THE DEMAND AND SUPPLY OF WORK-RELATED TRAINING: EVIDENCE FROM FOUR COUNTRIES

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I. INTRODUCTION

There is an expanding literature that studies the relationship between training incidence and intensity on the one hand and worker and firm characteristics on the other. These studies reveal a fairly consistent picture even across countries. Most results indicate that training increases with firm size and level of formal schooling, decreases with age, and is lower for women than for men. Altonji and Spletzer (1991), Lillard and Tan (1986), Lynch (1992), Lynch and Black (1995), Royalty (1996), are examples of such studies for the United States; Greenhalgh and Stewart (1987), Booth (1991), and Arulampalam and colleagues (1996) for the United Kingdom; Pischke (1996) for Germany; Alba Ramirez (1994) for Spain; and Groot and colleagues (1995) and Oosterbeek (1996) for the Netherlands.

Although the same relationships are repeatedly found, there is still much lack of clarity as to why a particular variable is associated with high (or low) training incidence or intensity. Different theories are equally consistent with the evidence. For instance, Booth (1991) argues that the finding that women have lower training

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levels than men is caused by employer discrimination. Opposed to this is the finding by Royalty (1996) who points to the higher turnover rates among women as the underlying factor. Different, also, is the result reported by Oosterbeek (1996) who finds that the gender effect disappears once the analysis controls for job characteristics. Similar reasoning applies to other determinants of training. Are higher training levels in larger firms caused by different technologies, different turnover patterns or different characteristics of the workforce? And also, is the training level of more highly educated workers higher because firms find these workers more attractive trainees, or because these workers are more eager to engage in training activities?

These competing explanations for the observed findings illustrate that the usual analyses relate to reduced form models while the underlying structural form model remains unknown. Arulampalam and colleagues (1996) 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" [our italics]. In this sense the empirical training literature has not been able to bridge the gap between it and the theoretical literature, where explicit attention is given to the interaction of supply and demand (Acemoglu & Pischke, 1998b; Becker, 1962; Hashimoto, 1981, offer examples).

This discrepancy is partially due to lack of data allowing separation of worker and firm preferences. But besides the lack of proper data, most studies tend to focus on the firm in their explanations of training incidence. The implicit assumption typically found in the interpretations of these "reduced form" equations is that the employer provides training whereas the employee receives training. This is in practice, however, not automatic focusing on the employer side might be justified in the case of general training[1] but where specific investments are concerned cost-sharing and bargaining will occur (Becker, 1962; Hashimoto, 1981). Moreover, market failures related to liquidity constraints and imperfect and asymmetric information make bargaining between the worker and the firm more relevant. In short, the interests and possibilities of workers and firms will not necessarily coincide, and it is unclear how they are reflected in the reduced form equations mentioned above.

The main contribution of this chapter is to draw attention to the different contributions of supply and demand. Firstly, it presents descriptive information about employer and employee behavior with respect to financing, provision, methods and initiating of work-related training. Secondly, it exploits information from employees who report that they wanted to receive more training than they actually did. A simple demand and supply model of training is developed which uses information from rationed and unrationed workers to estimate this model.

The analyses in this chapter use data from the International Adult Literacy Survey (IALS). This data source contains comparable training data for a number of different countries. We present comparative descriptions and analyses for two North

American countries (Canada and the United States) and two continental European countries (the Netherlands and Switzerland). To the best of our knowledge, no such coherent analysis has ever previously been presented for different countries. International comparisons of (determinants of) training levels are important since the competitiveness of countries depends heavily on the relative quality of their workforces.

The remainder of this paper is organized as follows. Section II starts with a brief introduction to the IALS dataset. Then it presents descriptive statistics about who initiates training, how it is financed, who provides it and which methods of instruction are used in the four countries. Section III presents estimation results from the usual probit and tobit specifications to explain training participation and training intensity. These results are interesting in their own right because they offer a close comparison of training determinants in different countries, but also serve as benchmarks for the findings of the demand and supply model. Section IV gives descriptive information about the reasons for being constrained, and reports probit results to detect the characteristics which may explain rationing of training choices. Section V describes a model for demand and supply of training and presents estimation results for this model. Section VI summarizes and concludes.

II. CHARACTERISTICS OF WORK-RELATED TRAINING

This section starts with a brief description of the dataset and goes on to present descriptive statistics of some relevant demand and supply characteristics of the training received by respondents.

A. The Data

The International Adult Literacy Survey is the result of a unique initiative to collect comparable data about the literacy of adult populations in seven countries: Canada, Germany, the Netherlands, Poland, Sweden, Switzerland, and the United States. Researchers and statistical offices in these countries developed an instrument that is believed to be capable of comparing individual performance in literacy tests among countries with different languages and cultures. In each of the countries, between 2,000 and 4,500 individuals participated in the survey. The dataset includes individual sampling weights, which were used for all analyses in this chapter. Consequently, results are deemed to be representative for the populations in the respective countries.

In addition to the literacy tests, all participants completed a questionnaire gathering information about attitudes and behavior relevant to performance in the literacy tests. This questionnaire also included questions about labor market status, participation in training, education and demographic characteristics. Besides the comparable information about literacy, a unique feature of the dataset is that the

questions in the background questionnaire were intended to be the same in all countries and also that the coding of the answers is comparable.[2]

Although the original IALS sample contains information from seven different countries, suitable information about the training variables is available for only four countries. Germany is deleted from the analysis because the phrasing of the training questions in that country were slightly different, leading to under-reporting of employer training activities. Sweden could not be included because that country did not include the detailed training supplement in the questionnaire.[3] Finally, Poland is excluded from the analysis. The main reason is that training incidence there is very low and very few workers report constraints on their training choices. This makes the sample size overly restrictive.

Since results may be sensitive with respect to the exact phrasing of the training question, it will be useful to give the question here in verbatim form. Whether a person participated in any work-related training is deduced from a combination of the following questions: "Did you receive any training or education since August 1993?" and "What was the main reason you took this training or education?" (Respondents are only counted if they give "career or job-related purposes" as the main reason), and "Were you taking this training towards . . ." (where we did not count those courses leading to a formal education qualification). Respondents could then report, for up to three training episodes, the number of weeks the training lasted, the average number of days per week, and the average number of hours per day.[4] This information was employed to calculate the actual number of training hours (which we divided by 40 so that we could measure training intensity in full-time weeks). The questionnaire also asked whether the respondent had participated in training in the course of the previous five years. The information from this question was discarded for two reasons. First, the question does not allow a distinction to be made between work-related training and training undertaken for other purposes. Second, since five years is a rather long period relative to the duration of a short training episode, respondents might have forgotten short periods of training (cf. Bartel, 1995, p. 402; Loewenstein & Spletzer, 1996; Pischke, 1996, p. 3).

Table 1 gives summary information about participation rates and length of training. Participation rates range from 29 percent in Switzerland, through 32 percent in the Netherlands and 34 percent in Canada, up to a high 40 percent in the United States.[5] This order is reversed when training is measured in full-time weeks of training: the average unconditional intensity of training is the lowest in the United States, with an average length of about 0.75 weeks; Canada comes third with 0.91 weeks; the Netherlands is now second with 1.26 weeks of training during the past year, and Switzerland occupies the top position with 1.41 weeks. For workers who participated in training, the average spell in the Netherlands lasts about 3.4 weeks, compared with only 1.5 in the United States.

Table 1. Participation Rate and Intensity by Country

Variable	*Canada (1)*	*Netherlands (2)*	*Switzerland (3)*	*United States (4)*
Participation rate	0.34	0.32	0.29	0.40
Training intensity	0.91	1.26	1.41	0.75
- among trained	1.97	3.42	2.31	1.46

B. Characteristics of Work-Related Training

The IALS background questionnaire includes a detailed section on training. This includes questions on important characteristics of the delivery of training such as financing and provision (for a maximum of three training episodes). Table 2 presents descriptive information about these characteristics. The unit of measurement in this table is training episodes and not respondents. Therefore, if a respondent provides information about two or three different training episodes, both or all three will be included separately in Table 2.

A prerequisite for any training to occur is that someone initiates it. The actual question included in the survey reads: "Who suggested you should take this training or education?" Possible categories of response to this question are given in the first panel of Table 2. The figures in the table are percentages of training episodes that have the characteristic. For instance, 42.6 percent of training in Canada was initiated by the worker. Since the questionnaire allows multiple answers (pointing to joint initiatives), the sum of the percentages per column may exceed 100.

Clearly, the two main parties involved in the process of initiating training are the worker and the firm. In Switzerland the worker's own initiative is as important as that of the firm. In the other countries, the likelihood of the employer initiating training is more than twice that of the worker doing so. The gap between employers and employees in this respect is largest in the United States: U.S. employers top the list of initiative-takers while U.S. workers rank lowest. All the other possible initiators, including colleagues, collective agreements, unions and legal requirements, seem relatively unimportant.

The pattern and percentages found seem to suggest that workers and firms coordinate training decisions more in Switzerland than in the other countries. Cross tabulations (not reported here) show that one in four training courses in Switzerland was the result of a joint initiative by both the worker and the firm, whereas in Canada the figure was one in seven (13 percent), in the United States one in ten (10 percent), and in the Netherlands one in twenty (4 percent). To sum up, it seems that both workers and firms take the training initiative. Firms do so more often than their employees, but the demand side is definitely not negligible.

Table 2. Characteristics of Work-Related Training

Characteristic	*Canada (1)*	*Netherlands (2)*	*Switzerland (3)*	*United States (4)*
Initiative				
Firm	63.1	58.0	62.5	71.7
Worker	42.6	35.1	58.8	33.4
Collective Agreement	2.0	0.2	1.5	0.1
Colleagues	4.8	5.7	2.6	2.2
Friends/Family	3.4	2.0	1.6	0.9
Legal Requirement	5.5	2.7	7.9	5.2
Social Services	0.9	0.0	0.1	0.0
Union	1.2	0.8	0.4	0.1
Other	0.9	2.8	1.2	1.1
Finance				
Firm	80.9	85.8	72.6	85.3
Worker	15.5	12.2	22.8	9.6
Government	10.2	4.9	15.1	5.8
Union	3.1	0.6	1.7	1.0
No fees	2.6	0.5	0.9	3.1
Other	0.2	1.7	1.5	1.7
Provider				
Firm	52.2	40.2	45.0	45.0
Commercial Org.	19.1	22.2	11.3	22.2
Supplier of equipment	5.7	6.0	9.5	8.8
Further Education	6.4	8.5	n.a.	3.8
Higher Education	8.1	8.1	12.1	10.6
Non-profit Org.	9.0	0.9	10.9	11.5
Other	4.0	14.9	60.5	7.4
Method				
Class	88.1	77.8	90.5	86.6
On-the-job Training	39.4	30.8	29.5	22.4
Reading	71.4	74.1	61.5	29.5
Software	21.0	26.5	28.4	11.1
Video/tape/disc	42.4	31.4	25.1	20.7
Radio/TV	4.1	11.0	6.6	1.1
Other	2.3	5.0	11.5	2.0

The second part of Table 2 shows how training is financed. The exact phrasing of the question is: "Was this training or education financially supported by...?" Possible categories are listed in the table. Two remarks are in order here. First, the question is not explicit about the types of costs to which it refers. It is not clear whether it relates only to direct costs such as tuition fees, books and other materials, or also to opportunity costs in terms of productivity forgone. Second, not all

cost-bearing is explicit: when a worker bears part of the cost of training in the form of a lower wage rate, he may not perceive that this is the case and thus not report that he supports the training financially. Since more than one financial source is possible, the sum of the percentages per column in this part of the table may exceed 100.

It is quite clear that the main source of funding for training is the employer, followed by the worker and the government. This ranking holds for all four countries, but the absolute figures differ. In the Netherlands, 86 percent of training episodes are funded by the employer. In Switzerland the percentage is only 72, while Canada and the United States are closely behind the Netherlands with 81 and 85 percent. The mirror image of this is the finding that the percentage of courses which workers report that they themselves helped to fund is highest in Switzerland. This is consistent with the earlier finding that workers more often initiate training in Switzerland than in the other countries.

Government seems to be a more important source of funding in Canada and Switzerland than in the Netherlands and the United States. Here again, there may be some difference between the actual situation and workers' perception of it. If firms receive government subsidies or tax deductions when they train their workers, financial support is actually from the government rather than from the employer, although workers answering the question may not realize this. A similar remark holds for the costs paid by the worker. If training expenditures by workers are tax-deductible, the government contributes to the training costs. Again, it is unclear whether respondents will take this into account.

Although there is no information about the exact share of the costs of training that employers bear, the percentages in Table 2 suggest that employer involvement is widespread. According to the standard human capital approach to training, this is only possible if training is firm-specific. Based on cross-tabulations of "source of financing" and "party that initiated training," the top panel in Table 3 shows that courses where the worker initiates the training and the firm supports it financially are frequent: percentages range from a low 64 percent in Switzerland to a high 77 percent in the United States. The breakdown by initiative suggests that it is not the Swiss employers who are different but the Swiss workers, who finance more of the training they initiate than workers in other countries. This seems to suggest that Swiss workers initiate more general training than workers in other countries.

Furthermore, a cross-tabulation of "source of financing" and "provider of training" shows that employers often provide financial support for training provided outside the company (the second panel of Table 3 is based on this cross-tabulation). Although the percentages for external training are lower than for training provided by the firm, they remain substantial. While firm-specific training may in principle be initiated by the worker and provided outside the company, this seems unlikely.

We conclude, therefore, that our results tend to indicate that firms fund general training. This conclusion is not new; others have found similar indications (cf. Bishop & Kang, 1996). A number of recent theoretical papers have attempted to

Table 3. Source of Finance by Initiative and Provider

A. Source of finance by initiating party

Initiative	*Canada (1)*	*Netherlands (2)*	*Switzerland (3)*	*United States (4)*
Worker				
- Firm finance	65.7	76.2	63.8	76.5
- Worker finance	29.3	26.4	36.2	22.0
Firm				
- Firm finance	92.7	96.5	88.4	90.8
- Worker finance	7.9	2.0	7.9	3.6

B. Firm finance by type of provision

Provider	*Canada (1)*	*Netherlands (2)*	*Switzerland (3)*	*United States (4)*
Firm	95.0	91.1	91.7	91.3
Supplier of equipment	81.4	93.8	86.5	86.2
Commercial Org.	76.9	85.2	56.9	88.2
Higher education	43.2	92.7	72.5	81.9
Further education	49.1	68.2		80.2
Non-profit Org.	78.8	48.0	65.8	74.5
Other	58.0	78.3	59.6	75.9
All courses	80.9	85.8	72.6	85.3

explain this phenomenon (see, Acemoglu & Pischke, 1998a; Katz & Ziderman, 1990; Stevens, 1994). A common feature of the models in these papers is that some kind of labor market imperfection is introduced. Finally, the patterns match the hypothesis that employers are more likely to initiate specific training and employees are more likely to initiate general training.

A third characteristic of training is the way it is provided. Here the question reads "Was this training or education given by . . .?" Again the categories are given in Table 2. In all countries, the provider with the highest frequency is the company. The percentage ranges from 40 percent in the Netherlands to 52 percent in Canada. A majority of training is therefore not provided by the company itself. Consequently, there are many other sources of provision; commercial organizations and higher and further education institutions all train considerable numbers of workers. Training by equipment producers and by non-profit organizations is not very common. The unspecified category of "other" providers is far from absent. Especially in Switzerland, a disturbingly high percentage of workers report this category.

A fairly wide variety of methods of instruction are used in education and training. Traditional methods of class instruction (including seminars and workshops) may be used, but so may other modes using non-traditional media such as computer software, television and videos. Instruction on the job is another possibility. The

question asked was "whether the training or education was provided through . . . ?" The fourth part of Table 2 lists the different categories of response and their frequencies in the four countries. Again, because multiple answers are allowed, the sum of percentages of all methods may exceed 100. Clearly, frontal instruction in classes, seminars and workshops is the method most often used in all countries. The proportion of training episodes for which this method was used ranges from 78 in the Netherlands to 90 percent in Switzerland.

Very substantial differences between the four countries can be observed regarding the frequency of media use. Use of computer software is two to three times as popular in Canada, Switzerland and the Netherlands as it is in the United States. The United States also lags behind regarding the use of reading materials. While reading materials were used for 74 percent of the training episodes in the Netherlands, in the United States the figure is only 30 percent. The Netherlands also ranks highest with regard to use of television/radio and (together with Canada) videos, tapes, and discs. Note that specific training is most likely to take the form of on-the-job training and that this was used for up to 40 percent of the reported episodes (Canada).

The main findings of this section are as follows. First, there is a strong indication that employers fund training which is not entirely firm-specific. In all the countries in our sample, employers finance about 90 percent of the training episodes that they initiate and about three-quarters of those which workers initiate. Second, work-related training is more often initiated by employees in Switzerland than in Canada, the Netherlands and the United States, and Swiss employees are also more likely to share the costs of this training.

Our findings suggest that workers are more likely to initiate general training and to contribute financially to the costs of this form of training. Firms are more likely to initiate specific training and are less likely to pay for general training. Nevertheless, employer investments in general training are very frequent. Third, we observe a notable difference between countries with respect to the method of instruction. In the United States much less use is made of computer software and reading materials than in the other three countries.

Finally, there is clear evidence that training is the result of the interaction of workers and firms. Firms are the main initiators and funders of training but there is considerable room for employee initiative and where employees take the initiative they are more likely to share the costs.

III. DETERMINANTS OF TRAINING

In this section we present estimation results from the usual probit and OLS equations to explain training participation and intensity. These models can be seen as the reduced form of an underlying structural model that incorporates demand and supply factors. The reason for reporting these reduced form findings is twofold. First, these results may serve as benchmarks for the analysis of supply and demand

in the next section. Secondly, the results are interesting for their own sake, because of the unique degree of comparability across the countries in our sample. Before presenting and discussing the estimation results, we first define the variables included as regressors and give reasons for their use.

A. Choice of Regressors

The regressors used are variables common to the empirical training literature and available for all four countries included in our analysis. Some of the usual determinants, like firm-size, are available for some countries but not for others; because we aim at comparability among countries, we use only those variables that are available for all four countries. The first determinant included in the analysis is gender. In the introduction we have already mentioned some possible reasons for a gender gap in training (discrimination, turnover, and job characteristics). The next variable that we include is the level of formal schooling. Earlier findings show that more highly educated workers have higher training probabilities. This suggests that the marginal revenues to training are higher for more skilled workers and/or that their marginal costs are lower. Theoretically, however, this need not be the case. It might be relatively cheap to raise the skills level of a lower educated worker by a certain amount and at a low skills level the addition of an extra "unit" of skills may bring higher returns.

In addition to levels of formal schooling, the IALS dataset also contains information about direct skills measures of literacy and numeracy. Although the availability of these measures is an attractive feature of the dataset, it is unclear how to deal with such variables in an analysis of training. The reason is that skills levels have been measured after the training took place and may therefore be considered the result rather than the cause of the training. On the other hand, however, it is unlikely that the skills levels are greatly affected by the training programs (most of which are rather short-term). A positive correlation between skills and training can therefore be interpreted in two different ways: either that the more highly skilled have higher training probabilities, or that training raises skills levels. For this reason, we decided not to include the skills scores in the list of regressors.

The age of the respondent is included in the analysis. The reason for this is that potential benefits of training may vary directly in line with the worker's age. The younger the worker, the longer the expected pay-off period. On the other hand, however, younger workers are more mobile and employers therefore run greater risks of losing their investments due to quits. Unfortunately, information on labor market experience is scarce in the dataset; it was only possible to construct a dummy variable indicating whether the worker's tenure with the current firm is more than one year, or less than one year. Although imperfect, we include this variable in the list of regressors to proxy tenure.

Two other demographic variables included in the analysis are dummies for living in an urban area and for being of foreign origin. Living in an urban area rather than

a rural area and being native rather than non-native are often associated with stronger labor market positions. We test whether this also translates into higher training levels. Unfortunately, the IALS dataset is not very rich in information about employer companies. The only variable available in all countries is industry. It is hoped that the one-digit dummies for industry accurately capture the effects of such variables as firm-size and organizational and technical innovations.

Finally, we include a number of job characteristics in the list of regressors. These are: a dummy variable that equals one if the worker has a temporary rather than a permanent contract, a dummy for working full-time rather than part-time, and one-digit occupation dummies.[6] Workers on temporary contracts are assumed to be less likely to invest in specific training than workers on permanent contracts, because they are more likely to be dismissed or to quit. To the extent that training is general in nature, workers on temporary contracts should not be less willing to attend training since the returns on it can also be reaped in other places. For employers, however, investing in general skills of temporary personnel is not a very attractive proposition. Full-time workers are expected to participate in more training than their part-time colleagues. There is more time available to make the improved skills productive and the costs of training may be lower if it can take place during slack hours (which are more likely to occur for full-timers than for part-timers).

The occupation dummies refer to the type and level of occupation. According to Altonji and Spletzer (1991), higher job skill requirements increase both the marginal productivity of knowledge and the effect of training activities on knowledge. The prediction is thus that workers in higher job levels will participate in more training. The level of training refers to all work-related training taken in the last 12 months. Where workers have changed employers during the preceding year, some of the reported training may have been received during previous employment. The dummy variable for tenure of more than one year should capture this effect.

Compared with other studies dealing with the determinants of training, the analysis in this paper contains most of the usual explanatory variables but excludes marital status, trade union affiliation, firm-size, and a more informative measure of job tenure. It is hoped that the union and firm-size effects are effectively captured by the inclusion of industry dummies, but obviously this may not be the case. More detailed 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 having a full-time job.

B. Results

Now we turn to the estimation results. To analyze the amount of training (measured in full-time weeks), we use ordinary least squares to estimate a log-linear specification. For the participation equation, we use the probit model. For participants in training the dependent variable equals unity and for non-participants it

equals zero.[7] With the probit structure, predicted values are between zero and one, and can be interpreted as the probability that a particular worker participated in training. Tables 4 and 5 present the estimation results. Although they are not reported in the table, all equations also include dummies for one-digit industries and occupations.

Qualitatively, most results of the probit and OLS specifications are quite similar to earlier findings in the literature. In the United States and the Netherlands women have lower training rates than men, while in Canada, Switzerland, and the United States their training intensity is lower. In Canada, Switzerland, and the Netherlands, training participation and/or training levels decrease with age. Only in the United States do we find the strange pattern that the youngest workers have lower training rates than other workers. In all four countries, participation increases with the worker's level of formal schooling. Training intensity, on the other hand, does not vary greatly with the level of formal schooling; only in the United States do more highly educated workers participate in longer training spells. With the notable exception of the Dutch case, training is less common among immigrants than among natives. In Canada, the Netherlands and the United States, full-time workers participate more frequently in training or in longer training episodes than part-timers, while in Switzerland part-time and full-time workers have similar training

Table 4. Probit Equations for Participation

	Canada		*Netherlands*		*Switzerland*		*United States*	
Variable	*coef (1)*	*s.e. (2)*	*coef (3)*	*s.e. (4)*	*coef (5)*	*s.e. (6)*	*coef (7)*	*s.e. (9)*
Female	–0.09	(0.08)	–0.26	(0.10)**	–0.00	(0.11)	–0.15	(0.08)*
Age 16–25	–0.25	(0.12)**	0.07	(0.13)	0.32	(0.15)**	–0.60	(0.14)***
Age 26–35	–0.36	(0.09)***	0.02	(0.10)	0.33	(0.12)***	–0.01	(0.10)
Age 46–55	–0.55	(0.10)***	–0.22	(0.11)*	0.23	(0.13)*	0.11	(0.10)
Age 56–65	–0.20	(0.15)	–0.44	(0.20)**	0.13	(0.17)	–0.07	(0.13)
Primary	–0.18	(0.18)	–0.46	(0.16)**	–0.80	(0.30)***	–0.12	(0.19)
Lower Sec	–0.35	(0.12)***	–0.17	(0.10)*	–0.62	(0.20)***	–0.36	(0.22)
Tertiary	0.34	(0.09)***	0.18	(0.11)*	0.26	(0.11)**	0.51	(0.09)***
Urban	–0.25	(0.10)**	–0.07	(0.10)	–0.02	(0.10)	0.10	(0.08)
Immigrant	–0.07	(0.09)	0.30	(0.16)*	–0.20	(0.13)	–0.50	(0.12)***
Full-time	–0.04	(0.11)	0.36	(0.11)***	–0.12	(0.13)	0.42	(0.13)***
Temporary	–0.16	(0.19)	0.10	(0.17)	–0.25	(0.22)	–0.21	(0.23)
Tenure < 1 year	–0.19	(0.10)*	0.11	(0.14)	0.03	(0.14)	0.14	(0.11)
Pseudo R2	0.12		0.07		0.07		0.14	
N	1624		1314		1039		1442	

Notes: * = significant at the 10 percent level, ** = 5 percent, and *** = 1 percent. All equations include 7 industry and 6 occupation dummies.

Table 5. OLS Equations for Intensity (log)

	Canada		*Netherlands*		*Switzerland*		*United States*	
Variable	*coef (1)*	*s.e. (2)*	*coef (3)*	*s.e. (4)*	*coef (5)*	*s.e. (6)*	*coef (7)*	*s.e. (9)*
Female	–0.15	(0.12)	–0.33	(0.16)**	–0.54	(0.16)***	–0.30	(0.11)**
Age 16–25	0.38	(0.18)**	0.69	(0.20)***	0.23	(0.25)	–0.25	(0.23)
Age 26–35	–0.02	(0.12)	0.47	(0.16)***	0.05	(0.20)	–0.06	(0.13)
Age 46–55	0.21	(0.15)	–0.10	(0.19)	–0.25	(0.22)	0.00	(0.13)
Age 56–65	0.12	(0.22)	0.16	(0.40)	–0.42	(0.29)	–0.33	(0.18)*
Primary	0.12	(0.30)	–0.11	(0.33)	–0.69	(0.70)	–0.43	(0.34)
Lower Sec	–0.02	(0.20)	0.18	(0.17)	–1.11	(0.46)**	0.15	(0.43)
Tertiary	0.12	(0.12)	–0.13	(0.17)	0.08	(0.47)	0.32	(0.12)***
Urban	0.21	(0.14)	0.06	(0.16)	0.01	(0.16)	–0.02	(0.11)
Immigrant	0.09	(0.14)	0.60	(0.24)**	–0.23	(0.23)	0.05	(0.19)
Full-time	0.55	(0.16)***	0.55	(0.20)***	0.32	(0.22)	0.06	(0.20)
Temporary	–0.60	(0.29)**	1.09	(0.26)***	–0.24	(0.38)	0.77	(0.37)
Tenure < 1 year	0.32	(0.15)**	0.25	(0.22)	–0.08	(0.22)	0.23	(0.15)
Adjusted R2	0.07		0.15		0.10		0.06	
N	593		424		306		567	

Notes: * = significant at the 10 percent level, ** = 5 percent,and *** = 1 percent. All equations include 7 industry and 6 occupation dummies.

patterns. In all countries, workers on temporary contracts are as likely to receive training as workers on permanent contracts, but their training intensities differ; in Canada, temporary workers have shorter spells of training, while in the Netherlands and the United States their training episodes are longer. Perhaps this finding is related to different types of temporary contracts in different countries. In the Netherlands, temporary contracts are typically used during a one-year probation period for new hires. The finding may thus reflect the fact that new workers obtain more training.[8]

A convenient way to compare the estimation results from the different countries is to perform the kind of decomposition analysis which is standard in discrimination analysis. This enables us to see whether a high or low training level in a particular country can be attributed to the characteristics of the workers and jobs in that country, or to the weights attached to these characteristics. We calculate the predicted training levels for workers with characteristics of country j using the weights of country k, and do that separately for the participation rate and for the intensity of training.

The top panel in Table 6 gives the results for the participation rates. The table reads as follows: with characteristics of the row country and weights of the column country, the predicted participation rate equals the figure in the corresponding cell.

Table 6. Predicted Participation Rates and Training Intensity

		Training probability			
		Predicted using weights:			
Characteristics	*Actual (1)*	*Canada (2)*	*Netherlands (3)*	*Switzerland (4)*	*United States (5)*
Canada	0.34	0.34	0.36	0.30	0.38
Netherlands	0.32	0.34	0.32	0.27	0.36
Switzerland	0.29	0.35	0.34	0.29	0.36
United States	0.40	0.42	0.37	0.32	0.40
		Median training intensity (weeks)			
		Predicted using weights:			
Characteristics	*Actual (1)*	*Canada (2)*	*Netherlands (3)*	*Switzerland (4)*	*United States (5)*
Canada	0.9	1.06	1.36	1.10	0.65
Netherlands	1.4	0.92	1.24	0.95	0.62
Switzerland	1.0	0.91	1.35	1.11	0.61
United States	0.8	0.86	1.24	1.17	0.67

So for instance, with Canadian characteristics and Dutch weights, the predicted participation rate is 36 percent. A usual interpretation of the weights in this kind of exercise is that these relate to preferences and institutions (for instance, Gomulka & Stern, 1990, p. 172). Adopting this interpretation, we may conclude that training incidence in Switzerland is lower than in other countries because of different institutions or different training preferences of workers and/or employers. It does not seem to be caused by different characteristics of workers or jobs or a different industrial structure. For each pair of countries, we tested formally whether the restriction that coefficients are the same could be rejected. Likelihood ratio tests rejected the null hypothesis for all pairs except those that included the United States at conventional levels of significance.

The predicted training intensities in the bottom panel of Table 6 point in the same direction. Within a column, differences are much smaller than within a row. Hence, different coefficients are more important than differences in characteristics to explain international differences in training intensities. Here again we performed formal tests for equality of coefficients. The results show that the null hypothesis of equal coefficients was rejected for all pairs except Canada/the Netherlands (p = 0.00).

IV. RATIONED WORKERS

Before developing a demand and supply model of training that allows us to disentangle firm and worker preferences with regard to training intensities, we first

give some descriptive information about the reasons workers report for being constrained. Furthermore, we present results from probit equations which have been estimated to detect which characteristics may explain rationing of training choices.

An unusual question included in the IALS survey asked respondents whether "there was any training or education you wanted to take for career or job-related purposes but did not?" The proportion of workers who, according to this criterion, considered themselves constrained in their training choices varies from one country to another. Table 7 shows that the lowest percentage is found in the Netherlands, where 1 in 5 workers (21 percent) wanted to receive training but did not. Rationing is most prominent in Canada with 33 percent, while Switzerland and the United States occupy the intermediate positions with 28 and 26 percent, respectively.

When workers are rationed, does this mean that they are less likely to participate in training? Table 7 suggests that this is not necessarily the case; training probabilities for rationed workers are no lower than those of their non-rationed counterparts (not controlling for characteristics). In fact, in North America the situation is actually reversed: rationed workers are more likely to have participated in training. Only in Switzerland is training incidence among rationed workers lower than among non-rationed workers. When we look at training intensity, however,

Table 7. Rationing Characteristics

Variable	*Canada* (1)	*Netherlands* (2)	*Switzerland* (3)	*United States* (4)
Rationing rate	0.33	0.21	0.28	0.26
Participation rate:				
- Rationed workers	0.38	0.35	0.25	0.51
- Non-rationed workers	0.32	0.32	0.31	0.37
Intensity (median weeks), among trained:				
- Rationed workers	0.88	1.00	0.80	0.80
- Non-rationed workers	0.95	1.50	1.20	0.80
Why rationed? (percent)				
busy/lack of time	50.5	44.9	45.6	50.1
busy at work	16.9	15.7	19.5	18.8
inconvenient time	10.8	6.4	5.9	9.8
too expensive	28.4	13.0	10.4	29.6
not offered	10.7	7.2	14.1	6.3
lack of firm support	4.5	10.1	10.2	7.5
lack of qualifications	2.0	1.3	1.6	0.6
language	0.0	0.0	1.4	0.9
health	0.7	2.0	1.9	0.1
family responsibilities	21.8	5.9	7.6	14.5
other	11.9	12.2	18.0	6.5

this picture changes: with the exception of Canada, training intensity is lower for rationed workers than for those who report that they are not constrained. Our measure of rationing seems to reflect real differences in training intensity.

The IALS survey asked respondents what the reasons were for not receiving the training they wanted. Up to 11 different categories of reasons were available.[9] As the results in Table 7 show, the reason most often reported is "lack of time": in all four countries, between 45 and 50 percent of the constrained workers give this reason. Other reasons often given in all four countries are that the training was too expensive or that the respondent was too busy at work. The order of these two reasons differs between countries. The cost of training or education (too expensive) is more often given as a reason in Canada and the United States than in the two European countries. Pressure of work (too busy) is slightly less important in the Netherlands than in the other three countries. Only a few workers (between 4 and 10 percent of the rationed workers) report lack of employer support as an explicit reason for not taking the training they wanted.

It is important to note that the reasons listed in the first six rows could all be eliminated by employers. Employers could subsidize the training so that it would not be too expensive for workers. Likewise, they could free workers of tasks in order to eliminate the problems of "lack of time" and being "too busy at work." The same holds for the provision of courses and the times at which they are offered. Even where "family responsibilities" are concerned, it is not hard to imagine ways in which employers could facilitate training (e.g. child care facilities). Moreover, it is unknown whether the "other" reasons mentioned by up to 18 percent of the constrained workers relate to problems which employers could resolve. The explicit and concrete private reasons of "lack of qualification," "language reasons," and "health reasons" are, taken together, mentioned by at most 5 percent of the constrained workers. We think it safe to say, therefore, that constrained workers are constrained because their employers show insufficient interest in the particular worker taking the work-related training that he or she wants.

To investigate whether there is any systematic relationship between being constrained in training choices and characteristics of the worker or his job, we estimated probit equations where the dependent variable equals one if the worker considers himself constrained. We did not differentiate between the different reasons reported for constraints. As explanatory variables, we include the same regressors as in the analyses of participation and intensity. Results are reported in Table 8.

Four conclusions can be drawn from these findings. First, in Canada and the Netherlands, women have a higher probability of being constrained than men. Second, in all four countries, older workers are less likely to feel constrained in their training choices than younger workers. Whether this finding is due to the fact that older workers are less interested in training or that firms are more responsive to the training demands of older workers is at this stage unknown (but see below). Third, again in both Canada and the Netherlands, full-time workers have higher probabilities of being constrained than part-time workers. Finally, and perhaps most

Table 8. Probit Equations for Being Constrained

	Canada		*Netherlands*		*Switzerland*		*United States*	
Variable	*Coef (1)*	*s.e. (2)*	*Coef (3)*	*s.e. (4)*	*Coef (5)*	*s.e. (6)*	*Coef (7)*	*s.e. (9)*
Female	0.22	(0.08)***	0.24	(0.10)**	–0.01	(0.10)	0.08	(0.08)
Age 16–25	0.06	(0.12)	–0.03	(0.13)	0.04	(0.15)	–0.15	(0.13)
Age 26–35	0.16	(0.09)*	0.03	(0.10)	0.08	(0.11)	0.02	(0.10)
Age 46–55	–0.35	(0.11)***	–0.32	(0.12)***	–0.14	(0.13)	–0.17	(0.11)
Age 56–65	–0.29	(0.17)*	–0.48	(0.23)**	–0.61	(0.18)***	–0.43	(0.15)***
Primary	–0.14	(0.17)	–0.02	(0.16)	–0.16	(0.22)	–0.44	(0.20)**
Lower Sec	–0.28	(0.12)**	–0.12	(0.11)	–0.40	(0.17)**	–0.51	(0.24)**
Tertiary	0.34	(0.09)***	0.19	(0.11)*	–0.13	(0.12)	0.36	(0.09)***
Urban	0.11	(0.11)	0.05	(0.10)	0.02	(0.10)	–0.13	(0.09)
Immigrant	0.17	(0.09)*	0.20	(0.17)	0.21	(0.12)*	–0.05	(0.12)
Full-time	0.60	(0.12)***	0.28	(0.12)**	0.08	(0.14)	0.07	(0.13)
Temporary	0.69	(0.18)***	–0.01	(0.17)	0.13	(0.21)	–0.30	(0.22)
Tenure < 1 year	0.09	(0.10)	0.07	(0.15)	0.18	(0.14)	0.41	(0.11)***
N	1624		1315		1039		1442	
Pseudo R2	0.09		0.04		0.05		0.07	

Notes: * = significant at the 10 percent level, ** = 5 percent, and *** = 1 percent. All equations include 7 industry and 6 occupation dummies.

surprisingly, is that more highly educated workers seem to be more often constrained in their training choices than lower educated workers. This is the case in all countries except Switzerland. Although the results in Section III show that more highly educated workers are more likely to participate in training than lower educated workers, they are less satisfied with the amount of training they receive. Here too, we may perform the analysis to decompose the different constraint rates between countries into effects of different characteristics and effects of different weights. The results of this exercise are given in Table 9.

Again, it seems that different rates between countries are caused by different weights rather than by different characteristics. With given characteristics, rationing

Table 9. Predicted Average Constraint Rates

		Predicted using weights:			
Characteristics	*Actual (1)*	*Canada (2)*	*Netherlands (3)*	*Switzerland (4)*	*United States (5)*
Canada	0.33	0.33	0.25	0.27	0.23
Netherlands	0.21	0.27	0.21	0.26	0.20
Switzerland	0.28	0.30	0.22	0.28	0.23
United States	0.26	0.29	0.23	0.27	0.26

rates are lower in the United States and the Netherlands than in Canada and Switzerland, while differences between predicted constraint rates within a column are very small.[10]

V. UNRAVELING DEMAND AND SUPPLY

A. Econometric Specification

We have argued above that the usual approach to studying the determinants of training is based on a reduced form model. In the absence of very specific assumptions about functional forms or arbitrary exclusion restrictions, it is usually impossible to identify demand and supply factors separately. One approach might be to specify the usual univariate probit model as a bivariate probit model with partial observation. By allotting some explanatory variables to the vector of regressors that determine supply and others to the demand equation, identification could be achieved. In the context of unions, such an approach has been undertaken by Abowd and Farber (1982). The drawback to this approach, which as far as we know has not been applied in the field of training, is that the exclusion restrictions are arbitrary.

Given the new information about workers being constrained or unconstrained in their training choices, a different approach is feasible. In this section we propose a model based on the Nash bargaining approach. We assume that both parties have their own preferences for the amount of training. Instead of assuming a specific fixed value for the parties' relative bargaining power, we assume that all bargaining power is on the side of the party with the lowest preferred level of training. The assumption implies that a firm will never offer more training than it thinks is optimal, and also that a firm cannot force the worker to participate in a training program if the worker does not want the training.

The assumption is thus that a party can never be obliged to offer or receive more training than it wants. For a firm this seems obvious: if a firm has no interest in providing more than a certain amount of training, it simply will not offer, organize, fund, or facilitate it, whatever the level of worker demand. There is also a rationale for the assumption that a worker cannot be forced into a training program. Under perfect competition, there will always be an outside option with similar conditions but without the obligation to participate in training. Moreover, it is doubtful whether it is efficient to train a worker who does not want to be trained. Such workers are unlikely to be very motivated.

In a more general framework, the observed level of training would be somewhere in between the amounts preferred by the firm and the worker. The exact location of the observed level relative to the two preferred levels would depend on the relative bargaining power of the parties and their threat points. Without fixing the parties' relative bargaining powers at a specific value, empirical estimation of this more general model requires more information about parties' preferred training levels

than simply the information whether a worker is constrained or not. Hence, while we admit that more general models may improve the model outlined above, we think that our approach is an important first step in the process of gaining more insight into the underlying structural decision framework.

A very general specification distinguishes each party's decision to invest from its decision about the optimum amount of training. Two equations are then specified for each party, producing a full model of four interrelated equations. The following equations specify this model in a linear form.

$$I_w^* = X\alpha_w + u_w \tag{1a}$$

$$I_f^* = X\alpha_f + u_f \tag{1b}$$

$$q_w = X\beta_w + \varepsilon_w \tag{1c}$$

$$q_f = X\beta_f + \varepsilon_f \tag{1d}$$

where I_w^* and I_f^* are latent variables indicating the net return to the worker and the firm; q_w, q_f are the efficient levels of training for the worker and the firm (marginal cost equals marginal return); X is a vector of exogenous variables; α_w, α_f, β_w, and β_f are vectors of parameters to be estimated; and u_w, u_f, ε_w and ε_f are error terms.

After making assumptions about the joint distribution of the four error elements, this model can in principal be estimated. Obviously it is very demanding not only computationally but, most of all, in terms of data requirements. First, the covariance of ε_w and ε_f cannot be identified because we never observe realizations of q_w and q_f for the same worker. Second, the variances of u_w and u_f are not identified because one typically observes only whether the net returns are positive or not. Third, identification of α_w and β_w (α_f and β_f respectively) requires at least one explanatory variable to be included in (1a) and not in (1c) (or (1b) and (1d) respectively). A more general data requirement is a sufficiently large sample size. Since the samples available in the IALS survey are relatively small, a simplifying estimation strategy must be followed.

One possibility would be to estimate a hurdle-type model. The model above would then be split into two parts, the training decision (the hurdle) and the quantity equations. The quantity equations could then be estimated conditionally on the hurdle equation, or independence could be assumed conditional on the regressors (cf. Arulampalam et al., 1996). Applying this model to the IALS data revealed that the sample sizes are too small.

A feasible strategy is to estimate a bivariate tobit model. This transforms the two equations for the worker into one tobit equation, and the same for the firm. Moreover, the error terms of a selection equation and a quantity equation are compressed into a single error term. The assumption that all bargaining power is in the hands of the party who wants the lowest level of training means that the

agreed/observed level of training will be equal to the minimum of the optimum level of the firm q_f and the optimum level of the worker q_w. Essentially, the model is a demand and supply model with endogenous rationing. This model is described in a different context in Pudney (1989, p. 275–278).

It should be noted that the tobit model is an ad hoc modification of a regression model. As such it is a convenient approximation of a more complicated data generating process. When using a tobit model to estimate a demand function, zero expenditures are modelled through censoring of negative values of a latent variable even though these negative values do not make economic sense. The bivariate tobit model presented here is a similar pragmatic approximation to the more complicated model outlined by equations (1a–d). Non-participation in training is modelled through negative values of the latent variables q_w^*, q_f^*. This means that $q_w = \max\{q_w^*, 0\}$, and $q_f = \max\{q_f^*, 0\}$. Combined with the assumption that all bargaining power is on the side of the party with the lowest preferred level of training, this means that observed training $q = \min\{q_w, q_f\}$.

With the information about the level of training and the existence of rationing, the sample can be divided into four categories: (i) workers who did not receive training and also did not want it; this implies that $q_w^* < 0$, (ii) workers who did not receive any training but did want it; $q_w^* > 0$, $q_f^* < 0$, (iii) workers who did receive training and did not want more; $q = q_w^*$, $q_f^* > q_w^*$, and, finally (iv) workers who received training and wanted more; $q = q_f^*$, $q_w^* > q_f^*$. Each observation belongs to one, and only one, category.[11]

Using a linear specification as in (1c) and (1d) and assuming normality, the likelihood function can be derived. Notation is used where T stands for training, R for rationing, Φ for the cumulative standard normal distribution function, and φ for the standard normal density:

$$L = \prod_{T=0,R=0} \Phi(-X\beta_w) \times \prod_{T=0,R=1} \Phi(X\beta_w, -X\beta_f; \rho)$$

$$\times \prod_{T=1,R=0} \left(1 - \Phi\left(\frac{(q - X\beta_f)/\sigma_f - \rho(q - X\beta_w)/\sigma_w}{\sqrt{1-\rho^2}}\right)\right) \varphi\left(\frac{q - X\beta_w}{\sigma_w}\right)/\sigma_w$$

$$\times \prod_{T=1,R=1} \left(1 - \Phi\left(\frac{(q - X\beta_w)/\sigma_w - \rho(q - X\beta_f)/\sigma_f}{\sqrt{1-\rho^2}}\right)\right) \varphi\left(\frac{q - X\beta_f}{\sigma_f}\right)/\sigma_f \quad . \tag{2}$$

B. Estimation Results

Table 10 reports the estimation results for the training intensity equations of the worker and the firm. Since the discussion focuses on the three variables of gender,

Table 10. Quantity Equations for Demand and Supply of Training (bivariate tobit with censoring)

	Canada		*Netherlands*		*Switzerland*		*United States*	
Variable	*Coef (1)*	*s.e. (2)*	*Coef (3)*	*s.e. (4)*	*Coef (5)*	*s.e. (6)*	*Coef (7)*	*s.e. (8)*
Worker								
Constant	–2.20	(1.02)**	–3.03	(1.72)**	0.61	(1.04)	–0.31	(0.75)
Female	0.29	(0.33)	0.28	(0.68)	–0.30	(0.40)	–0.28	(0.22)
Age 16–25	–0.04	(0.48)	1.81	(0.85)**	0.96	(0.58)**	–1.12	(0.37)***
Age 26–35	–0.44	(0.37)	0.42	(0.67)	1.06	(0.45)***	0.05	(0.26)
Age 46–55	–1.84	(0.42)***	–2.39	(0.78)***	–0.42	(0.50)	–0.21	(0.28)
Age 56–65	–1.77	(0.65)***	–3.40	(1.38)***	–1.79	(0.65)***	–0.98	(0.36)***
Primary	–0.98	(0.66)*	–2.13	(1.08)**	n.a.		–1.00	(0.51)**
Lower sec.	–1.79	(0.48)***	–1.19	(0.69)**	–2.22	(0.66)***	–1.64	(0.60)***
Tertiary	1.54	(0.36)***	1.17	(0.75)*	0.39	(0.43)	1.50	(0.24)***
Firm								
Constant	9.04	(2.12)***	11.02	(5.08)**	–0.81	(3.17)	–0.82	(1.28)
Female	–1.64	(0.58)***	–5.86	(1.86)***	–0.83	(1.14)	–0.93	(0.38)***
Age 16–25	–0.36	(0.82)	3.45	(2.35)*	2.98	(1.72)**	–1.94	(0.66)***
Age 26–35	–2.46	(0.63)***	0.56	(1.75)	2.34	(1.31)**	–0.07	(0.43)
Age 46–55	–0.64	(0.78)	1.24	(2.26)	1.77	(1.56)	0.65	(0.47)*
Age 56–65	1.08	(1.22)	–0.45	(4.35)	5.52	(2.38)**	0.75	(0.67)
Primary	–2.22	(1.36)*	–7.24	(3.24)**	–6.76	(3.59)**	0.33	(1.09)
Lower sec.	–0.88	(0.94)	–0.84	(1.96)	–4.84	(2.64)**	–0.17	(1.38)
Tertiary	0.67	(0.60)	–1.30	(1.93)	2.95	(1.30)**	0.63	(0.41)*
σ_W	4.57	(0.22)***	7.66	(0.40)***	4.32	(0.29)***	3.13	(0.13)***
σ_F	5.81	(0.35)***	13.71	(1.39)***	8.86	(0.99)***	3.91	(0.23)***
ρ	0.23	(0.09)***	0.05	(0.13)	0.08	(0.15)	0.37	(0.09)***
Log-L	–3011		–2499		–1787		–2639	
N	1624		1315		1039		1442	

Notes: * = significant at the 10 percent level, ** = 5 percent, and *** = 1 percent. All equations include 7 industry and 6 occupation dummies.

age and formal education, the table only contains coefficients pertaining to those variables.

Overall, both workers' and firms' preferences matter, although this varies to some extent across countries. For the reported coefficients, workers' preferences seem more important in all countries but Switzerland for the reported coefficients. This confirms the earlier finding that workers and firms tend to coordinate their training decisions much more in Switzerland than in the other countries. Table 10 only report the coefficients on personal characteristics. The estimations included also industry and occupational controls. These effects, and particularly the industry effects, are more often significant on the side of the firm than on that of the worker.

The common finding that females receive less training than males is also found for the countries in the present sample with the exception of Switzerland. This is the main effect due to firm preferences (with the exception of the industry effects). Firms in Canada, the Netherlands, and the United States tend to prefer lower training levels for their female employees than for their male counterparts. This suggests that women are not less likely to invest in human capital because they have, for example, less opportunity to reap the benefits due to higher opportunity costs. Whether employers have lower preferred training levels for women because of discrimination, higher turnover, or job characteristics remains an open issue.

With respect to age, results are somewhat mixed. A consistent result in all countries is that workers aged 56 to 65 desire less training than the reference group of middle-aged workers (36–45). There are some age effects on the firm side although these are not very consistent. In the United States, firms have lower training preferences with respect to young workers aged 16 to 25, and slightly higher for those aged 46 to 55. In the Netherlands firms prefer higher training levels for the young (16–25), and in Canada for the 26 to 35-year-olds. It seems that, except in Switzerland, firm preferences tend not to differ much across age groups. Apparently age as a proxy for the pay-off horizon matters for workers but not for firms. This can be explained in part by the fact that training is a very imperfect statistic for expected tenure, which is the pay-off horizon of the firm.

For education, some general patterns can be distinguished. Education tends to be a significant determinant of workers' preferences and a less significant one of firms'. Switzerland stands, as before, a little apart. There, education tends to matter more for firm than for worker preferences. A problem here is that the Swiss sample size is somewhat limiting, which may explain the weak worker effects. The typical finding in the training literature, that training incidence increases with education, seems to depend on worker preferences (with a slight firm effect in the United States for college/university education). For those with primary education, both firm and worker preferences matter (but note that these are predominantly older workers). The lower training levels of workers with a lower secondary education (9th grade), and upper secondary education (12th grade) depends on their own lower preferences.

The bivariate tobit specification also produces an estimate of the correlation of the error terms of the worker's and firm's preferred training levels. For both Northern American countries, these correlations are positive and significantly different from zero (0.23 for Canada and 0.37 for the US): unobserved factors that have a positive impact on workers' training preferences affect firms' preferences in the same direction. For the two European countries, these correlation coefficients are not significantly different from zero.

The bivariate tobit results do a good job of describing the selection of workers in the four categories of workers, but quit a poor one of describing actual training levels for workers with positive training. Table 11 shows the predicted assignment to the four training/rationing regimes. Both predicted and actual sample sizes are

Table 11. Predicted Training and Rationing (nr. of obs.)

Training/Rationing Regime	*Canada (1)*	*Netherlands (2)*	*Switzerland (3)*	*United State (4)*
Not trained, not rationed:				
$q_w < 0$, $q_f < 0$	342	188	276	367
$q_w < 0$, $q_f > 0$	413	705	234	389
Total $q_w < 0$	755	894	511	756
Actual	740	708	514	673
Not trained, rationed: $q_w > 0$, $q_f < 0$	320	18	174	76
Actual	331	180	220	188
Total not trained: $q_w < 0$ *or* $q_w > 0$, $q_f < 0$	1075	912	684	832
Actual	1071	889	734	861
Trained: $q_w > 0$, $q_f > 0$	549	403	355	610
Actual	553	426	305	581

shown. In this respect, the Canadian sample shows the closest match. For the Netherlands, the number of people who did not receive training but were not rationed is overestimated, whereas the number of non-trained/rationed individuals is seriously underestimated. The Swiss data do pretty well, with some underestimation of the non-trained/rationed and overestimation of the trained. In the United States, the non-trained/rationed are also underestimated. By exploiting the information that is in the sample, some "back of the envelope" corrections can be made. This then allows a first estimate of the relative importance of worker/firm rationing.

The estimated firm and worker quantities allow identification of the individuals who were not trained but whose employer wanted training: $q_w < 0$, $q_f > 0$, which means that the firms were rationed. For Canada, this shows that 413 individuals were not trained although their employer preferred training. At the same time, 320 individuals would have preferred to engage in training but were confronted with unwilling employers. This shows that rationing is widespread and that firms are at least as often rationed in Canada as workers. Worker/firm rationing is 3:4.

For the Netherlands, the interpretation is more complicated because of the serious underestimation of the non-trained/rationed group. The non-trained/non-rationed group is overestimated because the model overestimates q_f. This suggests that we can balance the non-trained/non-rationed group to match the actual sample size by transferring 894 – 708 = 186 observations to the non-trained/rationed group and the training group. This is done by allocating 162 observations to the first group and 24 to the second. Consequently, the size of the group of workers in the Netherlands who were not trained but whose employer wanted training must lie

between 705 – 186 = 519 and 705 observations. This suggests that firm rationing by the worker is much more prevalent in the Netherlands than in Canada. Worker/firm rationing is 2:5.

In Switzerland the non-trained/rationed group is also underestimated, although to a much lesser extent, but here the trained group is overestimated. This suggests that the estimation of the size of the group of workers who were not trained but whose employer wanted training is not a problem. Consequently, we can compare this number, 234, with the sample size of the non-trained/rationed, 220. These numbers are of the same order of magnitude, and this is consistent with the earlier findings that employers and workers in Switzerland coordinate training and that co-funding and co-initiative are quite common in that country. Worker/firm rationing is 1:1.

Finally, for the United States the main problem seems to be overestimation of the group of non-trained workers with willing employers, and underestimation of the non-trained/rationed workers. Balancing the non-trained/non rationed group with 756 – 673 = 83 gives a lower boundary of 306. This means that firms are more likely to face workers who are unwilling to take training. Worker/firm rationing is 2:3.

Many countries now wish to promote lifelong learning activities, of which work-related training is a specific form (OECD, 1996). The kind of results reported here have potentially important implications for the choice of policy instruments in this field. For instance, instruments to increase training levels among lower educated workers should influence the training preferences of these workers. Instruments directed towards firms will be less successful because there is no indication that firms prefer shorter training spells for their lower educated workers.

We hasten to admit, however, that the demand and supply model proposed in this paper is based on some fairly strong assumptions. Firstly, we have assumed that the observed level of training equals the minimum of the levels preferred by the worker and the firm. This is equivalent to assuming a Nash bargaining approach where all bargaining power is in the hands of the party who prefers the lowest training level. The possibility of a different decision-making framework (for instance, a model where the firm determines the amount of training and the worker either concurs or leaves the firm) or a different division of bargaining power can not be precluded.

Secondly, within the specific demand and supply model, we have implicitly assumed that the only choice variable is the quantity of training, while in fact the degree of specificity of the training or the division of the costs and benefits may also be part of the training package open to negotiation. Thirdly, due to data limitations we have been unable to estimate the more general form of the model and have had to make some stringent assumptions. Hopefully, larger labor market surveys will at some stage become available which include the same training questions asked in the IALS survey. The results in this chapter show that, with one additional question, we have made some progress in identifying the demand and supply factors underlying observed training data.

VI. CONCLUSION

This chapter documents aspects of demand for and supply of training in Canada, the Netherlands, Switzerland and the United States. In the first part, we presented descriptive information about the initiation, financing, provision and methods of work-related training. In Switzerland employees occupy a more prominent position in initiating and financing training than in Canada, the United States and the Netherlands. In all four countries, the company is most identified as the provider of the training, but in all four countries many other providers also play a role. Firms also provide financial support for training initiated by the worker and for courses provided outside the company. This suggests that firms pay for general training. Another notable finding is that training methods used in the United States rely far less frequently on reading materials and computer software than those used in the other countries.

We also estimated usual probit and OLS equations to analyze the determinants of participation in training and intensity of training. The findings are in accordance with other work in this area. Comparing the findings for different countries we conclude that training levels between countries differ mainly because of differences in the weights attached to worker and job characteristics and not because the characteristics of workers and jobs differ between countries.

The main novelty of this chapter is the information it includes concerning workers who say that they wanted to receive training but did not do so. Examining the reasons given for not receiving the training that they wanted, we conclude that in most cases the employer could have lifted the constraints. Reasons relating to time or financial constraints are most important. We also analyzed the determinants of being constrained. A remarkable finding here is that more highly educated workers more often felt constrained than lower educated workers, despite the fact that their training levels are much higher.

Finally, we utilized the information from workers who wanted to receive more training than they actually got to disentangle demand and supply factors in training. Results indicate that different training levels by schooling level can be attributed to workers' preferences. The same holds for the age effect on training, though the causes of the gender gap can be attributed to firm preferences. We think that these results show the usefulness of our approach. With one simple additional question, more insight has been gained into the factors that determine training decisions. This can be helpful in policy-making decisions aimed at eliminating barriers to training. However, as we indicated, there remains room for improvement.

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NOTES

1. Although the observation that employers pay for general training seems to point in the opposite direction.

2. For a more extensive description of the IALS data and for first results, see OECD and Statistics Canada (1995).

3. As a consequence, it is impossible to distinguish in the Swedish sample between work-related training and training for other purposes (leisure-related training). Simple probit models for the other countries were estimated to see whether results differed between "work-related training" and "all training" as dependent variables. For all countries, the restriction that the coefficients for the two models were equal had to be rejected. In addition, even if that test had shown that equality of coefficients could not be rejected, it would have been impossible to construct the variable "amount of training" as the question concerning the average number of hours per day was not asked in Sweden.

4. Three is the maximum number of episodes which respondents could report. Since very few people report a third spell, truncation is unlikely to be a problem.

5. The percentage for the United States is higher than in previous studies. Loewenstein and Spletzer (1996) compare incidence rates from different samples and find in the 1991 CPS a training incidence of 44.1 percent for the United States. There, however, the reference period is the current job, as opposed to the previous 12 months in our sample. Their table suggests that reducing the reference period to the year prior to the interview would substantially reduce the incidence rate, probably to a figure in the region of 20 percent.

6. Unfortunately, the data do not allow us to refine the industry and occupation classification beyond the one-digit level.

7. Instead of estimating separate probit and OLS equations, one can also estimate a model that simultaneously explains participation in training and, conditional on participation, the intensity of training. Identification of such a model requires at least one explanatory variable to be included in the participation equation and not included in the intensity equation. This purpose could be served by variables relating to the fixed costs of training. The information in the IALS dataset is, however, not specific enough to identify such variables.

8. The results for the industry and occupation dummies not reported in the table can be summarized as follows. In all four countries, training is more frequent in the "financing, insurance, real estate and business services" sector than in "manufacturing." For other industries, results are mixed. For all countries, the occupation dummies reveal that training rates are lower in the group of "plant and machine operators and assemblers" than in the reference group of "technicians and associate professionals." Full estimation results are available from the authors on request.

9. Note that this question differs crucially from a similar question in the survey employed in Pischke (1996). There, the question was why respondents did not participate, irrespective of whether they themselves wished to do so.

10. Likelihood ratio tests rejected the null hypothesis of equality of coefficients for every pair of countries for all countries but Canada.

11. A third simplified version of the model (1a–d) is simply to ignore the quantity equations (1c) and (1d) and estimate a bivariate probit model. This has been done with the Dutch IALS data in Oosterbeek (1998). A problem with that approach is that all trained workers are allotted to the category $I_w^* > 0$ & $I_f^* > 0$. The information that some trained workers are constrained and others are not is not used in this setup.

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