property mortgage or securities. The employee may have no such securities, or own securities representing insufficient collateral. The employer, on the other hand, may often be in a position to pledge the company's plant, properties, etc. In addition, the bank will require a rate of interest that exceeds the corresponding interest rate for the employer.

The difference in interest rates is due to asymmetry in information between the bank and the employee as regards the employee's risk propensity and the prerequisites for repayment of the loan. Presumably, the employer is better informed about the employee's possibilities of achieving higher productivity after the training programme, and hence repayment of a loan to the employer is a safer proposition, with a lower rate of interest.[7]

In the light of this, it is rational to let the employer act as a credit institute on the employee's behalf by giving the employee higher pay during the training period than the low rate of remuneration that would be required to pay training costs in full, and then postpone the subsequent pay increase. As a result, general personnel training and the employee's limited liquidity lead to a

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[6] This inefficiency can take three different forms. Firstly, personnel can receive training, but to an inadequate extent. Secondly, training may be confined to an inadequate proportion of the personnel, and thirdly personnel may receive the wrong type of training. In order to simplify the arguments, no distinction is made between these three forms of inefficiency.

[7] In addition, the bank may be unwilling to offer the employee credit in any form. Stiglitz & Weiss (1981) describe the way in which a restricted credit market occurs as a result of the lender's inadequate information about credit risks. A higher level of interest would attract borrowers with a high risk propensity and encourage high-risk investments, but this would reduce the lender's expected return. As a result, the interest level is less than the level at which supply and demand are in equilibrium in the credit market. Instead, bank lending is limited by refusing to grant loans for certain purposes. Loans for human capital investments are a clear example of an area of this nature.

remuneration pattern which is similar to that for specific personnel training. However, in contrast with specific training, the employer is exposed to the risk of losing the return on the investment in general personnel training if the employee resigns. This risk calls for a risk premium which reduces the employee's investment in general training to a level which is lower than the employee would choose if he/she was able to borrow from the bank at the same rate of interest as the employer.

Asymmetry of information in the labour market is another reason for financing of general personnel training by the employer. The improvement in the employee's skills is often not sufficiently clear to other employers. As a result, the employee will not receive the full social value of the investment in training if he/she changes jobs. New employers will receive benefits that are not reflected in terms of the price in the labour market, due to asymmetry of information between employers and the employee's level of general know-how.[8] This reduces the employee's incentives to invest in general training.

Barron, Berger & Black (1999a) pose the fundamental question of why the parties concerned do not take steps to avoid asymmetry of information between current and potential employers regarding the contents of the training programme by implementing certification and course documentation specifying the training completed by the employee. Why not issue diplomas in the same manner as for upper secondary and university education? In this context, the authors denote a fundamental difference between secondary and higher education and personnel training. In school and university education, the employee is in the best position to determine the occupational focus and future income potential, in line with his/her personal prerequisites. Students select the course programmes in which they wish to participate, and they finance their participation by means of grants, loans or savings. In the case of personnel training, however, the employer is normally in the best position to identify skills requirements in the workplace, and to envisage potential gains as a result of investment in personnel training. Barron, Berger & Black consider that the employer has a paramount role to play in matching the employee with the optimum training programme. This raises the question of what makes the employer get involved in planning suitable training for employees. Apparently,

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[8] See Bishop & Kang (1996) and Bishop (1997), p 60.

the absence of certification of completion of personnel training is the factor that guarantees the employer's commitment. The reasons are as follows.

The employment contract between the employer and the employee is regarded as a *principal-agent relationship* when considering the planning of training programmes and the matching of employees with programmes. The employee is the principal who assigns his agent, the employer, to plan and choose the best training strategy. The asymmetry of information between the employer and the employee gives rise to some problems, however. The employee cannot be certain of the extent to which the employer is genuinely involved in finding the optimum personnel training programme. As a result, the employee must undertake to reward the employer in a credible manner and share the return on the training investment when the employer presents the most advantageous training option. Barron, Berger & Black wonder if such a promise can be credible in the case of general training. Once the optimal training has been conducted and the employee has received a higher market wage, it will be rational for the employee to abandon the original agreement concerning sharing the gains.

In the principal-agent relationship literature, the standard solution for this problem of incentives is that the principal sells the assets and means of production which provide ownership of the difference between the gain/profit and the investment cost to the agent, thus making the agent a "*residual claimant*". However, in the case of personnel training, this is impossible since the sale of human capital would be equivalent to slavery. The principal (the employee) must, in accordance with established legal principles, own the asset concerned (human capital). According to Barron, Berger & Black, the solution is to convert general training into specific training. This is achieved by actively hiding the content of the training programme from other employers, or by forming the course content in a manner which restricts its utilization in other workplaces. The result is that certification of personnel training is of no interest. By replacing general personnel training with a specific variant, the employee can undertake, with credibility, to compensate the employer's investment in the matching and planning of the personnel training activity concerned. This model thus continues to be based on a labour market subject to perfect competition. Instead, the focus is on the contractual difficulties which lead to the specific training programme chosen by the parties concerned, together with the resultant consequences for future remuneration.

2.3 Imperfect competition in the labour market

2.3.1 A compressed wage structure

Several theories which explicitly take into account imperfect competition in the labour market have been presented in the 1990s. Transaction costs and imperfect competition place the employer in a stronger position in pay negotiations with the employee. The employee can negotiate a level of pay which is less than the employer's marginal product in the workplace. As a result, the wage level will increase more slowly than the value of the marginal product after training – in other words there is a *compressed wage structure* in relation to the employee's skills and know-how. In its turn, this implies that the employer has incentives to finance general training, irrespective of possible liquidity problems on the part of the employee or other contractual problems.[9]

In addition, this compressed wage structure means that personnel training gives rise to positive external effects, since other employers can utilize investments in training made by the employer concerned without paying higher wages/salary, thus restoring the relevance of Pigou's (1912) original theory – the positive external effects of personnel training and imperfect competition in the labour market mean that neither the employer nor the employee receive the overall societal benefits (revenue) of personnel training. The employee does not receive a pay increase which corresponds to the increase in productivity. In turn, the employer receives a marginal increase in revenue after personnel training which is lower than the employee's marginal increase in productivity. This is due to three factors:

(i)   The employee's market wage rises after personnel training, even if it rises at a slower rate than the employee's productivity in the workplace.

(ii) The employee may demand part of the surplus created between the value of the marginal product and the market wage, depending on the relative negotiation strength of the employer and the employee.

(iii) The employee will tend to terminate his/her employment, with a certain degree of probability.

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[9] See Acemoglu & Pischke (1999a), p 120.

Hence, it may be established that personnel training is probably inefficient. The reasons for this inefficiency are open to interpretation. According to traditional human capital theory, the employer's incentives for financing general training diminish due to contractual problems between the employer/employee.[10] According to institutional theory, the employer's incentive to finance general personnel training is instead reduced by the three factors (i)-(iii) listed above.

2.3.2 Positive external effects of personnel training

There are number of possible reasons why personnel training gives rise to positive external effects. Information asymmetry between employers and the employee's general level of skills and know-how is one possible reason, since the employee's higher productivity is not fully reflected in the market wage.[11] The employee's costs for looking for new employment (search costs) also give the current and the potential employer an advantage in pay negotiations, enabling them to exploit the employee's general know-how.[12] Burdett & Smith (1996) discuss an additional form of external effects, in which the employee's and the employer's search costs in a recruitment context are taken into account. In this model, the employee and the employer negotiate pay, taking into account their respective alternative incomes in the event of breakdown of negotiations. If employees embark on on-the-job training, the employer's access to skilled labour increasees which, in its turn strengthens the employers' negotiation position on pay issues. This results in a lower level of pay, thus reducing the employees' expected return from training. Thus, personnel training generates a *matching externality* as a result of the employee's reduced expected return on the investment.

It should be added that the positive external effects of personnel training may also benefit the current employer. In the case of further training of personnel in various forms of information and communications technology (ICT) – for example the utilization of e-mail, the Internet and the company's

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[10] See Section 2.2.3.
[11] The concept of the significance of asymmetrical information for imperfect competition and employers' financing of general personnel training was introduced by Chiang & Chiang (1990), Katz & Ziderman (1990) and Chang & Wang (1996).
[12] Se Acemoglu (1997).

intranet – improved communications within the company will give rise to revenues that exceed the employees' higher productivity at the individual level, thus creating *network externalities*. The financing of ICT personnel training will be paid for by the employer, since only the employer can coordinate the necessary training measures, due to asymmetry between employees and their employer regarding the best ways of enhancing productivity in the workplace as a result of ICT. The employer also benefits from the network externality of personnel training. If the employee was to pay for training, this would be on an inadequate and inefficient scale. This type of positive external effect provides a further explanation of the reason for the employer's financing of general personnel training. The normal source of inefficiency occurs when an employer finances general personnel training involving skills which can benefit other employers. The employee's higher market wage and the increased risk of recruitment by other employers reduce the employer's incentive to give employees ICT training.[13, 14]

2.3.3 The complementary characteristics of personnel training

Other reasons for the financing of general personnel training by employers are based on the complementary relationship between general training and other investments or activities undertaken by the employer or the employee These complementary investments/activities increase the return on general training. But if these complementary elements are not reflected in the market price, perfect pricing of personnel training will not be achieved.

Specific personnel training
Acemoglu & Pischke (1996b) show that if specific personnel training increases the marginal return of general training in the workplace, training which

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[13] See Bishop (1997), p 61-62.

[14] Training can also give rise to positive external effects for society as a whole. An innovation or improved performance in the workplace as a result of regular personnel training activities increases the consumer surplus for all consumers who pay the same price, irrespective of the product's quality. An extreme case is an airline pilot who manages to land a damaged passenger plane safely as a result of recurrent simulator training. Also small quality differences which the consumer does not notice and which, as a result, are not reflected in the price can often be traced to differences in the scope of personnel training. See Bishop (1997), p 60-61.

contains both specific and general elements will increase employee's productivity more rapidly than his/her market wage. This gives the employer a stronger position in future pay negotiations, thus encouraging the employer to finance general training. The continuing sources of inefficiency are the employee's negotiating strength in future pay negotiations and the risk that the employee, nonetheless, resigns.[15]

Another reason for financing by the employer and the associated inefficiency, is that certain types of general know-how represent a specific combination for the company concerned.[16] This may, for example, involve the ability to cope with a given combination of computer software. Other employers may be able to benefit from each software program, per se, but the particular combination of programs is only used at the specific workplace concerned.

Stevens (1996) stresses that, on the whole, know-how tends to be neither completely general not fully specific, in the manner assumed in fundamental human capital theory. She considers that, instead, the employee's know-how is more or less transferable to other employers. This gives rise to imperfect competition in the labour market, in which competing employers gain if they recruit trained personnel.

The employee's capacity
The efficiency of personnel training is also affected by the employee's capacity and prerequisites for the acquisition of new know-how and expertise. The complementary relationship between further training and individual capacity leads to an information advantage for the employer regarding the value of personnel training, compared with other potential employers. The current employer is more aware of the employee's capacity and, as a result, the employee's wage rate will be lower that the value of his/her marginal product. As a result, other employers are faced with a selection problem which the current employer can exploit in determining the rate of pay. Acemoglu & Pischke (1998) show that the lower market wage probably reduces the likelihood that the employee will terminate his/her employment after completion of the

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[15] See factors (i)-(iii) above.
[16] See Bishop (1997)

training programme, and that this encourages the employer to provide general training programmes.

Malcomson, Maw & McCormick (2000) indicate that an apprenticeship system may be justified on the basis of the supplementary relationship between personnel training and the employee's capacity, and also the difficulty of specifying in advance in the employment contract what the employee's on-the-job training should include. Even if undertakings are made about what the employee is to learn, in practice it is impossible for an outsider to find out whether or not the contract has been fulfilled. Hence both sides can deviate from the contract without risking repercussions in a court of law. In contrast, an apprenticeship system may provide credible guarantees that the employee's training programme will be fulfilled. The parties can commit themselves in advance to a high rate of pay after completion of training, and they can decide how long the training period should be. Continued employment after the apprenticeship period gives other employers a clear signal that the employee/-apprentice has a genuinely high capacity, since the employer has no reason to retain apprentices with a low capacity at a high rate of pay. Hence, apprentices with a high capacity are guaranteed a higher market wage after completing their training, and they will therefore accept a lower initial rate of pay during the apprenticeship period.

Autor (2001) indicates that a similar mechanism may be at work in general training programmes in manpower companies. The manpower company provides computer training free of charge, despite the fact that the employee will move on elsewhere. But training gives better results for people with a high capacity, and this means that the manpower company can offer training at a limited rate of pay which only attracts the most suitable employee categories. People with lower capacity do not find it worthwhile to complete the training programme since their future pay will probably fail to match that of the most talented staff. This selection process is beneficial for employers who are customers of the manpower company and, as a result, the manpower company can charge the employer a fee which corresponds to the cost of personnel training.

The employee's commitment and efforts
In addition to the employee's individual capacity, training is also influenced by the employee's degree of commitment and effort in the training investment process. If the employee knows that he/she will receive the entire return from

training, commitment is hardly a problem. Once again, it is the limited ability of the employment contract to specify future events in a credible manner which gives rise to problems in the incentive area. Employees cannot be certain that they will be rewarded for their participation and involvement in personnel training, and the employer cannot be certain that the employee will make a genuine effort. These uncertainties lead to a mutual need for reliable promises and undertakings – for example a guaranteed minimum wage rate after completion of training, as discussed by Loewenstein & Spletzer (1998). A pay guarantee can be monitored by outsiders and, as a result, it is a credible undertaking. The employer is prevented from recouping a future surplus which should actually be allocated to the employee. In addition, a pay guarantee ensure that the internal wage structure is compressed – in other words the level of pay will have a lower degree of correlation with individual productivity, thus giving the employer incentives for financing general training.

The wage structure can also be compressed to safeguard the employee's degree of commitment in line with *efficiency-wage theory*. Acemoglu & Pischke (1996b) show that if the level of pay after personnel training is below a certain level, the employee will have an incentive to shirk in the workplace, notwithstanding the risk of discovery and possible dismissal. A specified rate of pay guarantees the employee's efforts. The compressed internal wage structure leads to financing of general training by the employer.[17,18]

Physical capital
The employee's incentive to invest in personnel training may also be affected by the extent to which the employer invests in machinery and new technology. These strategic considerations may be channelled via the complementary relationship between *human capital* and *physical capital*. Acemoglu (1996, 1997) analyses a model in which the employee's human capital (*H*) and the

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[17] Acemoglu & Pischke (2000) show that the certification of apprenticeship programmes can increase the employer's involvement in the programme in a corresponding manner.
[18] It may be noted that the problems linked with the employee's hidden commitment (moral hazard) lead to a compressed wage structure in the workplace, in contrast with imperfect competition in the labour market, which results a compressed wage structure between workplaces. However, if other employers in the labour market have a similar pay structure, the entire labour market will be characterized by a compressed wage structure.

physical capital (K) are part of the company's production function (F), in which $F = (H, K)$ and there is technical complementarity between H and K, so that $F_{12}(H, K) > 0$. Imperfect competition in the labour market reduces the employee's private return as a result of personnel training, resulting in a reduction in the investment in H.[19] In its turn, a reduction in the investment in H reduces the company's return on capital investment, K. Reduced capital investment results in reduced scope for wages, since F is declining. Hence the complementary relationship between H and K leads to a strategic decision regarding a commitment to personnel training – the employee reduces (increases) his/her investment in training when the employer's level of investment declines (increases). As a result, economies with similar technology and institutional structures may wind up with different levels of know-how and growth rates, due to accidental circumstances or differences in the original assets in capital and training systems.

2.4   Trade unions

The employee's membership of trade union organizations is one of the institutional factors that affects personnel training. There are theoretical argu-ments suggesting that union membership both hinders and encourages invest-ment in personnel training.

According to fundamental human capital theory, the employee pays for general personnel training in the form of lower remuneration during the training period. The employee has an incentive to implement the investment as a result of the expected increase in pay after completion of the training programme. Mincer (1983) considers that trade union pay agreements in which pay is established in line with the length of employment instead of individual

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[19] Imperfect competition in the labour market is modelled by assuming that the employee receives a proportion β $(0 < \beta < 1)$ of production, while the employer receives a proportion which is $(1 - \beta)$. The employer chooses K_e to maximize $(1 - \beta)F(H_e, K) - rK$, in which r is the cost of capital, while the employee chooses he to maximize $\beta F(H, K_e) - c(H)$, in which $c(H)$ is the cost of training. This results in the equilibrium condition $(1 - \beta)F_2(H_e, K_e) = r$ and $\beta F_1(H_e, K_e) = c'(H_e)$, which produces lower levels of K and H than in a market with perfect competition. In a labour market with perfect competition, the employee's level of training is determined by the market wage w, so that $w = c'(H^*)$. In this case, the equilibrium is determined by levels of K and H that maximize $F(H, K) - rK - wH$, resulting in the equilibrium condition $F_2(H^*, K^*) = r$ and $F_1(H^*, K^*) = w$.

performance reduce the employee's incentive to invest in general training. On the other hand, trade union membership results in reduced flexibility for the company among its employees, thus increasing the employer's incentive to invest in specific training. Hence, fundamental human capital theory indicates that the impact on the extent of personnel training is determined by the balance between reduced pay dynamics and longer periods of employment.

The outcome of this process depends on the factors governing the actions of the trade union. The traditional theoretical assumption is that the union follows majority decisions, thus maximizing the benefits for the median member. According to Grossman (1983), pay will be established at a level which balances the median member's utility resulting from increased pay with the risk of dismissal due to low profitability. Since the median member has greater security of employment than new employees, the increase in utility for older employees is achieved at the expense of their younger colleagues.

Ways in which this conflict of interest between different generations in the workplace may affect personnel training is discussed in more detail by Weiss (1985). Weiss assumes a model based on two generations of employees: older and younger. The older employees can influence requirements for the training of younger employees and, in practice, this is a tool which enables older employees to influence the recruitment of new employees, and their productivity and level of pay. In addition, the union sanctions transfers from the younger generation to the older in the form of a pay system based on seniority, minimum wages for new employees, priority rules in the event of redundancy and different work schedules. Weiss shows that, if there is no limit on these transfers between younger and older employees and there are no restrictions regarding the size of younger employees' transfer payments, the long-term level of personnel training for younger employees will meet the model's efficiency criteria. If, on the other hand, transfers are limited in view of the ability of younger employees to make transfer payments, the older employees will require inefficiently protracted and demanding training for younger employees. Training may be excessively extensive, for example, making irrelevant demands on school education requirements, with long waiting periods for examinations, long apprenticeships and a high proportion of examination failures. The reason why the older generation insists on this type of inefficiency and excessively high educational standards is that, where restrictions apply, they can only increase transfers from younger employees by increasing the number of younger employees in the workplace. In order to

avoid pressure on levels of remuneration from a greater number of younger employees due to the increased supply of labour, the older employees will introduce high educational and training requirements in order to reduce the younger generation's productivity during the training period.

Barron, Fuess & Mark (1987b) point out that Weiss' model may result in *lower* educational and training requirements by older trade union members. The only modification required is to specify the restriction for transfers from younger employees to older employees as a minimum wage floor. This means that older employees can increase transfers from their younger colleagues by raising their current productivity in the workplace. This increased productivity is achieved if younger employees devote less time to l training and more time to their normal work. Thus, the older employee's strategy for increasing their incomes is to *reduce* younger employee's work contribution, thus increasing the scope in terms of pay for older employees to *increase* the work input by younger employees and redistribute increased productivity to older employees. Barron, Fuess & Mark consider that this model mainly applies to occupations in which older employees can influence training requirements for younger employees (for example doctors). In other occupational areas, with lower requirements for experience and specialist expertise, older employees may be afraid that they will be replaced by younger trainees with lower pay and higher productivity. In this case, the union's strategy is to lift trainee pay rates to a minimum level in order to reduce competition from younger employees.

Thus, the presence of trade union organizations may reduce the supply of general training due to union minimum wage for new employees and personnel employed on a temporary basis. As a result, the employer will not pay for general training in exchange for low initial rates of pay.

But trade union membership can also encourage training. Reduced mobility due to increased redundancy costs will increase the employer's incentives to invest in firm-specific training. Freeman & Medoff (1984) consider, in addition, that union membership gives employees an opportunity to express dissatisfaction with working conditions (*a voice*), instead of "voting with their feet" and leaving the company (*exit*). In situations in which employees can express their views on equal terms in negotiations, the employer will be in a better position to draw up a personnel policy which will reduce staff turnover. A more stable relationship between the employer and employees will reduce the risk that the employer's investment in personnel training benefits other employers. In its turn, a reduced *poaching externality* increases the employer's

propensity to finance both general and specific personnel training. The fact that the median union member is less inclined to change his/her employment than new employees is a further argument for increased personnel training with union participation. In negotiations between the trade union and the employer, the union will represent median members and, if a balance between specific training and other benefits and improved working conditions is to be achieved, the median member's preferences will have greater priority than those of new employees. Since the median member has a long expected employment period, the parties in the negotiation will give priority to specific training rather than other benefits which might be preferred by new employees and other less permanently established employees. In line with this theory, Boot & Chatterji (1998) demonstrate in a model that union participation in pay negotiations reduces the likelihood that the employee will change jobs, and this results in increased personnel training.

Acemoglu & Pischke (1996b) emphasize that trade union pay negotiations establish the necessary compressed wage structure which guarantees a return on general training for the employer. Hence, general personnel training may be more efficient, due to the union's ability to separate pay issues from the volume of training. Booth, Francesconi & Zoega (2002) present an alterative explanation in which central trade union agreements at the industry level for both pay and personnel training permit the allocation of the surplus from training to employees, in the form of both higher pay and more personnel training.

3   Sources of data

3.1   Measuring personnel training

The collection of data about personnel training calls for questionnaire surveys, since information about training is seldom recorded in a register format.[20] Questionnaires can be directed both to the employee, with questions about

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[20] There are exceptions in the personnel databases for individual companies to which researchers have had access. See Bartel (1995), for example.

training programmes completed recently in a given period or employment, and to the employer, with questions concerning the extent of personnel training in the workplace.

Certain fundamental characteristics of the training programme should be taken into account if the quality of this data is to be analysed in greater detail. (See Figure 1) Training may either take place in the workplace (*on-site training*) or elsewhere (*off-site training*). In some cases, the questionnaires distinguish between these forms of training. If training takes place in the workplace, this may, in its turn, be in a formal format (courses, seminars, etc.) or in an informal context (instructions from fellow employees, etc.) The definition of these formats may vary from one questionnaire to another. Some questionnaires make no distinction between formal and informal training, while others exclusively target formal personnel training. Finally, training may be general, specific, or a combination of the two. There are questionnaires in which the questions are formulated in a manner designed to clarify this, while other questionnaires leave this aspect open.

In addition, questionnaire surveys may have different sample populations. For the most part, the questions are directed to participants in the private sector. This is often quite natural, since the assumption about profit-maximizing companies is a cornerstone in human capital theory. In addition, questionnaire surveys often have to choose between workplaces with a limited number of employees or major workplaces, and breaking down the data by the employee's gender and age-group or by his/her level of education.

A further difference between questionnaires is the reference period for the training in question. Questions may focus on current training, but they are normally posed retrospectively, covering previous training during a given period – in which the length of the period is also inclined to vary. In addition, the questionnaire may be confined to current employees, or it may include previous employees.

The results of questionnaires targeted at employees differ to some extent from those addressed to employers. Recent surveys match employers and

employees in an attempt to evaluate these differences. However, initially our focus is on questionnaires exclusively addressed to employees.[21]
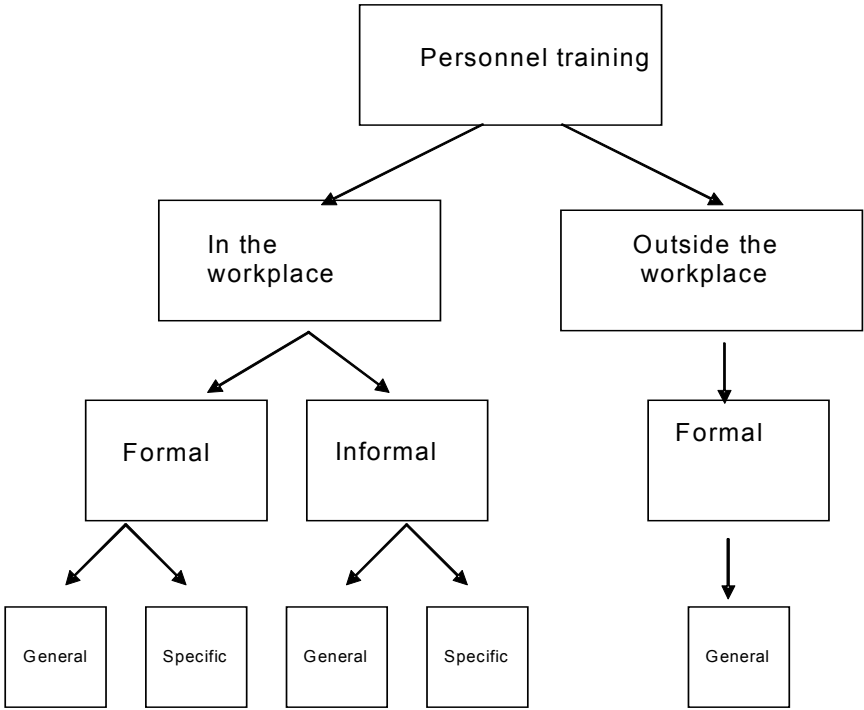
Figure 1 Chart depicting the characteristics of personnel training

3.2   Questionnaires addressed to employees

Table 1 depicts a selection of the commonest sources of data based on questionnaire surveys addressed to employees.

Duncan & Hoffman (1979) is a pioneering study which uses the *Panel Study of Income Dynamics* (PSID) to analyse ways in which training influences wage and salary developments. The question posed in PSID does not provide direct information about whether the individual in question is currently participating

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[21] See also Lynch (1998) for an overview of US data.

in, or has participated in, some form of personnel training and, in this case, how long the training has continued. Instead, a "*Whether Training for Current Job*" variable is constructed by comparing the stated time required for an average person to be fully trained, and the period of employment for the person concerned. If the period of employment is less that the period for full acquisition of skills, it is assumed that the person concerned is participating in some form of personnel training. Several other household-based questionnaire surveys have been modelled on PSID. The question about how long it takes for an average person to be fully skilled is included in the Swedish *Household market and non market activities* (HUS) survey, for example, and there is a similar question in the Swedish *Levnadsnivåundersökningen* (LNU) standard of living survey.

The *National Longitudinal Survey* (NLS) was one of the earliest surveys which asked employees direct questions about training in their current jobs. Respondents who stated that they had participated in training were asked about the longest type of training in which they had been involved since the previous interview. The location of training and its structure were broken down into three alternatives:

(i)   In- company schools or courses,
(ii)   Business, technical and vocational schools,
(iii)   Traditional schools, colleges and universities.

In other words, the questions primarily focused on formal training, which might be located either in the workplace or elsewhere.

Several subsequent surveys using panel data contain questions about personnel training since the last interview took place, for example the *National Longitudinal Survey of Youth* (NLSY), the *European Community Household Panel* (ECHP), the *British Household Panel Survey* (BHPS) and the Swedish *Arbetskraftsundersökningar* (AKU) labour force surveys. Cross-section surveys employ a variety of periods for retrospective questions about training programmes completed. The *Current Population Survey* (CPS) covers the period since the respondent started his/her most recent job. The French *Enquête sur la Formation et la Qualification Professionelle* (FQP) is interested in the last five years and the *British Social Attitudes Survey* (BSAS) in the last two years, while the Swedish *Undersöking av levnadsförhållanden* (ULF) living conditions survey focuses on the three previous years. There are also panel data surveys that specify a period which is not related to the previous interview. The

National Longitudinal Survey of the High School Class of 1972 (NLSHS72) specifies the period since the respondent started his/her most recent job, while the *German Socioeconomic Panel* (GSOEP) asks about the most recent three-year period.

All these surveys, with the exception of BHPS, BSAS, FQP and ULF, ask whether training has taken place in the workplace or elsewhere. The British BHPS survey asks whether the reason for personnel training was:

(i)   Introduction to present job,
(ii)   Skills improvement in current job, for example by learning new technology,
(iii)   Preparation for future jobs,
(iv)   Development of skills in a general sense.

These alternatives provide some indication of where the training took place – alternative (i) probably occurs at the place of work, while alternatives (ii) – (iv) are likely to take place elsewhere, to a large extent. There are no alternatives in BSAS, FQP and ULF which might provide some guidance.

Most surveys only report formal training, mainly due to the manner in which the questions are formulated and the absence of alternative answers reflecting more informal types of training. There are exceptions, however, in CPS, BSAS, NLSHS72 and NLSY from 1993. CPS asks what training and education was required to get the job in question, and what training is required to improve skills in the current job. In this context, the location and structure of the training programme is broken down by:

- in-company schools and courses,
- traditional schools and universities,
- informal training in the current job,
- informal training and experience in the previous job which were required to get the current job.

BSAS asks whether the respondent has participated in some form of informal training by:

- being asked to perform some task simply to get experience and learn the task in question,
- someone talking about the work or providing training,
- being placed with more experienced personnel to see how the job should be done,

- being shifted between different departments to see the work they do,
- being asked to read certain materials in order to learn the job,
- being taught by someone else in connection with the performance of tasks.

In NLSHS72, training is broken down into:
- apprenticeship positions,
- training in working hours in premises in the workplace,
- informal training (e.g. working alongside someone who instructs and demonstrates),
- training in working hours outside the workplace,
- financial support for training outside working hours.

Table 1 Questionnaires about personnel training addressed to employees

	Sample	Sample period	Number of observations	Data collection method	The questions	Key studies
Study of Income dynamics (PSID) US	Panel data, nationally representative sample, men and women aged 18-64 who worked at least 500 hours in the preceding year.	1976, 1978, 1985	Approx. 5 000	Interviews with the main household provider. Separate interviews with both men and women in the case of married couples.	*"On a job like yours, how long would it take the average new person to become fully trained and qualified?"*	Duncan & Hoffman (1979) Brown (1989)
National Longitudinal Surveys (NLS) US	Panel data, young men and women aged 14-24, women aged 30-44 and men aged 45-59 in 1996.	1967 -1981	Approx. 3 000	Interviews at intervals of 1, 2 or 5 years.	*"Do you receive or use training (other than schooling training) on your job?"* *"What was the longest type of training you have had since the last interview?"*	Mincer (1983) Lillard & Tan (1992)
Current Population Survey (CPS) US	Cross-section, nationally representtative sample, private sector employees aged 25-64.	1983, 1991	Approx. 10 000	Supplementary interviews for continuous surveys	*"What training was needed to get the current or last job and what training is needed to improve skills on the current job?"* (1983) *"Since you obtained your last job, did you take any training to improve your skills?"*(1991)	Lillard & Tan (1992)
National Longitudinal Survey of Youth (NLSY) US	Panel data, men and women aged 14-22 in 1979. Black and Spanish-speaking groups are over-represented.	1979 -	12 686 (1979)	Annual interviews 1979-1994, subsequently every other year.	*"In addition to your schooling, military and government-sponsored training programs, did you receive any other types of training for more than one month?"* (1979 – 1986)	Lynch (1992) Veum (1993, 1999) Loewenstein & Spletzer (1999a)

	Sample	Sample period	Number of observations	Data collection method	The questions	Key studies
National Longitudinal Survey of the High School Class of 1972 (NLSHS72) US	Panel data, graduated from high school 1971-72, with a full-time job between 1979 and 1986.	1986	22 652 (1972) 12 841 (1986)	Interviews in 1979, subsequently 5 follow-up interviews. Included questions about training in 1986.	*"Considering the most recent full-time job you have held, did you receive or participate in any type of employer-provided training benefits or programs?"*	Altonji & Spletzer (1991)
European Community Household Panel (ECHP) EU	Panel data, representative sample from EU countries.	1994 -	Approx. 80 000	Interviews organized at the national level, joint questionnaire for all countries.	*"Have you at any time since January been in any vocational education or training, including part-time and short-courses?"*	Brunello (2002) Bassanini & Brunello (2003)
Enquête sur la Formation et la Qualification Professionelle (FQP) France	Cross-section, representative sample, men and women aged 20-64.	1993	Approx. 18 000	Interviews in 1964, 1970, 1977, 1985 and 1993.	*"Have you participated in any employer-provided training programs between the beginning of 1988 and the beginning of 1993?"*	Hocquet (1999) Goux & Maurin (2000)
German Socio-economic Panel (GSOEP) Germany	Panel data, nationally representative sample, men and women aged 16-64. Immigrants from Turkey, Italy, Spain, Greece and Yugoslavia are overrepresented.	1989	Approx. 4 500	Annual interviews since 1984. Included questions about training in 1989.	*"There are various possibilities for work-related training. Thinking about the past three years, for your own job related education, have you read books and journals, participated in conferences and congresses, or participated in work related courses?"*	Pischke (2001)

	Sample	Sample period	Number of observations	Data collection method	The questions	Key studies
British Social Attitudes Survey (BSAS) UK	Cross-section, nationally repre-sentative sample.	1987	Approx. 1400	Interviews	*"In the last two years, have you been on any courses or had any other formal training, which was part of your work or helpful to your work?"*	Booth (1991)
British House-hold Panel Survey (BHPS) UK	Panel data, nation-nally representative sample.	1991 -	Approx. 10 000	Annual interviews since 1990. More detailed questions about training introduced in 1998.	*"Have you taken part in any other training schemes or courses at all since September 1st last year or completed a course of training which led to a qualification?"*	Booth & Bryan (2002) Booth, Francesconi & Zoega (2003)
Household market and non market activities (HUS) Sweden	Panel data, random sample of house-holds.	1984, 88, 91, 93, 96, 98	Approx. 2500	Interviews with the main household provider. Separate interviews with both men and women in the case of married couples. Included ques-tions about training in 1984.	*"On a job like yours, how long would it take the average new person to become fully trained and qualified?"*	Björklund & Åkerman (1989)
Levnadsnivå-undersökning-en (LNU) Sweden	Panel data, nation-nally representative sample, men and women aged 18-75.	1968, 1981, 1991, 2000	Approx. 6 800	Interviews. Included questions about training in 1991 and 2000.	*"Apart from the competence necessary to get a job such as yours, how long does it take to learn to do the job reasonably well?"*	Regnér (2002) Orrje (2003)

	Sample	Sample period	Number of observations	Data collection method	The questions	Key studies
Arbetskrafts-undersökningen (AKU) Sweden	Rotating panel data, 1/8 of panel repla-ced every quarter, nationally represent-tative sample, men and women aged 16-64.	1986 -	Approx. 13 000	Monthly interviews. Questions about training once a year, as from 1999 every 6 months	*"During the last 6 months, did you participate in any education, conference or seminar that was totally or partly paid by your employer/your company?"* If No: *"During the last 6 months, did you participate in any course, been taught by a supervisor to do new tasks or conducted studies on your own?"*	Wallette (2004) Ericson (2004)
Undersökning av levnads-förhållanden (ULF) Sweden	Cross-section, annual surveys, representative sample, men and women aged 16-84.	1974 -	Approx. 7 500	Personal interviews. Detailed questions about training during the period 1994-1999 and in 2002.	*"Have you, during the past 3 years, taken part in on-the-job training with your current or earlier employer that, counted full time, lasted at least one week? With on-the-job training we mean training that is arranged or financed by the employer."*	Evertsson (2004)

3.3 Questionnaires addressed to employers

An alternative strategy for determining the scope of personnel training is questionnaires addressed to employers. Two well-known US surveys – the *Employment Opportunity Pilot Project* (EOPP) and the *Small Business Survey* (SBA) - should be mentioned in this context.

EOPP focuses on training for the company's average new employees. As indicated in Table 2, questions relate to the volume of personnel training during the first three months of employment. The first question concerns formal training, while questions 2-4 involve informal training. The purpose of the final question is to ascertain the extent of human capital required for the employee's job.

The EOPP sample involves overrepresentation of low-income groups, and is targeted at workplaces benefiting from the federal grants programme. In addition, if the average new employee almost certainly had a job subject to high labour turnover, training for other positions in the company will presumably be longer and more extensive. In contrast, the SBA survey employs a representative sample of companies, and is supplemented by questions about formal training outside the workplace.

Table 2 Questionnaires about personnel training addressed to employers

	Sample	Sample period	Number of observations	Data collection method	The questions	Key studies
Employment Opportunity Pilot Project (EOPP) US	Employers at 23 different locations in the US participating in *Employment Opportunity Pilot Projects in 1980.*	1982	Approx. 4 000	Telephone interviews	*"During the first three months of work, what was the total number of hours spent on formal training, such as self-placed learning programs or training done by specially trained personnel?"* *"During the first three months…number of hours management and line supervisors spent away from other activities giving informal individualized training or extra supervision?"* *"During the first three months…number of hours co-workers who are not supervisors spent away from other activities giving informal individualized training or extra supervision?"* *"During the first three months of work, how many total hours does the average new employee spend in training activity in which he or she is watching other people rather than doing it himself or herself?"* *"How many weeks does it take a new employee for (X) type of position to become fully trained and qualified…?"*	Barron, Black & Loewenstein (1987a) Bishop (1997)

	Sample	Sample period	Number of observations	Data collection method	The questions	Key studies
Small Business Administration Survey (SBA) US	Stratified random sample, with over-representation of large companies..	1992	Approx. 3 600	Telephone interviews	Corresponding to EOPP + a question on the number of hours the average new employee received training outside the workplace during the first three months.	Barron, Berger & Black (1997a)

3.4 Methodological problems

3.4.1 Differences between employee and employer information

Barron et al (1997a) report an American study (the *Upjohn Survey*,1993) which posed identical questions on personnel training and other market-related varia-bles (pay, experience, etc.) to both employers and the "last worker hired". Approximately 300 companies and employees were interviewed out of a national sample of 5,000 companies. In order to improve the likelihood of encountering a new employee, there was a requirement that the company must have had at least 100 employees.

It appears that there are considerable differences between employers' and employees' information regarding the length of training. The correlation between the employer and the employee information is less than 0.5 for the aggregate quantification of personnel training in this survey. This is an abnormally low correlation compared with that achieved for other labour-market variables. Similar results occur for formal and informal training. The differences in comparison with the aggregate score are even more marked in the case of more specific measures. It is worth noting that employers tend to report more hours than employees (in about 25% of cases). Employers also report a longer period for inexperienced employees to be fully trained l. The difference between employers' and employees' estimates of the time required to be fully skilled (correlation 0.17) are even greater than estimates of the length of personnel training. It may nonetheless be noted that employees and employers indicated similar *incidence* of training – in other words a similar number of participants in personnel training.

Barron et al investigated whether the differences between employers' and employees' results might have been due to individual characteristics on either side. They found a significant negative correlation between employers' information about employee levels of education and the difference in information about the total number of training hours. In other respects, the discrepancy between the number of personnel training hours stated appears to be independent of other variables and, as a result, the differences between employer and employee information is probably simply due to measurement problems as regards an accurate statement of the number of hours devoted to training during the first month of employment. As a result, there is an obvious risk that regression analyses of the impact of personnel training on employee pay, for example, will lead to skewed parameter estimates, since the

independent variable in the regression equation (training) becomes stochastic, and thus may be correlated with the error term in the equation.

3.4.2 The distinction between general and specific personnel training

The 1993 NLSY questionnaire included a question about the general and specific features of the personnel training programme, with the following wording: *"How many of the skills that you learned in this program do you think could be useful in doing the same kind of work for an employer DIFFERENT than [the current employer]?"*. Of those who said that they had completed a training programme, 63% selected the *"all or almost all"* alternative, 14% opted for *"about half of the skills"*, while only 11% indicated *"less than half of the skills"* or *"none or almost none of the skills"*. This indicates that employees regarded a considerable proportion of the training programme as general.[22]

A comparison with Swedish data reveals a similar pattern. The 1991 LNU poses the following question: *"Do you know any other employer where you could have considerable advantage of what you have learnt in your present job"*. In this case, 48% of employees in the private sector answered "*Yes, several*" to this question, 8% said "*Yes, one or two*", and 16% gave a negative response.[23] In 1994-1998, the ULF survey asked whether *"the training programme (= the most recent internal programme) can be used with another employer?"* and *"Can the training programme (= the most recent internal programme) be used in a number of different industries?"*. 5% gave a negative response to the first question, thus indicating that they considered that the most recent internal training programme was specific, while 54% gave a positive response to the second question, which indicates that they considered that the most recent internal training programme was of a general nature.[24]

EOPP provides information about how general or specific training programmes are. The question addressed to employers is as follows: *"How many of the skills learned by new employees in this job are useful outside of the company?"* 58% responded *"almost all"*, 24% said *"most"*, 20% indicated

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[22] Loewenstein & Spletzer (1996b) present a more detailed analysis.
[23] See Regnér (2002).
[24] See Evertsson (2004).

"only some", and 8% answered "none". In confirmation of the NLSY, LNU and ULF surveys, the employer also regarded the major proportion of personnel training as of a general nature. To summarize: 5-20% of the respondents in these surveys regard training as clearly specific.[25]

The AKU statistics give quite a different picture. The 2001 personnel training questionnaire asked if "the course/training programme was mainly company-specific or general?", and three alternative response options were presented: "Mainly company-specific", "Mainly general" and "Partly company-specific and partly general". 48% replied: "Mainly company-specific" for all the courses in which they had participated during the previous six-month period[26]. This figure may be compared with the equivalent assessment of the LNU survey (16%). This may well be because respondents to the AKU survey did not understand the meaning of "company specific", as defined in human capital theory. Another explanation may be the formulation of the questions about personnel training in the various surveys. As indicated in Table 1, the question in AKU focuses on formal training, while the LNU question asks how long it takes to learn the job, on average. Given a broader definition of the learning process in the workplace, as in the LNU survey, it is not surprising that a smaller number of respondents considered that the know-how they have acquired could not be used by other employers. On the other hand, if learning in the workplace is confined to formal courses and seminars, more respondents will say that their know-how is "company-specific", even if it may well be viable with another employer. A clearer formulation of the AKU question would have been desirable.

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[25] Regnér (2002) states that more women than men receive specific personnel training (22% compared with 15%), and that the proportion receiving specific training is higher in the public sector (21%).
[26] See Ericson (2004).

4   How much, and for whom?

4.1   Incidence and intensity

Table 3 shows the percentage of employees who participated in training, according to five US surveys. Column 2 indicates that 17% of the sample in CPS and 28% in NLS72 had participated in training during their current employment. The proportion who had received training during the last 12 months was 17% according to NLSY and, in the first three months as new employees 15% (EOPP) and 21% (SBA). Notwithstanding the brief reference period, the incidence of training in EOPP, SBA and NLSY is comparable with the scores in CPS and NLS72. This is particularly noteworthy in the light of the broader definition of training in CPS and NLS72, since formal school education is included as a response option, while school education is excluded in EOPP, SBA and NLSY. As indicated in the following discussion, one contributory factor may be that there is a younger sample population in NLSY compared with the representative sample in CPS, and the fact that EOPP and SBA only cover new employees.

In Column 3, we see that that the information about informal personnel training varies significantly between the various surveys. Questionnaires addressed to employers (EOPP and SBA) indicate a considerably higher proportion of informal training (approx. 95%), compared with employee surveys in which the incidence of informal training is 15-20%. One explanation may be that the employer regards instructions to employees as a form of informal training, while employees regard it as general supervision and normal instruction. In addition, Loewenstein & Spletzer (1999a) point out that the response options for informal training in CPS and NLS72 are in the form of follow-up questions, after questions about formal training. As a result, these questionnaires ignore people who have only received informal training since they cannot continue to answer the questionnaire because they have not received any formal training. In the 1994 NSLY survey, on the other hand, all new employees were asked whether they had received some form of informal

personnel training during their first year of employment, and roughly 80% considered that they had participated in some form of informal training[27].

Column 4 shows the percentage who received training outside the workplace. The new employees in the SBA survey received a relatively low proportion of external training, but the proportion was higher in NLS72. This is probably because external personnel training involves expenditure for new employees which the employer does not wish to pay, in view of uncertainties regarding the duration of their employment and their productivity.

Overall, the US questionnaire surveys suggest that approximately 45% of the employees had received training at one time or another during their current employment, and that roughly 15% had received training during the preceding year. These surveys also indicate that informal training is very common among new employees, with figures of around 80% according to employees, and 95% according to employers.

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[27] See Loewenstein & Spletzer (1999a) for further details.

Table 3 The incidence of personnel training

	(1) Some form of personnel training	(2) Formal personnel training	(3) Informal personnel training	(4) Personnel training outside the workplace
NLSY[1] (1993-94) Current job, 1 year	-	17 %	80 % (1994)	2 % (*Apprentice, Business School, Voc-Tech*) 4 % (*Outside Seminars*)
CPS[2] (1991) Current job	42 %	17 %	16 %	13 % (*School*)
NLS72[3] (1986) Current job	46 %	28 %	20 %	20 %
EOPP[4] (1982) New employee, 3 månader	96 %	15 %	88 % (*manager*) 63 % (*co-worker*) 81 % (*watching others*)	-
SBA[4] (1992) New employee, 3 months	98 %	21 %	91 % (*manager*) 60 % (*co-worker*) 65 % (*watching others*)	7 %

[1] Loewenstein & Spletzer (1999a)

[2] Bishop (1997)

[3] Altonji & Spletzer (1991)

[4] Barron, Berger & Black (1997b)

The intensity of training that has taken place is stated in Table 4 in terms of the average number of hours. Both CPS and NLS72 indicate that 8-10 weeks on average were devoted to personnel training in the current job. EOPP and SBA suggest that, on average, training represented roughly half the new employee's time during the first three months of employment, and that this time was divided between formal and informal training on a relatively evenly distributed basis.

Table 4 The intensity of personnel training, average number of hours for training that has taken place

	(1) Some form of personnel training	(2) Formal personnel training	(3) Informal personnel training	(4) Personnel training outside the workplace
NLSY[1] (1993-94) Current job, 1 år	-	48 hrs	96 hrs	78 hrs (*Apprentice, Business School, Voc-Tech*) 38 hrs (*Outside Seminars*)
CPS[2] (1991) Current job	-	9,6 weeks	-	-
NLS72[3] (1986) Current job	338,3 hrs	190 hrs	233 hrs	101 hrs
EOPP[4] (1982) New employee, 3 months	150 hrs	78 hrs	57 hrs (*manager*) 42 hrs (*co- worker*) 68 hrs (*watching others*)	-
SBA[4] (1992) New employee, 3 months	152 hrs	66 hrs	64 hrs (*manager*) 54 hrs (*co-worker*) 62 hrs (*watching others*)	48 hrs

[1] Loewenstein & Spletzer (1999a)

[2] Bishop (1997)

[3] Altonji & Spletzer (1991)

[4] Barron m fl (1997b)

According to AKU, 46% of employees participated in personnel training during the first 6 months of 2003[28]. The proportion of participants in Sweden is

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[28] See Statistics Sweden press release No. 2004:075.

much higher than the US figures, since AKU does not take informal training into account. The average intensity of training also appears to be higher in Sweden – the average intensity during the first six months of 2003 was 6.1 days per individual according to AKU, compared with a similar number of days in a 12-month period in NLSY.

The 1996 Eurobarometer posed the following question: *"Did you receive any education or training in the last five years paid for by your employer or by a former employer?"* 40% of employees in the EU's 15 member states (EU15) had received training of this nature[29]. There was considerable variation between the EU countries, and the Nordic countries headed the list with 60-70% participation in personnel training. In countries in southern Europe – Italy, Greece, Portugal and Spain – only 20-30% of employees had participated in training. See Figure 2.)

Figure 2 Proportion of employees who participated in personnel training during the previous five years, Eurobarometer 1996.

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[29] See Gallie (1997).

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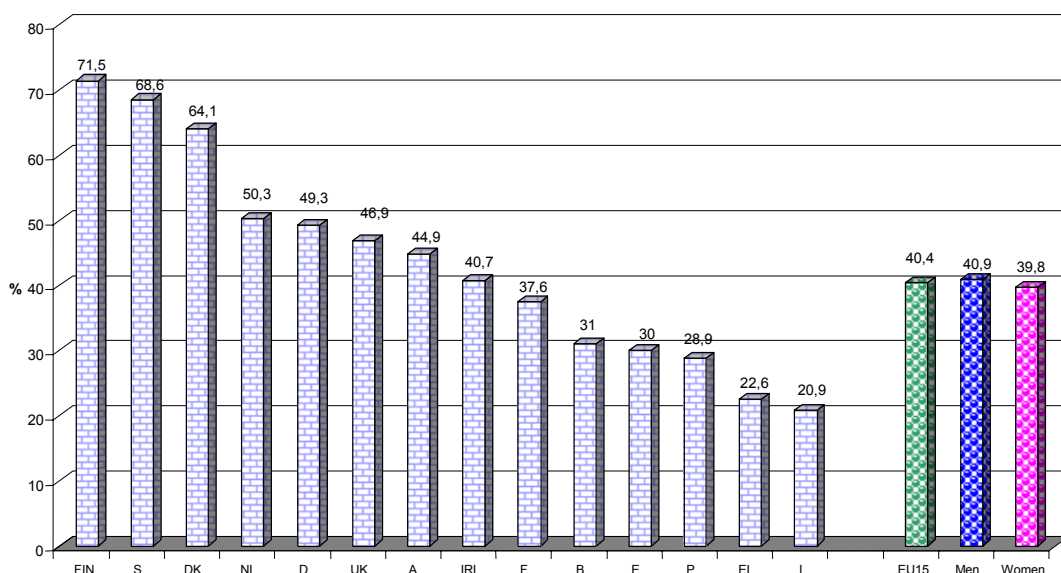
Figure 3 Breakdown of personnel training by duration, EU 15, Eurobarometer 1996.
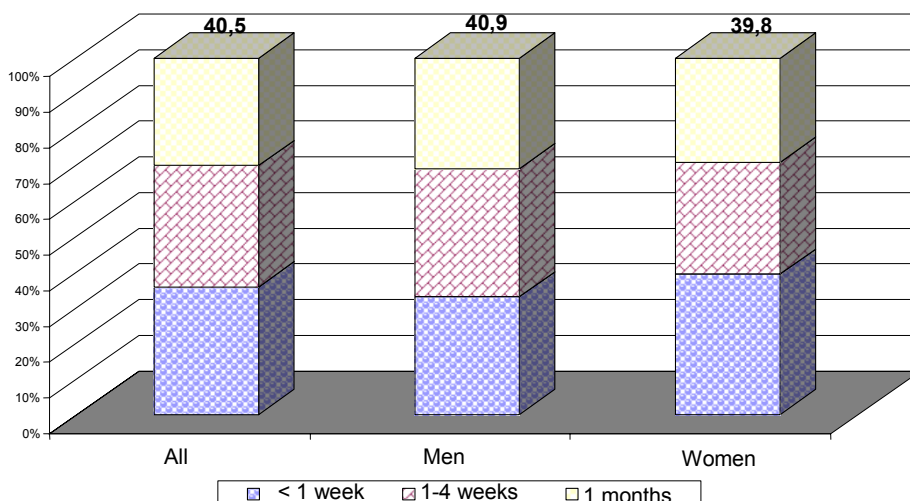
4.2 Who receives personnel training?

Table 5 summarizes the way in which specific employee characteristics influence the likelihood that the employee will receive personnel training, according to some key studies. The personal characteristics that reduce the like-lihood of training are the employee's age, period of employment and non-native ethnic background. The negative impact of the employee's age and duration of employment are in line with the theory that a shorter period of return reduces willingness to invest in training. As a result, the age and employment-time factors, per se, will restrict the employer's willingness to make financial sacrifices to achieve higher future income. Similarly, the em-ployer's incentives to finance and organize personnel training will decline in the light of the employee's relatively advanced age and experience of the assignments concerned. Some studies indicate that women tend to receive less training than men, mainly because women have jobs with lower expertise requirements. On the other hand, other studies indicate that women receive more training, due to more positions entailing recruitment outside the workplace.

It is interesting to note that, in the EU15 countries, female employees receive a higher proportion of training with a duration of less than a week (see Figure 3, above). In contrast, men have a higher proportion of training ranging from one week to four weeks and training lasting more than a month. There is a

similar pattern for non-native ethnicity, since a higher proportion of employees with a non-native background have jobs with lower requirements in terms of formal qualifications, and this tends to reduce the volume of training.

Specific factors in Table 5 which increase the employee's training include working hours, formal education, the size of the workplace and the complexity of job assignments. It is not unreasonable to assume that longer working hours and increased presence in the workplace result in greater responsibilities and, as a result, greater incentives for personnel training. The correlation between a higher level of formal education and the volume of training is in line with the theoretical hypothesis that education and training give an indication of the individual's abilities and future productivity. Studies also indicate that major workplaces provide more training than small companies, possibly because training is used to screen the employee's capacity and skills. Large companies appear to invest in formal training and informal training by colleagues, while small companies tend to use managers to assess the employee's abilities[30]. As already mentioned, there is more personnel training in jobs involving complex assignments. The 1996 Eurobarometer statistics (Figure 4) indicate, for example, that 60.7% of the *Professionals and managers* occupational group had received training during the previous five years, while the corresponding figure for the *Elementary occupations* group was only 18.3%.

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[30] See Bishop (1997).

Figure 4 Personnel training in various occupational categories, Eurobarometer 1996.
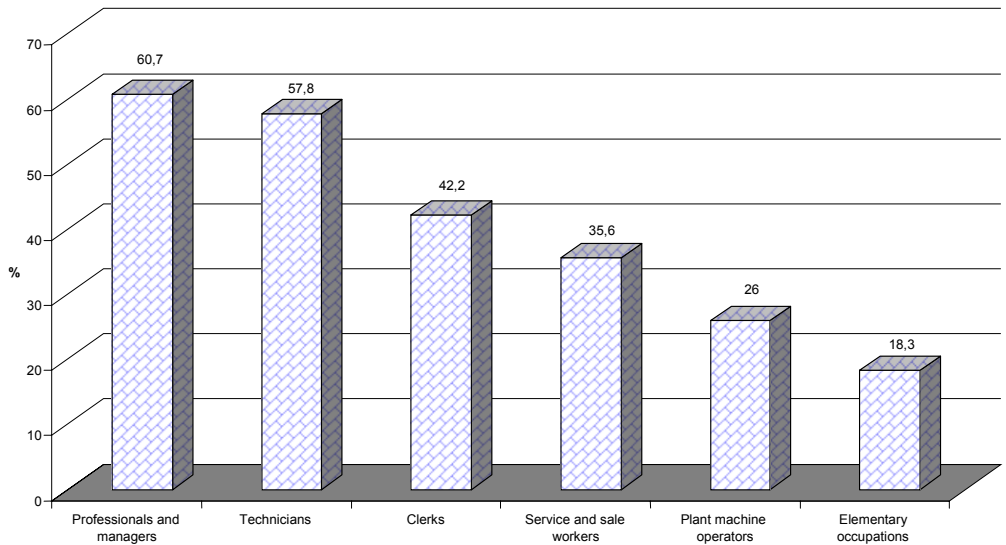
Finally, in Table 5 we can see that the impact of experience of working life on training is unclear. On the one hand, an experienced employee needs less training while, on the other hand, employers appear to recruit experienced employees for jobs involving more complex tasks, and this calls for more personnel training.

Table 5 Specific impacts of the likelihood of receiving personnel training

	Impact on the likelihood of receiving personnel training	Studies
Age	(-)	Booth (1991) Barron m fl (1997a)
Working hours	(+)	Bishop (1991) Barron m fl (1997a)
Length of employment	(-)	Bishop (1997)
Working life experience	(-)	Barron m fl (1987b)
	(+)	Barron m fl (1997a)
Education	(+)	Barron m fl (1987b) Booth (1991) Barron m fl (1997a)
Size of workplace	(+)	Barron m fl (1987a) Booth (1991) Holtmann & Idson (1991)
Woman	(-)	Altonji & Spletzer (1991) Olsen & Sexton (1996) Sicilian & Grossberg (2001)
	(+)	Veum (1996)
Non-native ethnicity	(-)	Lynch (1992) Veum (1993) Booth (1991) Barron m fl (1997a)
Complex job assignments	(+)	Booth (1991) Bishop (1997)

The specific impacts indicated in Table 5 are confirmed by the correlation between participation in personnel training and characteristics of the labour force in Sweden. Table 6 shows the proportion of employees who received training during 2001, according to AKU. The proportion with personnel training was less than half for part-time employees with less than 20 hours a week. This proportion was more than double in the case of employees with a significant period of studies in higher education, as compared with people with only basic education. The size of the workplace is also of major importance – the training proportion was almost double in workplaces with more than 1,000 employees compared with workplaces with 9 or fewer employees. However, in contrast with the EU15 statistics, a higher proportion of women than men participated in training, probably due to higher female participation in the

labour force in Sweden compared with other EU countries. In addition, employees born outside the Nordic region had a roughly 25% lower rate of participation in training. Finally, as in the EU15 study, the incidence of training appears to be lower for less responsible posts and less complex tasks.

Table 6 Participation in personnel training in Sweden according to AKU

		Participation in personnel training, %
Working hours	Full-time	62.5
	Part-time (20-34 hrs. per wk.)	52.0
	Part-time (1-19 hrs. per wk.)	22.9
Education	Compulsory school less than 9 yrs.	37.3
	Compulsory school 9 yrs.	38.4
	Senior secondary school max. 2 yrs	55.9
	Senior secondary school more than 2 yrs.	54.5
	Higher education less than 3 yrs.	71.7
	Higher education more than 2 yrs.	79.55
	Post-graduate education	78.9
Size of workplace	-9	36.1
	10-49	48.1
	50-99	53.0
	100-249	57.7
	250-499	63.0
	500-999	66.0
	1,000 -	68.8
Gender	Men	56.5
	Women	60.5
Place of birth	Sweden	59.5
	Other Nordic countries	56.8
	Non-Nordic countries	44.1
Occupational category	1. Legislators, senior officials and management	76.0
	2. Professionals	79.4
	3. Technicians with brief higher	73.1

			Participation in personnel training, %
		education	
	4.	Clerks, administration and customer service	54.8
	5.	Service, care and sales	51.2
	6.	Agriculture, gardening, forestry and fishing	34.8
	7.	Craft and related trade workers	44.1
	8.	Plant and machine operation, transport, etc.	42.0
	9.	Elementary occupations	27.9
	10.	Military	79.2

5 Impact on pay

5.1 Theory

In principle, human capital theory assumes a labour market in perfect competition, in which factor prices are adjusted to an equilibrium level without any entrepreneurial profit, and at wage levels equal to the value of employee's marginal product. Inefficiency in the personnel training context are attributed to difficulties for the investing parties to regulate the training component within the framework of the employment contract. There are several reasons for this: the employee's limited liquidity, which hinders the financing of general training, the uncertain return on the investment, and the fact that the investment cannot be covered by insurance due to *adverse selection* and *moral hazard*, information asymmetry regarding the improvement in the employee's skills, and the difficulty of specifying training and credibly undertaking to implement it.

An alternative line of the literature focuses on a labour market characterized by imperfect competition, as a result of institutions and regulations, information asymmetry, transaction costs and a limited number of employers. This takes account of the employer's personnel-training initiatives to a greater extent. A pay structure which, for various reasons, is not perfectly correlated with the employee's productivity results in a profit margin for personnel training for the employer. Inefficiency is said to be due to the fact that the

employee's market rate of pay is nonetheless influenced by the investment in training. In addition, the employee can negotiate on the difference between the marginal product and the market rate of pay since the training investment is relation-specific and the employer's revenue will diminish if the employee leaves the company. The fact that other employers can take advantage of the differential between the employee's marginal product and rate of pay leads to the inefficient generation of positive external effects as a result of personnel training. The difficulties experienced by parties to the investment in privatizing the return on the training investment are the main reason for this inefficiency.

Table 7 summarizes the various theoretical predictions about pay trends in the personnel training context. Column 1 indicates that the employer and the employee share the costs in all models, with the exception of Model 1 and Model 5. In Model 1 (perfect competition and general training) the employee will pay the entire cost of training, since the wage is less than both the employee's marginal product during the training period (MP_t) and the employee's marginal product with no training (MP_0). In Model 5 (imperfect competition and general training), the employer, in contrast, pays the entire cost of training, since MP_t is lower than W_t and W_t is equal to the pay which the employees would receive without training (MP_0).

Column 2 indicates pay after the implementation of training. In all models except Model 1, the employer and the employee share the return on personnel training. In Model 1, the employer receives the entire return, since pay is equal to the marginal product. In other models, the employer receives a proportion of the return when MP_{t+1} exceeds W_{t+1}.

Column 3 demonstrates the major difference between the models in Table 7 by indicating the impact of training on pay in other jobs. In Model 1, the wage has an identical impact on other employers' wage, due to the assumption of perfect competition and general personnel training. In Model 2, training will have a *greater* impact on other employers' pay-rates, where there is perfect competition and general personnel training, but with participation in financing by the employer. As a result, the employer will expect to receive part of the return, and W_{t+1} will be less than W_{t+1}^*. The employee's temptation to change employer after training in order to receive the higher W_{t+1}^* acts as a constraint on the investment propensity of the current employer, and is one of the reasons for inefficiency. In Model 3, training has no impact on other employers' rate of pay since training is assumed to be specific, thus eliminating the source of inefficiency in Model 2. However, there are other sources of inefficiency in the

case of specific personnel training as a result of difficulties in arriving at a credible agreement concerning the future allocation of revenues. In Model 4, the impact on other employers' wages *will be less than* the impact in the current workplace, since the training programme is both specific and general. There is an upward pressure on wages with other employers, however, as a result of the general training component, but the specific component means that pay increases will be less with other employers. Finally, Model 5 results in higher or equal wage increases for other employers due to the assumption about the current employer's stronger negotiating position in a pay context.

Table 7 Summary of the impact of personnel training on rates of pay in accordance with various economic models

Model	**(1)** Wage (W_1) during ongoing personnel training	**(2)** Wage (W_{t+1}) after personnel training	**(3)** Impact on wage in other workplaces ($W_{t+1}*$) after personnel training
(1) Perfect competition, general training	$W_t < MP_t < MP_0$	$MP_0 < W_{t+1} = MP_{t+1}$	$MP_0 < W_{t+1} = W_{t+1}*$
(2) Perfect competition, general training, credit restrictions	$MP_t < W_t < MP_0$	$MP_0 < W_{t+1} < MP_{t+1}$	$MP_0 < W_{t+1} < W_{t+1}*$
(3) Perfect competition, specific training, credit restrictions	$MP_t < W_t < MP_0$	$MP_0 < W_{t+1} < MP_{t+1}$	$MP_0 = W_{t+1}* < W_{t+1}$
(4) Perfect competition, both specific and general training	$MP_t < W_t < MP_0$	$MP_0 < W_{t+1} < MP_{t+1}$	$MP_0 < W_{t+1}* < W_{t+1}$
(5) Imperfect competition, general training	$MP_t < W_t = MP_0$	$MP_0 < W_{t+1} < MP_{t+1}$	$MP_0 < W_{t+1} \leq W_{t+1}*$

MP_0 = value of the employee's marginal product with no personnel training

MP_t = value of the employee's marginal product during personnel training

MP_{t+1} = value of the employee's marginal product after personnel training

5.2   Empirical model

The most general linear empirical model for the impact of personnel training on pay after T years of employment is as follows:[31]

$$W_{ijT} = \sum_{t=1}^{T} \alpha_t P_{ijt} + \delta \sum_{k=1}^{j-1} P_{ik} + \beta_1 X_i + \beta_2 X_{ij} + \beta_3 X_{ijT} + \gamma_T + \mu_i + v_{ij} + \varepsilon_{ijT}$$

$$(1)$$

P_{ijt} are the variables indicating the existence and extent of personnel training for an individual i in a job j and with t years of employment. P_{ijt} is summarized over $t = 1, \ldots, T$ in order to arrive at the impact of cumulative training in the current job.

P_{ik} are variables indicating the individual i 's total volume of personnel training in previous jobs k. Training in previous jobs is summarized over $k = 1, \ldots, j$-1.

X_i are various background variables which are specific for the individual (e.g. gender, place of birth).

X_{ij} are various background variables which may vary with the nature of the job (for example the size of the company).

X_{ijT} are background variables for an individual i in a job j and at a point in time T (e.g. marital status and place of residence).

γ_T is a specific effect of the period of employment T's impact on the wage which is identical for all individuals i and all jobs j (*tenure effect*).

μ_i are specific effects for the individual i not covered by X and P, and which may be assumed to be constant over time (*individual fixed effects*).

V_{ij} are matching-specific effects on wage which depend on how well the individual i fits into the job j.

ε_{ijT} are other effects on wage over time not covered by X.

The expected signs for parameter estimates for the five theoretical models above are summarized in Table 8. In Column 1, we see that ongoing training is expected to have a negative impact on pay in all models, with the exception of Model 5, in which pay is not affected by ongoing training since the employer

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[31] See for example Loewenstein & Spletzer (1999a).

pays the entire cost of training. In Models 2-4, the employer pays part of the cost and, as a result the estimated α_T is expected to be greater in Model 1. Column 2 shows that all models predict a pay increase as a result of previous personnel training in the same job. This effect, however, is expected to be greatest in Model 1, in which the employer receives the entire return. In other models, the parties share the return. Column 3 shows the effect on wage of training in a previous job. In Models 1, 2 and 5, training is of a general nature, which results in identical or higher pay with a new employer. In Model 3, with specific training, there is no expected effect, while in Model 4, with some specific training, the expected wage increase is less than in the other models.

It is difficult to draw a line between the various models in empirical studies since the nature of training programmes (general or specific) and the market (perfect or imperfect competition) may vary over time.

Table 8 Expected values for parameter estimates in the pay equation

Model	Characteristics	(1) Expected value for αT	(2) Expected value for α_t, $t = 1,\dots, T\text{-}1$	(3) Expected value for δ
1	Perfect competition, general training	- *	+ *	+
2	Perfect competition, general training, credit restrictions	-	+	+
3	Perfect competition, specific training	-	+	0
4	Perfect competition, specific and general training	-	+	+ **
5	Imperfect competition, general training	0	+	+

* Greater expected effect than other models

** Less expected effect than other models

5.3   Wage during ongoing personnel training

Empirical tests of the impact of personnel training on wage during the training period may be based on data concerning the employee's initial rate of pay. Let W_{ijl} be the initial wage for individual i who starts the job j at timepoint $T = 1$. In this case, Models 1-4 predict that $\alpha_1 < 0$, while Model 5 results in $\alpha_1 = 0$. The problem in estimating α_1 is due to unobserved variables. It is reasonable to

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assume, for example, that the employee's general talents and abilities are not fully covered by the variables in *X*. Individuals with greater ability will tend to have a higher initial wage, and the employer will tend to invest in more training for individuals with greater ability. As a result, there is a positive correlation between μ_i and P_{ij1} in equation (1). If we take this into account, the estimates for α_1 will be positively biased.[32]

The literature describes three methods of correcting this measurement error:
(i)   Ability-proxy variable, which identifies the individual's hidden hetero-geneous characteristics via variables that are positively correlated with the individual's abilities.
(ii)   Position fixed-effect, identifying differences in the impact of personnel training on pay between different jobs (v_{ij} in equation (1)).
(iii)   Individual fixed-effect, which identifies the impact of personnel training on pay via the variation in training over time for individuals in a panel data set.

5.3.1   The ability-proxy variable

The simplest analysis is based on cross-section data. As a result, the empirical model is simplified to:

$$W_i = \alpha P_i + \beta_1 X_i + \beta_2 X_{ij} + \gamma_i + \varepsilon_i, \quad i = 1, \ldots, n. \tag{2}$$

In order to reduce the bias of α, an attempt is made to control for non-observable employee characteristics by including variables in *X* which may be assumed to be positively correlated with these hidden characteristics. Barron, Berger & Black (1996) analyse data from EOPP and SBA in which the em-ployer reports training for the average new employee, including a variable in X_{ij} indicating the complexity of the job. The idea is that the most talented employees are matched with the most complex tasks. A variable in X_{ij} is also introduced, indicating the number of hours the employer devoted to interviewing and investigating each applicant for the vacant position. A longer search process indicates that the job is more complex and demanding. The

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[32] See Barron, Black & Loewenstein (1989).

additional variables result in negative and significant estimates of α in both EOPP and SBA. The elasticity is limited, however – the elasticity with the highest value in absolute terms does not exceed -0.018. In addition, the parameter estimates for external personnel training (*off-site training*) are significantly positive, which contradicts the theoretical predictions.

Veum (1999) uses data from NLSY 1996 based on annual interviews with younger men and women in the labour force. Here too, a negative estimate of α is discerned, but this is not significant. Only personnel training outside the workplace which is not financed by the employer produced significant negative estimates at a 10% level.

Hence, analysis of cross-section data appears to be unable to provide robust empirical support for human capital theory and Models 1-4. At the same time, this weak support may be explained by the fact that the "better" employees are not covered by the variables in X_{ij}. As a result, matching for jobs with more training and higher initial pay will continue to produce skewed parameter estimates.

5.3.2 Position-fixed effect

An alternative method of analyzing cross-section data is based on matching theory. When recruiting new personnel, the employer is looking for people who fit the job well. This means that each job will be matched with employees who have specific characteristics that fit the job concerned. As a result, the variation in the initial pay and personnel training for two individuals with the same job may be assumed to be devoid of hidden heterogeneity. In other words, information from the variation in personnel training between various jobs is not utilized. Instead, the impact of training on initial pay is identified via the variation in training for new employees for a given job.

The variation in the job can be arrived at in different ways. Sicilian (2001) uses EOPP, in which the employer supplies information about two new employees for the same job. Since two different people are observed, their individual hidden heterogeneity will continue to be present. The assumption that the employer tries to employ two people with the same abilities and characteristics for a specific post reduces the skew in the parameter estimate, however. The difference in training and pay between these two new employees presumably depends on factors other than their hidden heterogeneity. Hence, the empirical Model (1) is modified to become:

$$W_{ij} = \alpha P_{ij} + \beta_1 X_i + \beta_2 X_{ij} + \gamma_i + v_j + \varepsilon_{ij}, \qquad i = 1, 2, \; j = 1, \ldots, J \qquad (3)$$

In a comparison with (1), we note that the hidden position-specific effect is assumed to be the same for the two new employees, $v_{ij} = v_j$, i = 1.2. By transforming the variables into the difference between the two observations for new jobs, we arrive at:

$$W_{2j} - W_{1j} =$$
$$\alpha(P_{2j} - P_{1j}) + \beta_1(X_2 - X_1) + \beta_2(X_{2j} - X_{1j}) + (\gamma_2 - \gamma_1) + (\varepsilon_{2j} - \varepsilon_{1j}).$$

This *first-difference regression* results in an estimate of α as -0.048 at a 1% level of significance. In accordance with this model, 100 hours of personnel training – the average value in the data – will reduce initial pay by almost 5%[33].

Barron et al (1999a) employ a similar method to estimate the impact of personnel training on initial wage, using data from the *National Assessment of Vocational Education* (NAVE). Instead of stating training and initial pay for two employees in the same job, in NAVE the employer provides the corresponding information for the most recent employee and for the "typical" employee (*the typical worker*) in this post. Regression analysis of the differrences between the most recent employee and the typical employee indicates an elasticity of -0.016. In other words, the effect is less than in Sicilian's study.

Barron et al (1999b) use SBA data to compare the proportion of the most recent employees who have higher pay and less training than the "typical" employee, and vice-versa. This shows that only a small proportion (1.5%) of the most recent employees who received less personnel training than the typical employee had lower pay. In this case, the comparison is consistent with Models 1-4. However, lower pay was only noted for 6.8% of the most recent employees with more training than the typical employee. Hence, employers appear to be less willing to reduce pay for new employees who receive more training, which does not comply with Models 1-4.

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[33] When Sicilian (2001) takes into account the stated degree of personnel training, the effect varies between 4% and 12%

5.3.3 Individual fixed-effect

A third method of checking for hidden employee heterogeneity is using panel data to check for *individual fixed-effects*. In this case, it is assumed that the individual's hidden qualities are covered by μ_i in (1) so that ε_{ijT} is not correlated with the independent variables. If we take the difference between two points in time for each individual in the data set, we arrive at the pay equation:

$$W_{ijT} - W_{ijT-1} = \alpha_T P_{ijT} + \beta_3 \left(X_{ijT} - X_{ijT-1} \right) + \left(\gamma_T - \gamma_{T-1} \right) + \left(\varepsilon_{ijT} - \varepsilon_{ijT-1} \right). \qquad (4)$$

Hence, the individual fixed effect μ_i is eliminated in equation (4). The job matching-specific effect v_y is also eliminated, providing the individual does not change jobs between the two timepoints T and T-1. However, this means that it is not possible to use the initial wage to arrive at wage during ongoing training. Instead, a separate variable P_{ijt} is used, indicating whether training was underway at the timepoint for data collection.

Loewenstein & Spletzer (1998) use this method for the analysis of NLSY panel data in the period 1988-1991. In order to determine whether participants' wage was lower during ongoing training, they introduced a variable in P_{ijt} which indicates the marginal effect on pay if training was not completed by the date of response to the questionnaire. If the parameter estimate for this effect was negative, this meant that wage declined during the training period. However, it proved that only "seminars outside the workplace" resulted in a negative parameter estimate (-0.0907), which does not differ significantly from zero. In addition, the proportion of uncompleted personnel training was relatively small, so the results should be cautiously interpreted.

The Loewenstein & Spletzer study may be compared with a previous study by Lynch (1992) who was looking for a corresponding effect in the NLSY cross-section in 1983. Lynch found that people with a low level of education (*Less than the school degree*) received lower pay during ongoing training in the workplace, but that this did not apply to better-educated employees. This might mean that the former category received more general training, and paid this cost in the form of a lower wage.

To summarize, only one study (Sicilian, 2001) clearly supports Models 1-4. Other studies indicate that the employer at least participated in financing the general training, which is consistent with both Model 2 and Model 5 in Table 8.

5.4 Wage increases in the same job

Increased pay in the same job may be classified under two headings or components: the period of employment (seniority) and performance/quailfications. There is extensive literature which discusses increased pay as a result of the first component: wage may increase as the length of employment increases in order to provide an incentive for the employee to do his/her best and not to shirk, since the employee's expected pay increase will cease in the event of dismissal[34]. Wage can also be maintained at a lower level and gradually increased in order to attract employees who do not intend to resign after a brief period of employment[35]. A third explanation for increased wage in line with seniority is that good matching between employees and jobs leads to longer employment and higher levels of pay[36].

There are divided opinions about the importance of personnel training for pay increases due to seniority. According to Models 3 and 4 in Table 7, wage increases due to seniority occur because no value is attached to specific personnel training in other workplaces. As a result, someone who stays at the same workplace for some time will receive a greater pay increase than someone who often changes jobs. Hence, the empirical prediction is that a pay increase due to seniority will be higher if specific training occurs. However, several studies indicate that personnel training is not one of the main reasons for increased pay due to seniority. Barth (1997), using data from the 1989 *Norwegian Survey of Organizations and Employees* (NSOE) found a significant negative correlation between the job's training requirements and increased pay due to seniority for specific know-how. And in a sample of companies in the US and Japan, Levine (1993) found that companies with high wage increases on the grounds of seniority did not have more personnel training than average. However, one explanation may be that the training was general and took place in the initial stages of employment. In Sweden, Regnér (2002) indicates that, based on LNU cross-section data, training increases the employee's level of pay, but that increased pay is not linked to seniority[37]. According to Regnér, one possible

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[34] See Lazear (1981).
[35] See Salop & Salop (1976).
[36] See Jovanovic (1979).
[37] Pay increases due to seniority tend to be modest in the Nordic countries.

explanation is that personnel training reflects the impact of promotion on wage, and that personnel training in Sweden may be employed as a tax-free benefit. As in the Norwegian study, the questionnaire addressed to employees makes a distinction between general and specific training. It indicates that general l training has a greater impact on the level of wage than specific training, which is consistent with Models 1 and 3 in Table 8. In addition, the impact on wage of general training is greater for men in the private sector than for women in the public sector.

One key question is whether the data for personnel training is of sufficiently good quality to provide accurate estimates of the impact of tenure and training on increased wage rates. Loewenstein & Spletzer (1999a) discuss the question of whether the lack of data about informal training in surveys based on individuals leads to biased estimates of $(\gamma_T - \gamma_{T-1})$ and α_T in equation (4). They use the 1993 and 1994 NLSY surveys, which include a measure of informal training. They find that the inclusion of information about informal training in P_{ijT} in (4) reduces the parameter estimate of the *tenure effect* $(\gamma_T - \gamma_{T-1})$ by a third, and the parameter estimate of α_T by a fifth. For example, an isolated wage increase due to long employment declines between the first and second years of employment from about 3.6% to approximately 2.5% if informal personnel training is included in equation (4), and the isolated wage increase due to formal personnel training declines between the first and second years of employment from about 5.5% to 4.6%. The pay increase due to informal training is about 3.3%, and hence the total pay increase for employees who received training during the second year of employment is about 10.4%. The wage increases declines drastically for employees with more than two years of tenure.

Bartel (1995) applies an alternative strategy to improve the quality of the data, by analysing a specific major company's personnel database, thus eliminating errors due to the inability of individuals to recall previous training periods and the variation in the need for personnel training in various occupational fields. Formal training in a company often only lasts for a couple of days[38]. As a result, NLSY, which measures personnel training in terms of

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[38] This can also be seen in the Swedish AKU survey. Wallette (2004) reports that in the case of employees who participated in personnel training during the previous 6 months in the period

weeks, may miss many shorter training programmes. Bartel considers that there continues to be a selection problem in (4) since ($\varepsilon_{ijt} - \varepsilon_{ijt-1}$) may be correlated with the probability of receiving personnel training in period T. The company can monitor the employee's performance over time and train employees whom the employer wishes to promote. Alternatively, the employer can provide training for employees whose performance has deteriorated. This source of bias of α_T can be corrected by estimating an instrumental variable for P_{ijT} which is not correlated with ($\varepsilon_{ijt} - \varepsilon_{ijt-1}$). In this case, Bartel uses information about the individual's pay in relation to comparable colleagues in the company. This indicates that employees with relatively high wages receive management and technical training, while employees with relatively low rates of pay receive personal development training (enhancement of oral performance, stress management, conflict management, etc.). Regression analysis based on the instrumental variable for personnel training indicates that training has a significantly positive impact on increased wage.

5.5 Wage increases in connection with a change of employer

Increased wage following a change of job or employer is influenced by (i) cumulative training in the previous workplace, (ii) the extent to which the new employer attaches value to this training, and (iii) the way in which the matching between the employee and the new employer changes, in comparison with the previous matching.

Assuming $T - 1$ years of employment before a change of employer, the wage increase for the first year of employment T will result in the following modification of (4):

$$W_{ijT} - W_{ij-1T-1} = \alpha_T P_{ijT} - \sum_{t=1}^{T-1} \alpha_t P_{ij-1t} + \delta P_{ij-1} + \beta_2 \left(X_{ij} - X_{ij-1} \right) + \beta_3 \left(X_{ijT} - X_{ij-1T-1} \right)$$
$$+ \left(\gamma_T - \gamma_{T-1} \right) + \left(v_{ij} - v_{ij-1} \right) + \left(\varepsilon_{ijT} - \varepsilon_{ij-1T-1} \right)$$

$$(5)$$

1995-2000, 46.9 had a training period of 1-2 days and 32.1% had a training programme which lasted 3-5 days.

Thus, the matching-specific effect ($v_{ij} - v_{ij-1}$) is not eliminated, as in the case of pay increases in the same job. Loewenstein & Spletzer (1998) show that this biases the parameter estimate of δ towards zero, resulting in an underestimate of the impact of previous training on increased wage in the event of a job-change, irrespective of whether this impact is positive or negative. The intuitive explanation is that specific training with the previous employer has a negative impact on increased pay, and hence we may expect *δ<0* for a specific training P_{ij-1}. The matching with the new employer must improve if the employee is nonetheless prepared to change jobs, and this means that ($v_{ij} - v_{ij-1}$) > 0. If this aspect is ignored, the regression estimate of δ will be systematically greater – in other words biased towards zero. On the other hand, if training with the previous employer was of a general nature, the parameter estimate will result in *δ* > 0. As a result, employees with general training can systematically change jobs with a less satisfactory matching, and this means that ($v_{ij} - v_{ij-1}$) < 0. The regression estimate of *δ* will once again be skewed towards zero.

However, the skewing of *δ* towards zero in (5) means that a significant parameter estimate of *δ* will provide a clear indication that training in the previous workplace influences pay in the next job. This provides opportunities for testing whether the return on general training is shared between the employer and the employee. Loewenstein & Spletzer used NLSY 1988-1991 to compare the wage increase attributable to training with another employer with training that took place under the current employer's auspices. This showed that "seminars outside the workplace" and "business schools, vocational schools, etc." arranged by a previous employer resulted in a 10-15% higher wage increase than the corresponding training provided by the current employer. As a result, training outside the workplace – which is often of a formal and general nature - provides a higher return for the employee if a previous employer has financed the training. This may be a sign that the employer receives part of the return from general personnel training. On the other hand, since training in the workplace may be assumed to be more specific than training which takes place elsewhere, this is an indication that the employer receives a proportion of the return on general personnel training.

Booth & Bryan (2002), using BHPS data for the period 1998-2000 and the *fixed-effect* model, also conclude that general training provided by a previous employer has a greater impact on pay than training provided by the current employer. General training with a previous employer increases wage by 7.5%,

while the occurrence of training with the current employer increases pay by 2.4%.

Goux & Martin (2000) point out that there are two hidden selection mechanisms that must be taken into account in the wage equation. Firstly, selection of employees for personnel training is presumably dependent on the employee's hidden characteristics, which are also correlated with the level of wage (cf the selection problem during ongoing personnel training). Secondly, if the employer considers that the employer is highly likely to resign after training, the probability of receiving training will presumably diminish. If the employee's propensity to resign also affects his/her rate of pay, estimates of the payoff as a result of participation in training will be biased. Using French data (FQP) which permits matching of the employee and the workplace, they were able to identify two selection equations for participation in training and for changing employers after training. When estimating a wage equation (pay level 1992) to check the two hidden selection mechanisms, they found no significant impact on wage as a result of participation in training during the previous four years. On the other hand, an estimate of the wage equation without this selection check resulted in 5% higher wage as a result of participation in training. This result indicates that the major proportion of the pay differential between employees who have, and who have not, received training is due to hidden characteristics for employees who have received training.

5.6 The impact of a compressed wage structure

In a labour market with imperfect competition, the employee's market wage may increase more slowly than his/her productivity in the workplace concerned, due to the employer's stronger negotiating position. The pay structure becomes squeezed with regard to the employee's productivity and skills. If the employer finances general personnel training, training will increase more if the wage structure is compressed. If, on the other hand, the employee finances general training, training will decline if the wage structure is compressed.

This prediction has been tested at the empirical level to some extent. Bassanni & Brunelo (2003) use the ECHP survey to investigate the way in which compressed pay structures in the EU affect the incidence of personnel training. The degree of compression is measured by calculating the difference between the median wage increase for employees with, and without, training during the previous year. There is a significant negative correlation between this variable and participation in general training, where general training is

approximated to training outside the workplace. This result supports the thesis that general training is financed by the employer.

Almedia-Santos & Mumford (2004) use linked data for workplaces and employees in Britain, and use the ratio of the 90th percentile wage to the 10th percentile wage in the workers' wage distributions as a measure of wage compression. They find that wage compression is positively related to both training incidence and training duration. In contrast to these studies, Ericson (2004) cannot find any positive relation between the same measure of wage compression and training based on data from the Swedish AKU.

The fact that the distinction between general and specific training differs in the three studies might partially explain the different results. Bassanini & Brunello approximate general training as training outside the workplace while specific training is defined as training at the workplace. Almeida-Santos & Mumford do not distinguish between general and specific training, while Ericson uses a direct question to the workers whether training was "mainly general" or "mainly specific".

5.7 The impact of a wage floor

The United States has institutional regulation which affects the volume of personnel training in the form of legislation which establishes a pay floor for new employees. According to fundamental human capital theory, a wage floor reduces training since the employee is not allowed to reduce his/her pay to the extent required to defray the cost of general personnel training[39]. As a result, the presence of a wage floor should inhibit wage growth, in comparison with similar jobs with no wage floor. Leighton & Mincer (1981) and Hashimoto (1982) have also found empirical support that this is the case. Lazear & Miller (1980), however, concluded that it is not certain that higher initial pay and a lower rate of wage growth really prove that training has declined. Lazear (1979), for example, predicts a slower wage increases in a situation involving high initial wages since long-term employment contracts take into account the employee's incentive to perform well.[40] In addition, a wage floor may

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[39] See for example Rosen (1972) and Hashimoto (1982)

[40] Low initial pay is compensated by a steeper wage increases to reward and encourage a high level of endeavour on the employee's part throughout his/her working life.

encourage a longer school education and, in its turn, this augments the increase in productivity resulting from training.[41]

So far, there are a limited number of studies on the correlation between wage floors and the incidence of training, and the results are not conclusive. Using EOPP data, Grossberg & Sicilian (1999) found that employees with a wage floor had slower wage growth, but they could not demonstrate that this was due to less training. Acemoglu & Pischke (1999c) presented theoretical arguments explaining that a wage floor should, in point of fact, *increase* personnel training, based on a model with friction and rigidity in the wage process. The employer profits from the difference between the employee's productivity (MP_t) and the employee's level of pay (W_t). If the employer's profit $MP_t - W_t$ increases after training, the employer will have an incentive to invest in training. In this case, the wage floor established the prerequisites for an increased $MP_t - W_t$ differential since wage is constant if the wage floor constitutes a binding restriction. As a result, training leads to increased MP_t, but a constant W_t. The employee, who has no incentive to reduce his/her pay in order to receive l training, will therefore receive more training if there is a wage floor. Acemoglu & Pischke find empirical support for this theory, based on NLSY data, and this also applies to Arulampalam, Booth & Bryan (2003), based on BHPS data. However, using CPS data, Neumark & Wascher (2001) find support for the alternative theory under which a wage floor reduces training in current employment.

5.8 The impact of trade union membership

Trade union membership may result in a more compressed wage structure, and may therefore result in more or less personnel training[42]. Empirical studies of the impact of union membership of personnel training provide different messages. Duncan & Stafford (1980) (PSID) and Barron et al (1987b) (EOPP) conclude that employee union membership reduces training in the US. On the other hand, Booth (1991) (BSAS) concludes that union membership resulted in increased training in the UK. Based on data from the 1989 British labour-force survey, Green (1995) finds that union membership increases personnel training

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[41] See, for example, Agell & Lommerud (1997).
[42] See section 2.4

in companies with less than 25 employees, but had no impact in larger companies. Kennedy, Drago, Sloan & Wooden (1994) indicate that training increased in Australia, but only if the union appeared to play an active role in negotiations with the employer. Boot et al (2003) use BHPS data, in which they find that men covered by union collective agreements are more likely to receive training, and that they receive a higher return in the form of wage increases than employees not covered by collective agreements.

6 Conclusions

This review of the literature in the field has discussed some of the many question marks in connection with studies of personnel training. We have noted that the research normally takes human capital theory as its starting point, and also its predictions regarding employees' pay.

Personnel training may be studied from two different perspectives. Fundamental human capital theory is based on the employee's incentive to invest in his/her own human capital, and relegates the employer to a role as a passive actor in a competitive labour market. The employee is the party that takes the initiative for general training, since only the employee can obtain any return in the form of higher future income. When training is specific, the employer has more initiative and interest in the realization of training. In this case, the parties have a relationship based on equality, in the knowledge that their alternative return outside the employment contract is limited, due to a competitive labour market. An alternative perspective has been developed more recently in connection with attempts to explain why employers also pay for general training. This institutional approach focuses, instead, on the employer's incentive structure. In a labour market with imperfect competition, and with institutions which maintain various regulations in the labour market, it is shown that the employer has considerable interest in, and influence on, the extent and organization of training.

In the case of empirical research into the impact of personnel training on wage rates, it appears that the latter point of view has the widest support. The impact on wage during the training period is not sufficiently negative to lead one to expect that the employee will pay for the training. The impact on pay after the conclusion of training is less for the current employer than for new

employers, and this indicates that the current employer receives part of the return from general training.

However, it is not possible to determine definitively which of these two approaches should be rejected, and perhaps this would not be desirable. The labour market extends over a wide range of different occupations and situations which make varying demands on skills development and organized personnel training. The employee's motives for training may be a crucial factor in some jobs, while the employer's motives may be the most important factor in other jobs. Theoretical models should indicate the way in which the initiative for training varies between the parties involved in the labour market under different circumstances.

In addition, in order to investigate the way in which personnel training is initiated and implemented, the empirical analyses need to be extended to ensure that details concerning the employee's workplace and the employer are included in the independent variables. This will permit closer study of the extent to which training affects the company's productivity, and of the correlation between higher productivity and pay increases. Matching company-based and individual-based data will probably be a key strategy for the future in this research area.

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