

Unravelling supply and demand factors in work-related training

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This paper attempts to unravel supply and demand factors of work-related training by exploiting information from workers who wanted to receive such training but did not get it. Workers' willingness to receive training varies with their level of education, background characteristics, and job characteristics. Firms' gains from training vary across industries, and with workers' gender and age. Half of the untrained workers are not trained because the net returns to the worker would be negative, while the net returns to the firm would be positive. For another third of the untrained workers exactly the opposite is the case.

1. Introduction

A well-educated workforce is considered to be a prerequisite to maintaining a high level of wealth. At the same time, it is acknowledged that systems of formal education fail to provide the workforce with all the required productive skills. Consequently, attention is shifting to other forms of human capital formation. One form attracting a lot of renewed attention is work-related training of employees. In her introduction to a recent international comparison of private sector training, Lynch (1994) notes that '...employer-provided training creates significant gains for both workers and firms. Productivity is higher in firms with a better-trained workforce, and wages are higher for individuals who acquire post-school training, especially general training.'

If training is so profitable, it is important to know which factors determine who gets it and who does not. Several studies have addressed this question, amongst them: Lillard and Tan (1986), Barron *et al.* (1987), Altonji and Spletzer (1991), Lynch (1992), and Royalty (1996) for the US; Greenhalgh and Stewart (1987), Booth (1991), Greenhalgh and Mavrotas (1994), and Arulampalam *et al.* (1996) for the UK; Pischke (1996) for Germany; and Groot *et al.* (1994) and Oosterbeek (1996) for the Netherlands. The general picture that emerges from these studies is that younger and more highly educated workers are more likely to receive training, as are workers who are employed in larger firms. Furthermore, training probabilities differ by gender and from one industry to another. The findings are broadly consistent with theoretical notions based on a human capital framework.

Workers who are supposed to have a comparative advantage in their costs and/or benefits to human capital acquisition are more likely to receive training.

The theoretical literature on training explicitly distinguishes between supply and demand factors. Following Becker (1962), Hashimoto (1981) developed a model in which the gains and costs of training are shared between firm and employee in such a way that it is *ex ante* a profitable venture for both parties. Also the recent contributions by MacLeod and Malcomson (1993) and Acemoglu and Pischke (1996) deal explicitly with the interaction between demand and supply factors. Yet the empirical studies mentioned above generate estimates that relate to reduced form models as opposed to structural form models. For instance, a more highly educated worker is found to be more likely to receive training than a less highly educated worker. The studies do not explain, however, whether this is so because it is more profitable to a firm to train a highly educated worker, or because highly educated workers are more eager to participate in training programmes. Likewise, Booth (1991) argues that women have lower training levels than men because of employer discrimination, while Royalty (1996) points to higher turnover rates of women as the underlying factor. Researchers in this field rarely mention that their results apply to a reduced form model; a notable exception can be found in Arulampalam *et al.* (1996), where the authors state this clearly when they say that: 'The experience of work-related training is the result of optimizing decisions made by both an individual worker and an employer. . . . Since the data preclude it, we do not model the structural framework for the training decision'.

From a policy perspective, however, it is important to know why certain regularities are observed. For instance, if a government aims at a more equal distribution of human capital formation (and many governments claim to do so) then the effectiveness of different instruments will depend on the relative importance of the two forces. If firms have no preference with regard to the type of worker they train, but if less well-educated workers are simply not interested in training, instruments should be aimed at stimulating such workers to participate in training. If, on the other extreme, both types of workers are equally interested in participating in training but firms are discriminating against the lower educated workers, then policy instruments should primarily be aimed at firms.

The typical question on which empirical analyses of the determinants of training are based asks respondents whether they have participated in any work-related training or course during the last x months, where x often equals 12 or 24. The data set that we use in this paper is unique as it contains an additional question which, to the best of our knowledge, has not been asked and analyzed before. This question is whether 'there is any training or course that [the respondent] wanted to follow during the last 12 months for reasons of work or career, but did not do so.'¹ The basic idea of this paper is that workers who report that they received training during the last 12 months constitute cases where it is beneficial for both the worker

¹ It should be stressed that this question relates to the same types of training as the work-related training participation question does.

and the firm to engage in training, whereas workers who report that they wanted to receive training but did not do so reflect cases where the net gains from training would be positive for the worker but non-positive for the employer. Workers who did not receive training and also did not want to do so, represent cases where the net returns to the worker would be negative, while the net returns to the firm might be either positive or negative. Because we now distinguish three instead of the familiar two groups, we have additional information which allows us to identify demand and supply separately.

One might argue that workers who wanted to receive training but did not do so were constrained by other factors than the firm's willingness to provide training. The data set also includes information about the reasons for not participating in work-related training.² Of the 299 cases in our sample who wanted to receive training but did not do so, 239 mentioned at least one of the following reasons for this: not enough time available, too busy at work, too expensive, lack of support from the firm, the course was not offered, or the course was offered during unsuitable hours.³ In our view, these are all reasons that could in one way or another be eliminated by the employer. For instance, if a course is not offered or is offered during unsuitable hours, the firm could facilitate training participation by offering the course at a time which fits the worker's schedule. But as this might be an over-optimistic interpretation of the different reasons reported by workers, the empirical section of this paper reports results from tests investigating the robustness of the main findings.

A recent paper by Greenhalgh and Mavrotas (1994) is in some respects related to the present paper. In that paper, separate logit equations are estimated with a number of different training variables as dependent variables. Some of these training variables relate to past training and others to expected future training. The authors suggest that past training experiences reflect joint decisions by firm and worker, while expected training reflects the worker's willingness to train. Expected training is based on the question whether the respondent can 'in fact imagine any circumstances in which s/he might go on a training course' (p. 593). Note the difference between this measure of a worker's willingness to receive training, and the measure employed in our paper. The measures have in common that a worker's participation in a training course shows her/his willingness to do so; i.e. a worker is not sent to train against her/his will. But whereas our measure also captures cases where the worker wants to have training but doesn't get it, Greenhalgh and Mavrotas' measure is based on some perceived form of future training participation. It might therefore be queried whether an affirmative answer to Greenhalgh and Mavrotas' question really reflects all cases where workers are willing to be trained. According to Greenhalgh and Mavrotas' definition a worker who really

² Literally, the question reads: 'What were the reasons for not taking this training or course?'; 'this' refers to the previous question which asks about the incidence of rationing.

³ Of the remaining 60 cases, another 33 persons mentioned 'other reasons'; these may or may not refer to employer-related considerations.

wants to go on some prestigious training course which he cannot himself afford and for which, at the same time, he cannot imagine his employer paying, is not willing to receive training. With in mind this reservation, their results indicate that workers in mid-career are more willing to receive training, while it is younger workers who actually get it. Part-timers and those in small enterprises are less willing to train and also receive less training, pointing to some degree of self-selection (p. 594/5). We will return to these findings when we discuss our own results.

The remainder of this paper is organized as follows. Section 2 outlines the statistical model employed in the empirical analysis. Section 3 describes the data source. Section 4 presents and discusses the estimation results. Section 5 summarizes and concludes.

2. Statistical model

Let y_{wi} be a variable measuring the net gains from training to worker i , and let y_{fi} measure the net gains to the firm from training worker i . We assume that y_{wi} and y_{fi} are affected by a vector of observed explanatory variables X_i , parameter vectors β_w and β_f respectively, and disturbance terms ε_{wi} and ε_{fi} . The following model structure is proposed (omitting the individual subscript i)

$$y_w = X\beta_w + \varepsilon_w \tag{1}$$

$$y_f = X\beta_f + \varepsilon_f \tag{2}$$

Four different situations are possible:

- (i) the net gains to both parties are positive: $y_w > 0$ and $y_f > 0$.
- (ii) the net gains to the worker are positive and the net gains to the firm are negative: $y_w > 0$ and $y_f \leq 0$.
- (iii) the net gains to the worker are negative and the net gains to the firm are positive: $y_w \leq 0$ and $y_f > 0$.
- (iv) the net gains to both parties are negative: $y_w \leq 0$ and $y_f \leq 0$.

It is only in the first situation that training will occur, while in the other three situations no training will take place because at least one of the parties involved will be better off without the training. Usually it is impossible to distinguish between these other three situations. Therefore, without very demanding and arbitrary exclusion restrictions, it is impossible to identify β_w and β_f separately. In the present case, however, due to the unique question which identifies workers who were willing to take part in a training programme but did not do so, we are able to single out the second situation.

The net gains to the firm and the worker are not actually observed, but we do observe whether situations (i), (ii), or (iii)/(iv) apply, and from this we can draw conclusions about whether the net gains to the parties are positive or negative. We are then able to construct two dichotomous indicators: y_w^* which equals unity if the net returns to the worker are positive and zero otherwise; and y_f^* which equals

unity if the net returns to the firm are positive and zero otherwise. After making assumptions with regard to the distribution function which generates the disturbance terms ε_w and ε_f , we can formulate the log-likelihood function of the model. We assume that the disturbance terms follow a joint normal distribution with $E(\varepsilon_w) = E(\varepsilon_f) = 0$, $\text{Var}(\varepsilon_w) = \text{Var}(\varepsilon_f) = 1$, and $\text{Cov}(\varepsilon_w, \varepsilon_f) = \rho$. With these assumptions, the log-likelihood function equals

$$\begin{aligned} \log L = & \sum_{y_w > 0, y_f > 0} \log \Phi_2(X\beta_w, X\beta_f, \rho) + \sum_{y_w > 0, y_f \leq 0} \log \Phi_2(X\beta_w, -X\beta_f, -\rho) \\ & + \sum_{y_w \leq 0} \log (1 - \Phi(X\beta_w)) \end{aligned} \quad (3)$$

where Φ is the distribution function of the univariate normal and Φ_2 is the distribution function of the bivariate normal. The first term on the right-hand side relates to the cases where both parties extract positive net gains from training. The second term relates to the employees who wanted to get training but did not do so, while the third relates to situations (iii) and (iv), where the net gain for the worker is negative. Whether situation (iii) or (iv) actually occurs—that is: whether the net gains to the firm are positive or negative—is unknown. (But our estimation results allow us to draw some inferences: see Section 4.1.)

One might argue that the proposed model is wrong in assuming that if a worker receives training both parties benefit from it. Instead it might be the case that the firm is the sole decision-maker determining whether a worker receives training, independent of the worker's willingness to participate. We offer four arguments against this view. Firstly, in a competitive labour market the argument cannot hold because the worker will always have the option of moving to another firm which offers the same wage but does not force the worker into a training programme. The competitive benchmark is fairly dominant in much of the training literature. For instance, Becker's prediction that workers pay the full costs of general training and reap the entire benefits is based on the notion that if the current firm does not pay the worker for his marginal productivity there will be another firm prepared to do so. It would be inconsistent to assume that such relevant outside options are available only after training has occurred and not before. Secondly, as the quote from Lynch in Section 1 shows, results from empirical studies show that both parties benefit from the training that actually takes place. References showing that workers profit from training include Barron *et al.* (1987), Booth (1991), Brown (1989), and Mincer (1988). Thirdly, it can be questioned whether it is really profitable for a firm to train a worker who does not want to receive training. Workers who receive training against their will may not be very motivated and are therefore unlikely to upgrade their skills substantially as a result of the training course. Finally, and anticipating the results of the analysis in this paper, our calculations indicate that in the vast majority of cases where training occurs both parties reap positive gains from it.

Note that if the correlation coefficient (ρ) equals zero, the estimation procedure is equivalent to estimating two separate (univariate) probit equations. In the first probit, the dependent variable equals unity if the worker did receive training or

wanted to receive training but did not get it, and zero otherwise. The second probit equation is estimated only for the sub-sample that belonged to the 'unity' category in the first equation; the dependent variable in this second equation equals unity if a worker received training and zero if a worker wanted to receive training but did not get it. Hence, the vector β_w is identified using the differences between the workers who received training or wanted to receive training but did not get it, and the workers who did not receive training but also did not want to do so. The vector β_f is identified using the difference between the workers who received training and the workers who wanted to receive training but did not get it.

3. Data

The data are taken from the Dutch wave of the International Adult Literacy Survey (IALS). This data set was collected in 1995. The main goal of the data set is to provide detailed and precise information about the literacy and numeracy skills of the Dutch population. To that end, over 3,000 individuals participated in a test measuring their literacy and numeracy skills. In addition, the respondents answered questions relating to their educational attainment, their labour market status and some background characteristics.⁴ For the purposes of the present paper, the two most important questions asked are related to training. One question asked the respondents whether they had participated in any training or course during the last 12 months, and if so whether this training was related to work or career. The other question asked whether there was any training or course that the respondent had wanted to follow during the last 12 months for reasons of work or career, but had not done so. After deleting respondents who were not employed during the previous 12 months, we were left with 1970 observations. 654 of them (33%) received training (situation (i)); 299 persons (15%) wanted to receive training but did not do so (situation (ii)); while 1,017 cases (52%) did not receive training and also did not want to do so (situations (iii) or (iv)).

The explanatory variables used in the analysis can be divided into four categories: personal attributes, human capital variables, firm characteristics, and job characteristics.

The personal attributes that we include are age and dummy variables for non-Dutch background, gender, and whether the respondent is the head of the household. We also include the level of education of the respondent's parents and the number of persons in the respondent's household. Age is included since the potential benefits of training vary directly in line with the worker's age. The younger the worker, the longer the payoff period. Females may receive less training than males because of their presumed weaker attachment to the labour market. However, as Booth (1991) points out, a lower training probability for females may also result from discrimination. The same effect might emerge for non-Dutch workers.

⁴ A description of the International Adult Literacy Survey is given in OECD (1995).

Parents' levels of education are included as they are assumed to proxy the worker's individual discount rate. Individuals from lower social backgrounds are believed to have higher discount rates. Since enrolment in a training programme may place workers on a steeper tenure-earnings profile, workers with high discount rates may be less inclined to choose such a track. Being head of the household and the number of persons in the household indicate the urgency of the respondent's need to earn an income and thereby her/his attachment to the labour market.

The human capital variable included is number of years of schooling. The inclusion of years of schooling is motivated by the idea that a higher level of schooling reflects a greater learning ability and therefore better trainability. Previous studies have found that more highly educated workers have a higher probability of participating in training. From the point of view of both the employer and the employee, this need not be the case. To employers, it might be more beneficial to train their low-skilled workers than workers who already possess high skill levels. Likewise, a lower educated worker may benefit more from a particular investment in training than a more highly educated worker. Apparently, however, it is more beneficial for at least one of the parties (firm or worker) that more highly educated workers get trained, and this effect dominates a possible opposite effect for the other party. It is an important issue whether the positive relationship between current skills and training probabilities is caused by the employer, by the worker, or perhaps by both parties. Our results allow us to draw conclusions in this respect.

A special feature of the IALS data set is that it includes information about respondents' literacy and numeracy. Although it is tempting to include these variables as regressors in the training equations, we decided not to do so. The reason is that it is unclear in which direction causality runs; by including literacy or numeracy scores as exogenous regressors we would implicitly assume that literacy and numeracy affect training decisions, but that training participation does not affect a participant's literacy and numeracy levels. Although this is a plausible assumption for some training courses, it cannot be maintained across the board. Furthermore, literacy and numeracy scores are highly (positively) correlated with years of schooling. Including literacy and numeracy scores as regressors might therefore influence the estimates of the effects of schooling on training decisions. This would reduce the comparability of our results with findings from other studies.

Unfortunately, the IALS data set is not very rich in information about the firm employing the respondent. From previous research, it is known that the probability of training varies with the size of the firm; larger firms provide more training. Also, theory suggests that training is more likely if the firm is innovative, either in terms of physical capital or in terms of organization. The only firm characteristics that are available, however, are a series of 14 industry dummies. It is hoped that these dummies accurately capture the firm effects.

Finally, we include in the list of regressors three job characteristics. These are: (i) a dummy variable that equals one if the worker has a permanent contract (and zero

otherwise); (ii) the number of working hours per week; and (iii) the level of the post that the respondent occupies, measured on a scale from 1 (lowest) to 5 (highest). Workers with a permanent contract are expected to have a higher probability of training as they are less likely to quit or to be dismissed. Workers with longer working hours are thought to be more likely to receive training as the amount of time available to reap the returns of training is greater. With regard to the effect of job level on the training probability, Altonji and Spletzer (1991) argue that higher job skill requirements increase both the marginal productivity of knowledge and the effect of training activities on knowledge (p. 73); they therefore predict that employees in high-level jobs are more likely to receive training.

Compared with other studies dealing with the determinants of training participation, the analysis in this paper contains most of the usual explanatory variables. The only exceptions are: marital status, trade union affiliation, firm size, and job tenure. To compensate for the absence of information on marital status, the characteristics 'head of the household' and 'number of members in the household' are included. The absence of details on trade union membership is considered less of a problem here, given the institutional setting in the Netherlands, than it would be in some other countries. The reason is that all agreements negotiated between firms and trade unions are extended to cover non-union members as well. As stated, it is hoped that the effects of firm size are effectively captured by the inclusion of industry dummies; but obviously this might not be the case. Information on job tenure is not available, and as a result the effects of job tenure on training decisions will now be included in the effects of other variables related to tenure; more particularly, this may bias the coefficients of age, gender, schooling levels, possession of a permanent contract, and job levels.⁵

The above discussion lists the variables that are expected to influence training participation. The arguments given for these predictions sometimes refer to a specific mechanism, but are often more general in nature. Only for some of the explanatory variables is it possible to predict *a priori* whether the effect operates through the worker's decision or through the firm's decision. For instance, when we interpret the effects of parents' education in terms of the worker's discount rate, we expect these variables to affect the worker's decision. It would not make much

⁵ Greenhalgh and Mavrotas (1994) include in their analysis a number of explanatory variables usually not inserted in this kind of study. These unusual variables relate to respondents' financial position (current income and housing assets) and attitudes to self-improvement and career. The second type of variable is not often used in other work because of the lack of this kind of information. Information on financial variables is contained in most surveys (and also in the IALS data set), but seldom used as an explanatory variable. The most important reason for this is probably that, as Greenhalgh and Mavrotas admit (p.585), it is unclear in which direction causality goes. A related branch of literature on training firmly establishes that workers receive financial returns from participation in training. Measuring income in a small number of broad bands (as Greenhalgh and Mavrotas do) does not seem a very convincing method to cure this endogeneity problem. For this reason, and to keep our results as comparable as possible with the majority of studies in this field, we have chosen not to include current income as a regressor.

sense for these variables to affect the firm's gains. A similar argument holds for the variables that indicate the worker's private responsibilities. (On the other hand, it could possibly be argued that firms anticipate this and select such workers for their training programmes.) Likewise, we expect the firm characteristics to influence the firm's gains from training. Variables like age, gender, schooling, and job characteristics, however, may in general affect both the firm's and the worker's gains from training.

Appendix 1 of this paper gives a description of each of the variables included in the analysis. It also reports the mean values and standard deviations for each separate variable and for each of the three groups of workers.

4. Empirical findings

4.1 Results

Estimation results are presented in Table 1. The first column contains the estimates for the univariate probit equation in which the dependent variable equals one if the worker obtained work-related training, and zero for all others. These results are comparable with the usual analyses of the determinants of training.

The results of the univariate model are in line with earlier findings. Older and less highly educated workers have a lower training probability. Other things being equal, workers with years of schooling two standard deviations below the mean are six percentage points less likely to have received training during the past 12 months than workers with a mean amount of formal schooling. Elsewhere we have argued that the positive correlation between formal schooling and training has implications for studies on the rate of return to formal schooling. Just as the rate of return to formal schooling may be biased due to the omission of ability or due to self-selection effects (cf. Willis 1986), there may also be a training bias. To the extent that the worker contributes to the costs of firm training in forms other than reduced earnings—surrendered leisure, for instance—but receives returns to training in the form of higher earnings, omission of firm training in the list of regressors in an earnings equation biases the return to formal education in an upward direction (Oosterbeek, 1996).

Training probabilities are also influenced by the sector of industry, number of working hours, being non-Dutch, father's level of education, and having private responsibilities. Employees in the agricultural, building and hotels sectors are less likely to receive training than those in manufacturing (which is the reference category). By contrast, workers in financial services and public services/government are more likely to receive training than workers in manufacturing. A larger number of working hours per week increases the training probability; evaluated at the mean values of the explanatory variables, a one-hour increase in the working week increases the training probability by 0.3 percentage points. Non-Dutch workers are more likely to participate in a work-related training programme than Dutch workers. The reason for this finding might be that foreigners are not fluent in

Table 1 Estimation results

	Univariate probit	Bivariate probit	
		P (worker's return > 0) β_w	P (train worker's return > 0) β_f
Constant	-0.932 (2.49)‡	-0.807 (2.21)‡	-0.653 (1.18)
Personal characteristics			
age	-0.023 (6.77)‡	-0.024 (7.23)‡	-0.013 (2.45)‡
non-Dutch	0.229 (1.69)*	0.280 (2.05)†	0.06 (0.31)
female	0.025 (0.31)	0.210 (2.70)‡	-0.252 (2.22)†
education father	0.026 (2.26)†	0.029 (2.54)‡	0.009 (0.52)
education mother	0.014 (1.00)	0.007 (0.55)	0.021 (1.09)
head of the household	0.232 (2.82)‡	0.296 (3.76)‡	-0.021 (0.18)
members in household	0.051 (2.11)†	0.063 (2.70)‡	0.016 (0.46)
Human capital			
years of schooling	0.041 (2.78)‡	0.036 (2.49)‡	0.032 (1.44)
Industry			
agricultural	-0.628 (2.73)‡	-0.466 (2.29)‡	-0.620 (1.80)*
manufacturing	reference	reference	reference
public utilities	0.412 (1.14)	0.384 (1.04)	0.217 (0.47)
building/construction	-0.439 (2.56)‡	-0.334 (2.13)‡	-0.428 (1.68)*
repair	-0.116 (1.03)	-0.150 (1.34)	-0.062 (0.38)
hotels, etc.	-0.466 (2.24)†	-0.215 (1.10)	-0.550 (2.04)†
transport/communications	-0.111 (0.73)	-0.145 (0.97)	-0.040 (0.18)
financial services	0.402 (2.65)‡	0.129 (0.84)	0.695 (2.75)‡
trade	-0.019 (0.15)	-0.093 (0.80)	0.074 (0.44)
public services/government	0.257 (1.99)†	0.023 (0.18)	0.529 (2.53)‡
education	0.103 (0.74)	-0.013 (0.10)	0.233 (1.19)
health	0.151 (1.29)	0.096 (0.83)	0.143 (0.85)
environment	-0.031 (0.19)	-0.055 (0.36)	0.031 (0.13)
Job characteristics			
permanent contract	0.087 (1.11)	0.011 (0.14)	0.096 (0.87)
working hours	0.008 (2.88)‡	0.015 (5.58)‡	-0.004 (1.15)
job level lowest	-0.114 (0.81)	0.016 (0.12)	-0.291 (1.45)
job level low	-0.106 (1.22)	-0.124 (1.77)*	-0.031 (0.23)
job level intermediate	reference	reference	reference
job level high	0.039 (0.45)	0.177 (2.04)†	-0.207 (1.72)*
job level highest	0.127 (0.98)	0.263 (2.00)†	-0.139 (0.78)
Log-likelihood	-1,151.33	1,809.36	
number of observations	1,970	1,970	

‡ indicates significance at the 1% level
 † indicates significance at the 5% level
 * indicates significance at the 10% level

Dutch and therefore follow Dutch language courses which they report as being related to their work or career. Workers with more highly educated fathers have higher training probabilities. This can be interpreted in terms of having lower discount rates and therefore attaching a greater weight to the future returns of training. Finally, those with more private responsibilities, because they are head of their household or come from households with more members, are more likely to receive training.

Contrary to most earlier results (but in line with results from another Dutch data set; see Oosterbeek, 1996), we find no significant gender effect. If, however, the household characteristics are deleted from the list of regressors, the gender effect reappears in the usual way: women are less likely to participate in work-related training.

The results in the last two columns of Table 1 represent the model described in Section 2. The results in the second column relate to the probability that the firm wants the employee to receive training. The results in the third column relate to the employee's preferences. We first estimated the bivariate probit model with censoring without restricting the value of the correlation coefficient of the two disturbance terms (ρ). It turned out that this correlation coefficient is not significantly different from zero (estimate 0.19; standard error 1.01). This implies that the unobserved factors that affect workers' gains from training are neither positively nor negatively related to the unobserved factors that affect firms' gains from training. As the estimates for the other parameters of the model gain efficiency from imposing the restriction that ρ equals zero, the results presented in Table 1 are based on this restricted version of the model.

The two sets of parameters in these columns show a nice pattern. Firm characteristics mainly affect the firms's decision, while most personal characteristics, human capital, and job characteristics only affect the worker's decision. For some of the variables, we did not expect to find otherwise. For instance, we would have been rather surprised if the level of education of the worker's parents or the household characteristics had affected the firm's decision. Indeed such findings would be suspect and question the validity of the proposed model, and hence of the other findings. These findings allow us to conclude whether a particular variable affects the training probability because it affects the worker's decision, or because it affects the firm's decision, or both.

The coefficients for age in both equations show that the lower incidence of training among older workers can be attributed to both sides of the training market: older workers are less willing to engage in training than their younger colleagues, and also firms prefer to train their younger rather than their older employees. For the worker's equation this result is expected; for the firm's equation the effect could have run both ways. For the worker, the benefits of training depend on the remaining length of their career, which is obviously longer for young workers than for older ones. For the firm, the benefits depend on the remaining time that the worker is likely to stay with the firm. As mobility is greater among young workers, firms need not have a preference to train younger rather than older workers. Our results indicate nevertheless that they actually prefer to train their younger workers. Our findings deviate from the results reported by Greenhalgh and Mavrotas (1994), who find that older workers want to receive training but young ones get it.

While for age the effects in both equations go in the same direction, the coefficients for gender are opposite in sign. The result in the first column (that men and

women have equal training probabilities), masks the fact that women are more eager to engage in training than men, but that firms prefer to train their male workers. One interpretation of these results is that women who are working have on average greater training needs than men, in order to compensate for more frequent labour market career interruptions. At the same time, employers anticipate that their female workers may interrupt their career and—because it is uncertain when and where they will re-enter the labour market—this puts the firm's training investment at risk.

Non-Dutch workers have higher net gains from training and have therefore a higher probability of wanting to take a training course. The firm is indifferent about whether to train a non-Dutch or a Dutch worker.

Perhaps, the most interesting results are related to the findings with respect to the level of schooling. Workers who possess higher levels of education prove to receive higher net gains from training than low-skilled workers. To firms, however, it does not matter whether they train a high or a low-skilled worker. Thus, the usual finding that more highly educated workers are more likely to participate in training than less well-educated workers is caused by the fact that these workers benefit more from training and not from firms favouring one group of workers over the other.

Most of the sector effects in the univariate probit model occur because firms in different sectors earn different returns from training their workers. In two cases, however, the sector effects arise from the fact that workers in these sectors gain less from training. These sectors are agriculture and building/construction. For the agricultural sector this finding may be explained by the fact that the worker's and the firm's decisions coincide because many workers in this sector are self-employed.

Employees working longer hours are more likely to receive training because they earn higher returns from training than employees with shorter hours. This is consistent with the result found by Greenhalgh and Mavrotas (1994). Firms seem not to distinguish in this respect between employees with long and short working hours. This might be the case if not only the firm's benefits but also the firm's costs of training are proportionate to hours of work. Furthermore, workers in higher-level jobs prove to be more eager to receive training, but firms are not more likely to train their higher ranking personnel. This does not support the hypothesis advanced by Altonji and Spletzer (1991) that higher job skill requirements increase both the marginal productivity of knowledge and the effect of training activities on knowledge. In that case, firms would benefit more from training their high ranking workers. Instead, our findings suggest that, if a positive relation between job level and training probabilities is found, this is due to the fact that workers in high-level jobs gain more from training.

Apparently, costs and benefits are shared in such a way that firms are indifferent between different types of workers. For some types of employees, on the other

Table 2 Untrained, unrationed workers by worker and firm gains from training

	$X\beta_w > 0$	$X\beta_w < 0$
$X\beta_f > 0$	354	491
$X\beta_f < 0$	8	164

hand, the sharing of the costs and benefits from training is more favourable than for other types of employees. An alternative explanation of our results is that firms may have stated or written training policies that apply to all workers independent of the type of background variables included in our analysis. In that case, a firm's agreement to training participation may not always lead to net gains for the firm. From the perspective of our model, however, firms act as if they retrieve net gains.

A majority of the workers in the sample did not receive any training during the previous 12 months and also did not want to receive training. With our estimation results it is possible to infer whether it is only the worker who has negative predicted net gains from training, or whether the predicted net gains are negative to either party. To that end, we calculate for these workers the signs of the predicted values of net gains to the firm and to the worker. Table 2 shows the results.

Not all cases are allotted to the two cells that correspond to the actual situations (iii) and (iv). A rather large number of 354 untrained workers have predicted values for $X\beta_w$ and $X\beta_f$ exceeding zero. These untrained workers have characteristics that make them likely to receive training. An explanation for this unpleasant finding might be that in the data set training incidence is measured over the relatively short period of the previous 12 months. Presumably, many of the respondents in the upper-left cell of Table 2 received training just before that period or will receive it just afterwards. Another eight respondents to whom situations (iii) or (iv) apply, are incorrectly assigned to the group who wanted to receive training but did not do so. Of the remaining 655 cases, 491 belong to the group of workers whom it would be beneficial for the employer to train, but who do not reap positive net gains from it. The results do not enable us to determine whether the sum of the worker's negative gain and the firm's positive gain is positive or negative. If the joint gain is positive, the current situation of no training is inefficient but, as we have no metric to compare the values of $X\beta_w$ and $X\beta_f$, the issue is unsettled. For another 164 respondents, the calculations suggest that the worker nor the firm would gain from training.

A similar table can be constructed for the workers who actually received training; see Table 3. This establishes that, for a vast majority of the trained workers, both the firm and the worker extract positive net gains from training. This is evidence against the argument that the firm is the sole decision maker concerning training decisions (cf. Section 2).

Table 3 Trained workers by worker and firm gains from training

	$X\beta_w > 0$	$X\beta_w < 0$
$X\beta_f > 0$	415	212
$X\beta_f < 0$	10	17

4.2 Sensitivity of the results

The results presented so far are based on our interpretation that workers who wanted to receive training but did not do so were the victims of rationing by the firm. Firms are assumed to receive negative net gains from these workers' training participation and will therefore not provide training for these workers. It can be argued, however, that workers might be rationed for reasons unrelated to their employers. As the questionnaire also includes a question on why workers did not participate in the training they wanted, we can investigate whether the results of this paper are robust with regard to this issue.

As reasons for not attending the training course they wanted, the questionnaire gives the following: (i) too busy at work (39); (ii) too expensive (53); (iii) lack of support from the employer (19); (iv) inconvenient hours/not offered (32); (v) not enough time available (96); (vi) personal reasons (family, health, language) (27); (vii) other reason (33).⁶ The figures in brackets represent the number of cases mentioning that reason. In the analysis presented in the previous section, we made no distinction between any of the reasons. The implicit assumption is that each of these reasons could have been eliminated by the firm. This is easiest to imagine in relation to reasons related to time and money. If the worker has not enough time available (either at work or outside of work), the firm could just reduce the number of working hours or the tasks assigned to the worker during the training period. If courses are offered during unsuitable hours or not offered at all, the firm could facilitate the worker's training participation by offering the course during hours which fit the respondent's schedule. Lifting the worker's constraints is probably most difficult when the reasons are related to personal circumstances such as family responsibilities, language problems, and health problems. But even here the employer could remove constraints, for instance by offering the course in another language.

To investigate the robustness of our findings, two kinds of analyses were carried out. By taking all the reasons together, we in fact pool different states. In the context of a multinomial logit model, Cramer and Ridder (1991) developed a test to investigate whether reasons are really different or whether some distinctions are irrelevant. We started with the most elaborate specification distinguishing all

⁶ The categories 'inconvenient hours/not offered' and 'personal reasons' cluster reasons which were listed separately in the questionnaire, but which were mentioned not often enough do distinguish them separately in our analysis.

reasons as separate states. Next, we tested whether differences between some of the states can be considered as irrelevant. The test statistics indicate that (at the confidence level of 95%), the categories 'too expensive' and 'lack of support from the employer' are identical. The same is true of the reasons 'too busy at work' and 'not enough time available'. On the other hand, 'too busy at work' and 'inconvenient hours/not offered' turn out to be different reasons, as are the reasons relating to time and those relating to financial resources. The important conclusion we draw from this is that the reasons 'too busy at work' and 'not enough time available' are related to a similar underlying phenomenon. This holds also for the reasons 'too expensive' and 'lack of support from the employer'. Since 'too busy at work' and 'lack of support from the employer' are definitely reasons which can be eliminated by the firm, these empirical results suggest that the same is true of the reasons 'not enough time available' and 'too expensive'. These results therefore support the argument expressed in the previous paragraph.

As another test for the robustness of our findings, we simply eliminated from the analysis respondents who reported reasons not explicitly related to firm behaviour. We re-estimated the bivariate probit model with censoring using different subsamples. First, we removed the respondents who reported 'personal reasons (family, health, language)' and 'other reasons'. Secondly, we also eliminated those mentioning 'inconvenient hours/not offered', and finally we removed those respondents reporting 'not enough time available'. This reduces the sample used for the estimation from 1970 to respectively 1,910, 1,878, and 1,782 observations. For all three possibilities we tested whether the newly estimated coefficients were significantly different from those obtained using the full sample. In the first two versions, this turned out not to be the case, but in the third version equality of the coefficients had to be rejected.⁷ Closer inspection of the results from the third version shows that equality is rejected because the sizes of the coefficients are different. The signs of the coefficients and their levels of significance are, however, almost unaffected. The only coefficients that change from significantly different from zero into insignificant are those for gender in the worker's decision equation and those for age, gender, and some industry dummies in the firm's decision equation. This shows that we should treat our previously reported results on gender and age effects with some caution. All in all, the findings presented in this subsection indicate that the main results of our analysis are quite robust.

5. Conclusion

Theoretical studies stress that investment in work-related training is a joint decision by employer and employee. So far, empirical studies have been unable

⁷ This is easily tested by comparing the log-likelihood values at the new optimum and when the coefficients are restricted to equal those obtained from the full sample. Minus twice the difference between these values is Chi-square distributed with 54 degrees of freedom. The respective test statistics for the three versions are 19.2, 42.2, and 153.8.

to distinguish the two parts of the training decision. Results are therefore interpreted in a reduced form mode. This paper attempts to unravel supply and demand factors by exploiting information from workers who wanted to receive work-related training but did not get it. Workers' willingness to receive training varies with their level of education, background characteristics, such as age and gender and job characteristics. Firms' gains from training are found to vary across industries, and with workers' gender and age. With the exception of the latter findings, the results are quite robust. The findings suggest that half of the untrained workers are not trained because the net returns to the worker would be negative, while the net returns to the firm would be positive. For another third of the untrained workers exactly the opposite is the case. The remaining 17% is untrained because the net returns to both parties would be negative.

In addition to these empirical findings, this paper also makes a methodological contribution. What it shows is that one clever additional question enables extra information to be obtained which is useful in identifying demand and supply forces. Such information is required to bridge the existing gap between the theoretical and empirical training literature. As always, there remains room for improvement. In particular, it would be helpful if more precise information were available about the reasons why those workers who wanted training did not get it. Moreover, it would be very useful to have information about possible rationing on the part of the firm.

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Appendix 1

Table A1: Description of variables, means, and (in brackets) standard deviations

	situation (i) trained workers	situation (ii) untrained, rationed workers	situation (iii) and (iv) untrained, unrationed workers
Personal characteristics			
age	35.56 (9.7)	36.5 (9.5)	39.1 (11.8)
non-Dutch (dummy)	0.06 (0.24)	0.06 (0.24)	0.04 (0.19)
head of the household; dummy equal to 1 if the respondent is head of the household; 0 otherwise	0.72 (0.45)	0.70 (0.46)	0.64 (0.48)
number of persons in the household	2.76 (1.35)	2.78 (1.39)	2.77 (1.32)
female (dummy)	0.42 (0.49)	0.45 (0.50)	0.44 (0.50)
education father: level of education of respondent's father (in years)	10.90 (3.31)	10.46 (3.08)	9.72 (3.20)
education mother: level of education of respondent's mother (in years)	9.42 (2.77)	9.01 (2.70)	8.51 (2.67)
years of schooling: years nominally required to obtain the respondent's higher certificate	13.02 (2.58)	12.49 (2.62)	11.78 (2.75)
Industries			
agricultural	0.01 (0.11)	0.04 (0.19)	0.04 (0.20)
manufacturing	0.15 (0.36)	0.16 (0.37)	0.16 (0.36)
public utilities	0.01 (0.10)	0.01 (0.08)	0.00 (0.07)
building/construction	0.03 (0.16)	0.05 (0.23)	0.06 (0.24)
repair	0.12 (0.32)	0.14 (0.35)	0.16 (0.37)
hotels, etc.	0.02 (0.13)	0.05 (0.22)	0.03 (0.18)
transport and communications	0.05 (0.21)	0.05 (0.23)	0.06 (0.24)
financial services	0.08 (0.27)	0.03 (0.16)	0.04 (0.20)
trade	0.12 (0.32)	0.12 (0.33)	0.11 (0.31)
public services/government	0.11 (0.31)	0.05 (0.22)	0.07 (0.25)
education	0.10 (0.30)	0.09 (0.29)	0.08 (0.27)
health	0.17 (0.37)	0.15 (0.36)	0.13 (0.34)
environment	0.04 (0.20)	0.05 (0.21)	0.04 (0.20)
Job characteristics			
permanent contract: dummy equal to 1 if the respondent has a permanent contract; 0 otherwise	0.79 (0.41)	0.74 (0.44)	0.76 (0.42)
working hours: number of contractual working hours per week	36.3 (12.7)	37.1 (14.9)	32.7 (14.6)
job level lowest	0.05 (0.22)	0.08 (0.28)	0.08 (0.28)
job level low	0.17 (0.38)	0.18 (0.39)	0.28 (0.45)
job level intermediate	0.39 (0.49)	0.38 (0.49)	0.40 (0.49)
job level high	0.26 (0.44)	0.26 (0.44)	0.18 (0.38)
job level highest	0.12 (0.33)	0.09 (0.29)	0.06 (0.24)
number of observations	654	299	1,017