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Assessing the impact of training on employment: The case of East Germany

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**Assessing the Impact of Training
on Employment
The Case of East Germany**

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Assessing the Impact of Training on Employment

The Case of East Germany

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Abstract

This paper is concerned with the effects of training on the future employment probability of trainees. During the transformation process of the East German economy after reunification, employment decreased by a large amount. Therefore, many workers in East Germany participated in training programs which were heavily subsidized by the labor administration. However, at this point a thorough evaluation of such labor market programs does not exist. This paper attempts to fill this gap with regard to the impact of participation in training on the future employment probability of the trainees. Our analysis is based on the "Arbeitsmarktmonitor Ost", a large labor market panel data set used by the German labor administration to examine the development of the East German labor market. We analyze the effects of two types of training: training within a firm and training in an institution outside of the firm, where the worker is employed. In our empirical analysis, we are very careful about the intriguing selection issues involved, and we also take account of the severe attrition in the data set. Neglecting selection effects would lead to the result that training outside of the firm shows strong negative effects on employment probabilities whereas training in the firm shows strong positive effects. However, when taking account of selection effects, the results are completely reversed. Contrary to what is often alleged, we find in particular that training outside of the firm shows a considerable positive effect on the employment probability during the sample period.

Keywords : training, employment probabilities, selection,
dynamic random-effects probit

JEL-Classification : J20, J60, C33

¹Our research benefitted greatly from our discussions with Wolfgang Franz. We are also grateful to Bart Cockx, Bruno Van der Linden, Tom MaCurdy, Winfried Pohlmeier, Frank Wolak, our colleagues in Konstanz, and participants at the CEPR workshop on the "Skill Problem" in January 1995 for helpful comments. However, all errors are our sole responsibility.

1 Introduction

Just one month after German unification in October 1990, the Federal Bureau of Labor (BA) started a labor market survey, called "Arbeitsmarktmonitor Ost" (Labor Market Monitor, LMM), to interview a representative number of inhabitants of the former GDR about their economic situation. So far, there have been eight waves. From the beginning, the organizers have emphasized the importance of the LMM both as a first representative data base for the new East German states and as a flexible tool to provide quick information about changes in the East German labor market. This is even more important because labor market policy in East Germany has been a major field of public activity with total spending of 23 billion DM in 1993,² which represents more than 8 percent of East Germany's GDP, an unprecedented number for western market economies.³ At this point, however, a thorough evaluation of active labor market policies in East Germany does not exist. This paper attempts to fill in this gap with regard to the impact of participation in a qualification measure (training) on the future employment probability of the trainees. In the future, we also plan to study the effects on earnings.

The transformation process after reunification resulted in a tremendous fall of employment in East Germany, which fostered active labor market policies in order to enhance employment prospects. Participation in various types of subsidized training programs increased considerably after reunification. In order to evaluate the success of such active labor market policies, we estimate the impact of participation in two types of qualification measures on the subsequent employment probabilities of workers.

There exists a considerable literature concerned with the problems involved when estimating the impact of training.⁴ Björklund (1989) provides an excellent survey of the topic. The basic evaluation problem lies in the intriguing *selection* issues involved. Trainees might be different from other labor market participants because they are trainees. Therefore, if one wants to isolate the impact of training, one has either to find a comparison (control) group that correctly matches the group of trainees in all relevant characteristics or to fully control for the trainees' characteristics. Some researchers, e.g. Heckman and Hotz (1989), believe that it is possible to pursue the latter approach using non-experimental data, while others, e.g. Ashenfelter and Card (1985), doubt that one is actually able to obtain reliable estimates from such non-experimental data. These researchers rather suggest the implementation of experiments in order to obtain a satisfactory control group for the trainees. Due to the lack of experimental data, this paper pursues the strategy suggested by Heckman and Hotz. We use non-experimental data (LMM) and we try to control for the trainees' characteristics.

For our analysis, we focus on two types of training: training within a firm and training in an institution outside of the firm. Our empirical approach is to estimate a one-factor, simultaneous probit equations model, with separate employment, attrition, and qualification (training) probit parts. The LMM is severely plagued by attrition, and we can

²See ANBA, p.68.

³Numbers for western economies in 1986 vary between 0.8 % (USA) and 4.0 % (Netherlands), cf. Zweimüller/Winter-Ebmer (1994), p.6, and OECD (1988)

⁴See Ashenfelter (1978), Ashenfelter and Card (1985), Björklund (1989), Card and Sullivan (1988), Gritz (1993), Heckman and Hotz (1989), Heckman et al. (1987), and Zweimüller and Winter-Ebmer (1994) to mention a few sources.

show that not controlling for attrition has a significant impact on the estimates in the employment probit. Our main empirical findings are the following: Neglecting selection effects would lead to the result that training outside of the firm shows strong negative effects on employment probabilities whereas training in the firm shows strong positive effects. However, when taking account of selection effects, the results are completely reversed. Contrary to what is often alleged, we find in particular that training outside of the firm shows a considerable positive effect on the future employment probability within the sample period.

The paper is organized as follows: Section 2 describes the development of the labor market since unification as well as size and structure of labor market policies pursued in East Germany. Special attention will be given to qualification measures. Section 3 discusses some methodological problems when assessing the impact of labor market programs. The data set (LMM) is described in section 4. Taking account of the considerations in section 3, section 5 develops our empirical approach and contains the estimation results and our findings about the effectiveness of qualification measures in East Germany. Section 6 concludes.

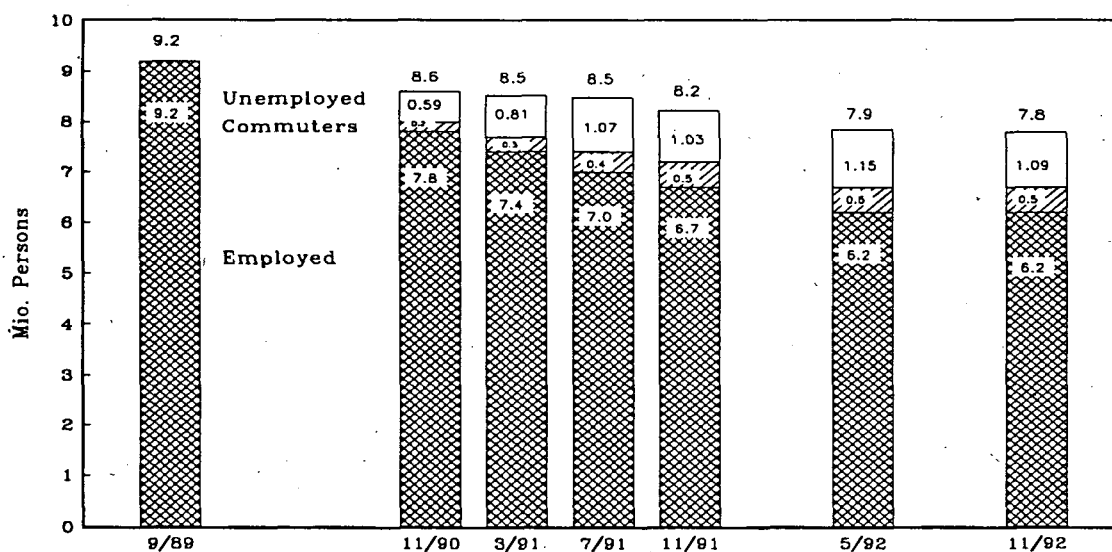
2 Labor Market Development and the Importance of Training in East Germany

Since unification, the East German labor market has undergone a fundamental change. The sudden exposure to a western-style economic environment and the loss of the main trading partners in the East led to structural changes such that only some of the old firms (jobs) could survive. In the first years, many workers were kept in – often short-time – working contracts. A large fraction of these jobs were supposed to develop into new and permanent jobs created by the expected structural recreation of the East German economy. Instead, employment in East Germany decreased and unemployment increased, accompanied by a diminishing labor force. Figure 1 shows this development, based on the data of the “Arbeitsmarktmonitor Ost” (LMM).⁵

Employment in the former GDR was at 9.2 million in September 1989. Unemployment did not exist – or at least it was not officially recognized. With the opening of the borders in September 1989, economic and monetary union in May 1990, and finally political unification in October 1990, East-to-West commuting and unemployment appeared as new phenomena. Based on the first wave of the LMM, the Federal Bureau of Labor (BA) estimated 200 thousand commuters and 590 thousand unemployed, that is an unemployment rate of 6.8 percent. By then, employment had decreased by 1.4 million people. Labor supply had been diminished by 600.000 people which was the consequence partly of a considerable outflow of women out of the labor force, partly of active labor market policy that encourages elder workers to retire, and partly of permanent East-West migration. This pattern has remained almost stable over time. While labor supply and employment went down to 7.8 million and 6.2 million people, respectively, unemployment increased to more than 1 million people. Commuting seems to have reached a constant level of 500.000 people.

⁵ Franz (1992) and (1993) summarizes the labor market developments in East Germany right after reunification.

Figure 1: East Germany's Labor Force Since 1989, Estimates Based on the LMM



Source: ANBA, p. 139, LMM-Dokumentation (Wave 6) (1993), pp. 9 and 41;

As a consequence of the dramatic development of unemployment in the New Laender, the BA has spent an enormous amount of money to combat unemployment. There are basically four types of measures used:⁶

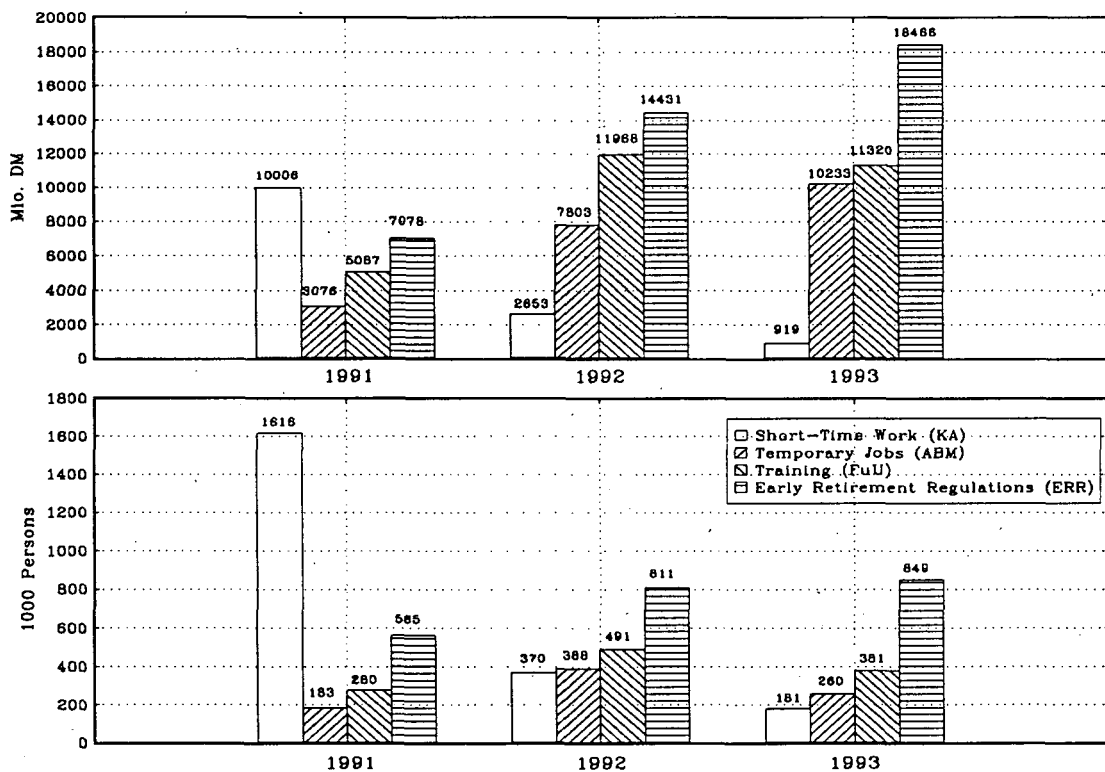
- subsidized Early Retirement Regulations (“Altersübergangsgeld”, AÜG, and “Vorruhestandsgeld”, VRG),
- subsidized temporary jobs (“Arbeitsbeschaffungsmaßnahmen”, ABM),
- subsidized short-time work (“Kurzarbeit”, KA), and
- subsidized training programs of various forms.

Until November 1993, almost 50 percent of East German's labor force went through at least one of these measures and were financially supported by the BA. Additionally, if those training measures that were not financially supported by the BA were included (for example training in the firm), this number would increase to almost 80 percent.⁷ The BA's expenditure on each of these measures has varied over time. Figure 2 presents the number of individuals involved in the various instruments of active labor market policy as well as their financial support measured by the BA's spending for each instrument. Right after unification, financing short-time workers was the dominant instrument, but in the meantime the role of ABM and training programs has been growing considerably both in absolute terms and relative to short-time work. In 1994, subsidizing short-time workers has become almost negligible compared to the very high level of 1.6 million people in short-time contracts in 1991.

⁶For detailed descriptions of these measures, see for example Bielenski et al. (1994), and Spitznagel (1993).

⁷Bielenski et.al. (1994), pp.13, 14.

Figure 2: Labor Market Policy in East Germany: Expenditures and Participants



Source: ANBA, pp. 13, 68; IW, No.6.;

The importance of Early Retirement Regulations (AÜG,VRG) increased continuously between 1990 and 1993, both in terms of expenditures and in terms of the number of workers involved. In 1993, it became the instrument of highest relevance among the instruments of active labor market policy and absorbed 852.000 people in 1993.⁸ Whereas these people are leaving the labor force permanently, people participating in training programs, short-time contracts or ABM are either still employed or searching employment, and thus only temporarily out of the "first" labor market.

Supporting people in short-time contracts was the tool the BA was able to implement most quickly. There are no real investments to be made and only few administrative costs to bear compared to the investments necessary to set up training programs or ABM. Because training and ABM programs are not only financing people but also investing in human capital or in the improvement of public infrastructure (such as removing contaminated soil or preparing touristic infrastructure) they are generally preferred to short-time work. Thus, the BA increased its efforts in training and ABM over time. As figure 2 shows, these tools have become more and more important with training being the dominant one.

Among the participants in qualification, the fraction of unemployed has increased over time. About 75 percent of those who started participating in qualification in 1992 had

⁸See ANBA, p.162.

been unemployed before. In 1993 this number was 80 percent.⁹ This not only reflects the rising unemployment itself but also the changing role of this instrument. In the first year after unification, training was aimed mainly at adjusting the qualificalional structure of the labor force in general to the new requirements of a western-style economy. In the meantime, training has also become a very important means to improve re-employed prospects of unemployed people and to prevent the loss of their human capital during the unemployment spell.

3 Assessing the Effectiveness of Training: Methodological Considerations

The extent to which the BA has supported training programs in East Germany suggests that it is considered a very effective means to improve the trainees' labor market prospects. Yet, there is no evidence that supports or rejects this presumption. There are frequent publications, mainly by the BA's research institute ("Institut für Arbeitsmarkt-und Berufsforschung", IAB), as well as the LMM-documentation (1993) itself, presenting some insights into the labor market experience after qualification. For example, the LMM-documentation reveals that of those trainees receiving financial support during a program in May 1992, 16 percent were employed. Six months later, in November 1992, 78 percent of these people are still employed, the other 22 percent are either unemployed or out of the labor force. Accordingly, out of those 84 percent who were not employed during the training program in May 1992, 40 percent have found a job within the following six months. The remaining 60 percent were still unemployed or out of the labor force.¹⁰

It is not immediately clear whether one can unambiguously assign any success or failure of former trainees to their participation in qualification. There may be several reasons why trainees might be better or worse than others that are not the result of the program. The most frequently stated reason is the problem of "selection bias", that is, trainees might be different from other labor market participants because they are trainees. Selection into the program occurs depending on observable or unobservable characteristics, and these characteristics themselves can determine one's labor market performance, not only with respect to the qualification. It would therefore be ideal to find a group of people with the same characteristics as trainees (except that they do not participate in the program) to be able to compare the labor market performance of both groups and to isolate the impact of training.

⁹See ANBA, p.159.

¹⁰LMM-Documentation (Wave 6) (1993), p. 50.

Table 1: Characteristics of Trainees and Non-Trainees^a

	November 1991		November 1992	
	Trainees	Non-Trainees	Trainees	Non-Trainees
employed at time of the last interview (%)	.82	.89	.61	.85
age (years)	38.86	41.44	39.05	42.67
sex (female,%)	.55	.49	.61	.49
occupational qualification: (in %)				
unskilled	.00	.03	.01	.02
Teilfacharbeiter ^b	.01	.04	.00	.03
Facharbeiter ^c	.40	.53	.42	.52
Meister ^d	.08	.08	.07	.08
Fachschule ^e	.26	.20	.25	.19
University	.26	.13	.24	.15
number of persons	741	4291	472	3775

Source: Arbeitsmarktmonitor Ost (LMM) – Sample as it is used in empirical analysis in section 5, i.e., it includes all individuals having participated in the first wave and having answered the full range of questions relevant for our estimation of employment (or participation in qualification) in each wave in specifications (1) to (6). See table 4 for the attrition numbers and table 9 in the appendix for the definition of each variable.

^a Trainees are those people who participated in a qualification measure within the firm or in an external institution; Non-Trainees are those people who did not participate in one of these qualification measures.

^b partial apprenticeship

^c craftsmen with completed apprenticeship

^d master craftsmen

^e specialized vocational schools

3.1 Descriptive Statistics

Based on the LMM, we compare trainees and non-trainees with respect to a number of characteristics such as age, sex, occupational qualification and lagged employment status. Our definition of trainees follows the categories used in the LMM. It was asked, whether people have participated in one of the following types of qualification since the last wave:

1. getting familiar with the workplace (“Einarbeitung/Einweisung am Arbeitsplatz”)
2. Qualification in an institution, which is not the firm, where person is employed (“Lehrgang/Kursus in sonstiger Bildungseinrichtung”)
3. Qualification in a firm where person is employed (“Lehrgang im Betrieb”)

Table 2: Employment Rates in March 1992

	Former Trainees	Former Non-Trainees
Total	76 %	83 %
women	71 %	78 %
unskilled	- ^a	72 %
Teilfacharbeiter	66 %	81 %
Facharbeiter	91 %	86 %
Meister	84 %	87 %
Fachschule	81 %	89 %
University	- ^a	63 %
number of persons	672	3499

Source: Arbeitsmarktmontitor (LMM) – Sample as it is used in empirical analysis in section 5, see table 1.

^a too few observations to report a number

In our opinion, the first category is a very vague one which can be valid for everyone starting a new job or moving to another desk. Thus, we decided to exclude this category from our definition of qualification. Table 1 provides employment frequencies for the fourth and the sixth wave. On average, trainees are younger than non-trainees. Females are slightly overrepresented and it is less likely that trainees were employed in the previous wave. Also, trainees are, on average, better educated than non-trainees. The qualificational ranking is as ordered in table 1. The category “unskilled” really includes only those people who have not finished any officially recognized occupational education. “Teilfacharbeiter” means having a certificate of a partial apprenticeship training and “Facharbeiter” hold an apprenticeship certificate. “Meister” are master craftsmen and people who completed “Fachschule” have attended specialized vocational schools (e.g. for artists or engineers) in the former GDR.¹¹

Considering the labor market performance of trainees relative to non-trainees, table 2 contrasts the employment status in the fifth wave of trainees (people who reported having participated in qualification within the last 5 months) with non-trainees (those who did not participate in a program within the last 5 months). The likelihood of being employed is higher for (former) non-trainees than for former trainees (83 % vs. 76 %), and considering the initial employment rate of non-trainees (89 %, see table 1) versus trainees (82 %, see table 1) before they started the program, one may conclude that the training program has not changed the relative labor market position of trainees. Being female reduces employment rates of both trainees and non-trainees by about the same amount. Lower qualified trainees seem to have a very low employment rate both compared to trainees in general and to their non-trainee-counterparts whereas craftsmen and – to a lesser extent – master craftsmen enjoy very good labor market prospects after qualification.

¹¹ For a detailed description of the GDR's education system, see for example: Fischer et al. (1993), pp. 179ff.

3.2 Econometric Evaluation

The descriptive statistics in the previous subsection confirm the initial statement: trainees are different from non-trainees in many respects. If one wants to isolate the impact of training, one has either to find a comparison group that correctly matches the group of trainees in all relevant characteristics or to fully control for the trainees' characteristics. As proponents of the first method, Ashenfelter and Card (1985) demand the implementation of experiments. In an experiment, the control group is generated by randomly selecting persons who are accepted for participating in qualification. Then, the members of this control group will not participate in the subsequent training. Ashenfelter states that only this procedure ensures a valid control group because of the principal similarity (or randomly chosen dissimilarity) between trainees and non-trainees. There are some problems involved when conducting experiments¹², one of them being that experiments are simply extremely expensive, another that they have only been implemented in a few countries and for a few number of programs although the demand for a thorough evaluation of training programs is very high.

For various reasons, one being that we do not have access to an experimental data set, we are pursuing nonexperimental methods to analyze the impact of training. Our analysis builds upon Heckman and Hotz (1989) who suggest a methodology to identify the presence of selection bias when comparing trainees and non-trainees in nonexperimental settings. We modify this approach to the problem at hand. The impact of training on employment can be estimated with the following equation (the index E denoting the employment equation):

$$(1) \quad Y_{it,E}^* = \gamma_E E_{i,t-1} + X_{it,E}' \beta_E + \epsilon_{it,E} \quad \begin{array}{l} i = 1, \dots, N \quad (\text{number of persons}) \\ t = 1, \dots, T \quad (\text{waves}) \end{array}$$

with $Y_{it,E}^*$ being a latent variable describing the individual's propensity of being employed, and the employment dummy, E_{it} , being defined by

$$E_{it} = \begin{cases} 1 & , \text{ if } Y_{it,E}^* \geq 0 \\ 0 & , \text{ otherwise} \end{cases}$$

which represents the employment status of person i at time t , $X_{it,E}$ being a vector of characteristics that explain one's employment status (in our case including the status as a former trainee or non-trainee), and $\epsilon_{it,E}$ as an error term.

In general, a selection bias exists if the error term $\epsilon_{it,E}$ is not independent of the explanatory variables, that is when the conditional distribution of $\epsilon_{it,E}$ is not equal to its unconditional distribution:

$$(2) \quad f(\epsilon_{it,E} | X_{it,E}, E_{i,t-1}) \neq f(\epsilon_{it,E})$$

where $f(\cdot)$ represents the probability density function. As pointed out by Heckman and Hotz, selection can occur under two circumstances. First, there may exist "selection on observables", which means that the employment performance of trainees differs from that

¹²For a more detailed discussion of experimental versus non-experimental methods, see for example Björklund (1989).

of non-trainees because of some observable characteristics that are not considered in the explanatory vector $X_{it,E}$. Therefore, the solution to the problem of selection on observables would be to include further variables in the vector $X_{it,E}$ that can explain the participation in qualification. Second, there may exist "selection on unobservables", where selection bias stems from unobservable characteristics (e.g. the individual's motivation) that influence the error term $\epsilon_{it,E}$. Both problems can be modelled by means of an index function (the index Q denoting qualification \equiv training)

$$(3) \quad Y_{it,Q}^* = X_{it,Q}'\beta_Q + \epsilon_{it,Q} \quad ,$$

with the index $Y_{it,Q}^*$ being a function of both observable characteristics $X_{it,Q}$ and unobservable characteristics $\epsilon_{it,Q}$ which determine whether the individual i will participate in the program or not. If $Y_{it,Q}^*$ is positive, the person will be a trainee, otherwise not. In this framework, selection on observables is present when the distribution of $\epsilon_{it,E}$ is not independent of $X_{it,Q}$ and selection on unobservables occurs when the distribution of $\epsilon_{it,E}$ is not independent of $\epsilon_{it,Q}$.

We suspect the error term $\epsilon_{it,E}$ to be serially correlated and use a model which allows for individual-specific and time-invariant effects that are not observable thus influencing the error term:

$$(4) \quad \epsilon_{it,j} = \rho_{t,j}\alpha_i + u_{it,j} \quad j = E, Q \quad ,$$

where the random effect α_i represents the part of the *unobservable heterogeneity* which is assumed to be constant over time but different among individuals, and the coefficient $\rho_{t,j}$ indicates the strength of the random effect. The random-effect-coefficient therefore explains, to what extent individual heterogeneity is responsible for the employment performance (and the occurrence of training) at time t .

Heckman and Hotz develop three very intuitive tests for the existence of selection bias, which they call pre-program test, post-program test, and test of model restrictions. The post-program test can only be conducted with the coexistence of an experiment and will not be further discussed here. With the test of model restrictions one can test e.g. for the validity of the functional form chosen. For the pre-program test one has to create a new dummy which has to be one for all those people who will be participating in qualification (but have not done so before!) and zero for people from the "comparison group" and former trainees. Then, the coefficient of this variable should not be different from zero if selection bias is properly controlled for, because in this case the explanatory variables should control for any systematic differences between the future trainees and the comparison group of non-trainees. Thus, this dummy variable accounts for any differences which are not being controlled for by the other explanatory variables.

4 The Data Set

The LMM is a 0.1 % representative sample drawn from the active labor market population of the former GDR. The first questionnaire was sent out in November 1990 and 10751 answer sheets were returned. The survey inquired about various characteristics relevant to the labor market activity both at present time and back in November 1989. Up to now, the LMM has been repeated 8 times and the data of all waves will be publicly available

Table 3: Sample Size and Central Variables

	wave 1 11/90	wave 2 03/91	wave 3 07/91	wave 4 11/91	wave 5 05/92	wave 6 11/92
(1) Valid Returns In Each Wave	10.751	7.929	7.300	7.956	10.956	9.763
(2) Of Those Who Answered Correctly In Wave 1 ^a	10.751	7.929	7.300	7.787	6.902	6.647
(3) Of Those Who Answered Correctly In All Waves	10.751	7.929	6.734	5.985	5.145	4.653
Central Variables (Base (2), percentages):						
Sex (Women=1)	50.7	50.6	51.0	51.7	52.1	51.6
Mean Age	39.1	39.0	39.0	41.4	42.6	42.9
Employed/Self-Employed	73.6	77.9	76.6	67.2	62.9	61.6
Officially Registered Unemployed	5.4	7.9	10.2	8.6	10.6	13.0
Qualification: Unskilled	6.5	5.5	5.3	7.0	7.1	6.8
Qualification: Teilfacharbeiter	3.8	3.0	3.0	3.6	3.2	3.3
Qualification: Facharbeiter	48.7	48.8	48.3	48.0	49.4	49.2
Qualification: Meister	6.0	6.4	6.3	6.8	6.9	7.1
Qualification: Fachschule	17.2	18.9	19.4	18.9	18.5	18.7
Qualification: University	9.4	10.6	11.1	12.7	13.8	13.6
Qualification: Others ^b	7.5	5.7	6.6	3.0	1.1	1.4

^a without retired people not seeking for a job

^b e.g. pupils or those who did not answer to this particular question

soon. When we started our analysis, we were able to use the first six waves capturing information about a total of 14993 individuals for the time period November 1989 to November 1992. The first four waves were conducted with a four-months time lag, that is in November 1990, March 1991, July 1991, and November 1991. The fifth and sixth wave took place in May 1992 and November 1992, respectively. In November 1991 and November 1992, the BA included two further age cohorts (born 1975 and 1976) to keep the age structure of the active labor market population (16 to 64 years old). Also, in May 1992, an additional sample was drawn which resulted in 3938 valid replies. Panel mortality is a serious problem as can be seen from the following table. If one took only those people who have answered in the first wave and looked at their attrition until the sixth wave (excluding retired people not seeking for a job), only 61.8 percent were left from the initial sample. Considering the balanced panel, only 43.3 percent were still present in the sixth wave.

For our purposes, we selected those people who returned the questionnaire in the first wave and gave correct answers about their basic characteristics such as age, sex, occupational training, marital status, and their employment status in November 1989. Starting with this initial sample, we checked for each wave and each individual whether all the variables needed were available. This allowed us to include observations which were unavailable only for some but not all waves. For our empirical estimates presented in the next section, we obtained a sample size of 8681 people for the first six specifications and 8751 people for the seventh and eighth specification, because for the latter, information about basic education at school was not required. Since we estimate a set of simultaneous probit equations, we

used the maximum available number of observations for each probit. This gives us 8681 or 8751 observations, respectively, for the initial condition and the attrition probit. For the employment probit, and, if estimated separately, for the qualification probit, the sample size decreases and is different for all specifications depending on the respective set of explanatory variables. The following table shows attrition for the estimated employment (or qualification) probit for all eight specifications presented in section 5.

Table 4: Size of Sample which Estimates^a are based upon

	total sample	wave 1 11/90	wave 2 03/91	wave 3 07/91	wave 4 11/91	wave 5 05/92	wave 6 11/92
Specification (1-6)	8681	7986	6295	5464	5032	4486	4247
Specification (7-8)	8751	7546	5595	4905	4318	3822	3790

^a See section 5 and tables 5 and 7 in the Appendix

5 Econometric Framework and Estimation Results

This section presents the details of our estimation approach and our estimation results. Our framework encompasses the methodological considerations discussed in section 3. Since our data set is quite large, we were, however, not able to go as far as we would have liked due to computational restrictions.¹³ Nevertheless, our main results proved to be quite robust. We estimated more specifications than presented in this section without the qualitative nature of the results changing.

5.1 Econometric Framework: One-Factor Model (Random-Effects Model)

We model the indicator (dummy) variables employment status, panel attrition, and participation in qualification (training) within a simultaneous probit model.¹⁴ The underlying latent variables themselves depend on various regressors and on the individual random effect which is invariant over time and which is supposed to take account of permanent unobserved heterogeneity across individuals. We define the relationship between the observable dummy variable $Y_{it,j}$ and the underlying latent variable $Y_{it,j}^*$ as follows

$$(5) \quad Y_{it,j} = \begin{cases} 1 & \text{if } Y_{it,j}^* \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

where $j \in \{A, E, Q\}$ and “A”: attrition equation (panel mortality), “E”: employment equation and “Q” participation in qualification measure. Our empirical analysis tries to explain employment status, $Y_{it,E} \equiv E_{it}$, participation in qualification, $Y_{it,Q} \equiv Q_{it}$, and

¹³Our estimation was done in FORTRAN code on an IBM RS 6000 (340). The optimization was done with analytical derivatives using the NAG-Routine “E04UCF”. To estimate our most elaborate specification (8), it took about 200 CPU hours.

¹⁴For instance, Flaig et al. (1993) applied a random-effects model for estimating a simultaneous dynamic employment probit with a balanced panel data set.

panel attrition, $Y_{it,A} \equiv D_{it}$. The dummy variables are defined as follows. The attrition dummy, D_{it} , indicates whether a complete observation vector for qualification and employment equation is available for individual i at time t ($D_{it} = 1$ available), thus, we allow for the case that an observation is unavailable for one wave but is again available for the next wave. Modelling panel attrition in this way allows us to keep a considerable number of observations, which seems important given the severity of panel mortality. On the other hand, it restricts the way how to model attrition.¹⁵ The employment dummy, E_{it} , describes the employment status of an individual i at time t , where $E_{it} = 1$ indicates employment and $E_{it} = 0$ represents all non-employment states which we simply call “unemployment”.¹⁶ The qualification dummy, Q_{it} , captures whether individual i participates in a qualification measure at time t , $Q_{it} = 1$. In our most general approach, we allow for three labor market states, employed, $E_{it} = 1$ and $Q_{it} = 0$, unemployed, $E_{it} = 0$ and $Q_{it} = 0$, and participating in qualification, $Q_{it} = 1$. In the latter case, we discard the information on employment status in the questionnaire. However, when explaining the two former cases, the information on lagged employment status is also used for those individuals participating in qualification in the previous period. We started, however, with a more restricted approach, where we assumed qualification to be exogenous to employment, so we just used Q_{it} as a regressor variable in the employment probit. With the more general approach, we try to evaluate whether there is a significant difference in the estimates for the employment probit depending on explicitly modelling participation in qualification versus taking it as exogenous.

The indicator variables $Y_{it,j}^*$ depend on the set of regressor variables in the following way

$$(6) \quad Y_{it,j}^* = X_{it,j}'\beta_j + \epsilon_{it,j}$$

where $X_{it,j}$ represents the vector of regressors, β_j the corresponding coefficient vector, and $\epsilon_{it,j}$ the error term. We assume the error vector $(\epsilon_{it,j})_{t=0,\dots,T; j \in \{A,E,Q\}}$ to be independently and identically distributed over the individuals, $i = 1, \dots, N$, but we allow the components of the error vector for a given individual to be correlated over time and across equations. The correlation is supposed to be captured by an individual specific random factor such that $\epsilon_{it,j}$ can be decomposed in the following way

$$(7) \quad \epsilon_{it,j} = \rho_{t,j} \alpha_i + u_{it,j}$$

where α_i represents the individual random effect (the factor) and $u_{it,j}$ an additional random component which is independently and identically distributed over t and j . Without loss of generality, we can assume $Var(u_{it,j}) = Var(\alpha_i) = 1$ and let the coefficient $\rho_{t,j}$ be estimated. $\rho_{t,j}$ measures the strength of the individual effect in equation j at time t and can be different across j and t . To derive the probability that $Y_{it,j} = 1$ for given $X_{it,j}$ and α_i , it is useful to define $z_{it,j}$ by

$$z_{it,j} \equiv X_{it,j}'\beta_j + \rho_{t,j}\alpha_i.$$

¹⁵ Lechner (1993) chooses a different way to account for attrition in the LMM. He does not use observations of people who do reply after not having replied in the past. This leaves him with less observations in the equation of interest but allows for a more flexible way of modelling attrition also as a function of past outcomes of the variables in the equation of interest.

¹⁶ Obviously, it would be of great interest to differentiate between the different types of “unemployment” states. This is, however, beyond the scope of this paper.

Then we obtain

$$(8) \quad P(Y_{it,j} = 1 | X_{it,j}, \alpha_i) = \Phi(z_{it,j})$$

where Φ denotes the cumulative standard normal distribution function.

In order to derive the likelihood function, we assume that the probabilities can be specified in a recursive system. The employment and qualification probabilities are allowed to depend on the previous employment status. This necessitates explaining the employment status in period 0, $E_{i,0}$, i.e., in fall 1989. There are several approaches suggested in the literature to handle such an initial condition problem, see for instance Heckman (1981). As in Lechner (1993), who also used the LMM, we choose to model $Y_{i0,E}^*$ as a linear "static" function of presample information. Since fall 1989 was the "hour zero" of German unification, it appears safe to assume there to be a "true" initial state.

Before specifying the contribution of individual i to the likelihood function, let us now present in detail the four probit equations to be estimated:

Initial Condition Probit

$$(9) \quad Y_{i0,E}^* = X'_{i0,E}\beta_0 + \rho_{0,E}\alpha_i + u_{i0,E} \equiv z_{i0,E} + u_{i0,E}$$

and

$$(10) \quad P(E_{i0} = 1 | X_{i0,E}, \alpha_i) = \Phi(z_{i0,E})$$

Attrition Probit

$$(11) \quad Y_{it,A}^* = X'_{it,A}\beta_A + \rho_{t,A}\alpha_i + u_{it,A} \equiv z_{it,A} + u_{it,A}$$

and

$$(12) \quad P(D_{it} = 1 | X_{it,A}, \alpha_i) = \Phi(z_{it,A})$$

Participation in Qualification Probit

$$(13) \quad Y_{it,Q}^* = \gamma_Q E_{i,t-1} + X'_{it,Q}\beta_Q + \rho_{t,Q}\alpha_i + u_{it,Q} \equiv z_{it,Q} + u_{it,Q}$$

and

$$(14) \quad P(Q_{it} = 1 | X_{it,Q}, \alpha_i) = \Phi(z_{it,Q})$$

Employment Probit

$$(15) \quad Y_{it,E}^* = \gamma_E E_{i,t-1} + X'_{it,E}\beta_E + \rho_{t,E}\alpha_i + u_{it,E} \equiv z_{it,E} + u_{it,E}$$

and

$$(16) \quad P(E_{it} = 1 | X_{it,E}, \alpha_i) = \Phi(z_{it,E})$$

We make the following distributional assumptions: For all $i = 1, \dots, N$, $t, t' = (0), 1, \dots, 6$, $t \neq t'$, and $j, j' \in \{A, E, Q\}$, $j \neq j'$, $\alpha_i, u_{i0,E}, u_{it,A}, u_{it,Q}, u_{it,E}$ follow a multivariate normal

distribution and are uncorrelated (i.i.d.) across individuals with $Var(\alpha_i) = Var(u_{it,j}) = 1$, $Cov(u_{it,j}, u_{it',j}) = Cov(u_{it,j}, u_{it',j'}) = Cov(u_{it,j}, u_{it',j'}) = Cov(\alpha_i, u_{it,j}) = 0$. Let $\phi(\cdot)$ denote the density of the standard normal distribution.

We introduce state dependence in the employment probit by allowing the employment probability to depend on the employment status at the previous interview, $E_{i,t-1}$. This is a somewhat awkward assumption since the time period between two interviews differs. Therefore, we routinely test and reject the hypothesis that γ_E is constant over $t = 1, \dots, 6$. In fact, we find that the data requires wave specific estimates of γ_E , although the orders of magnitude are quite similar. This has to be related, however, to the issue of heteroskedasticity of the error term $\epsilon_{it,E}$ across t . We do not allow for completely free heteroskedasticity for one probit equation across waves. However, heteroskedasticity can also result in wave specific coefficient vectors when the error variance is fixed and so we test for some regressors whether the estimated coefficients vary significantly across waves.¹⁷ The one-factor formulation of the dependency in the error term of individual i makes the model tractable, since only a one-dimensional integration is involved to obtain the individual contributions to the likelihood function. However, this restricts the dependency structure which is allowed for the error vector. Simulation methods¹⁸ do not seem feasible for our problem at this point due to the complexity of the estimation and the number of observations. The problem is mitigated by allowing $\rho_{it,j}$ to vary with t ¹⁹ and our results appear quite plausible.

By means of conditioning on the random effect and other endogenous (past and present) dummy variables, we obtain a recursive system and the probabilities become simple cumulative normals as described in equations 10, 12, 14, and 16. We assume that the random-effect accounts for a potential selectivity bias due to attrition. Concretely, we assume that conditional on the set of regressors, on the individual random effect, and on past employment status, participation in qualification and employment are independent of attrition, i.e., for $j = 0, 1$,

$$P(Q_{it} = j \mid D_{it}, X_{it,Q}, E_{i,t-1}, \alpha_i) = P(Q_{it} = j \mid X_{it,Q}, E_{i,t-1}, \alpha_i)$$

and

$$P(E_{it} = j \mid D_{it}, X_{it,E}, E_{i,t-1}, \alpha_i) = P(E_{it} = j \mid X_{it,E}, E_{i,t-1}, \alpha_i)$$

To model the relationship between employment and qualification, we pursue two different approaches. In the most general setup, we try to endogenize qualification by estimating a separate probit equation. In the second, more modest approach, qualification decisions are taken to be exogenous to the employment process. Taking the more general approach, the contribution of individual i to the likelihood function²⁰ becomes

¹⁷Since completely different coefficient vectors are estimated across the four (three) probits, heteroskedasticity across probits is not an issue.

¹⁸See e.g. Börsch-Supan and Hajivassiliou (1993) and Lechner (1993).

¹⁹For one multinomial simultaneous probit with $T = 3$, this allows for a completely arbitrary correlation structure. This also implies different total error variances for the different time periods.

²⁰When evaluating the likelihood function, the random effect α_i has to be "integrated out". The numerical integration is performed by means of Gauss-Hermitian quadrature techniques using the ESSL-routine "DGHMQ".

$$\begin{aligned}
L_i = & \int_{-\infty}^{\infty} \underbrace{\{[\Phi(z_{i0,E})]^{E_{i0}}[1 - \Phi(z_{i0,E})]^{1-E_{i0}}\}}_{\text{Initial condition}} \times \prod_{t=1}^6 \underbrace{([\Phi(z_{it,A})]^{D_{it}}[1 - \Phi(z_{it,A})]^{1-D_{it}})}_{\text{Attrition equation}} \times \\
& \underbrace{[\Phi(z_{it,Q})]^{D_{it}Q_{it}}[1 - \Phi(z_{it,Q})]^{D_{it}(1-Q_{it})}}_{\text{Qualification equation}} \times \\
& \underbrace{[\Phi(z_{it,E})]^{D_{it}(1-Q_{it})E_{it}}[1 - \Phi(z_{it,E})]^{D_{it}(1-Q_{it})(1-E_{it})}}_{\text{Employment equation}} \} \phi(\alpha_i) d\alpha_i
\end{aligned}$$

This formulation of the likelihood contribution assumes that the contribution of the qualification probit can only be used when $D_{it} = 1$ and of the employment probit when $D_{it} = 1$ and $Q_{it} = 0$. When taking qualification as exogenous, the qualification part in the likelihood contribution disappears and the “employment equation” part always comes in when $D_{it} = 1$.

The log-likelihood function for the entire sample of N individuals is :

$$L = \sum_{i=1}^N \ln(L_i)$$

The asymptotic variance-covariance matrix of the parameters can be consistently estimated by (“sandwich formula”):

$$\hat{V} = \hat{H}^{-1} OPG \hat{H}^{-1}$$

which allows for some forms of misspecification in the model, cf. White (1982). The hessian H is given by

$$\hat{H} = \sum_{i=1}^N \frac{\partial^2 \ln(L_i)}{\partial \theta \partial \theta'}$$

with the expected value of hessian $E(H) = -$ information matrix, and the outer product matrix of the gradient, OPG , is defined as

$$OPG = \sum_{i=1}^N \frac{\partial \ln(L_i)}{\partial \theta} \frac{\partial \ln(L_i)}{\partial \theta'}$$

with $\theta = (\beta, \gamma, \rho)$. \hat{H} and OPG are evaluated at the estimated coefficient vector.

Qualification Measures

There are two possible strategies to model the effect of qualification measures on employment in this setup. First, we take qualification as an exogenous regressor in the employment equation, and second, we model participation in a qualification measure as an endogenous variable by means of a third probit equation. As mentioned before, we consider two types of qualification measures:

- (i) Qualification in an institution, which is not the firm, where the person is employed (QS) and
- (ii) Qualification in a firm where person is employed (QB)

We break down the qualification effect into two components, namely a dummy variable capturing the temporary effect (QST or QBT) and another dummy variable capturing the permanent effect on the employment probability (QSP or QBP). Then, we set QST= 1 or QBT= 1 when qualification participation ended since the last interview, and we set QSP= 1 or QBP= 1 when participation in qualification measure happened at some time in the past.

Controlling for participation in qualification

In addition, if we take the first approach with qualification as an exogenous regressor in the employment equation, we add a regressor for current participation in a qualification measure, i.e., a dummy variable indicating that the qualification measure ends in the time period until the next interview. This implies that participation has started or is going to start within the period until the next interview, or that the person has participated in qualification since the last interview but it is unclear whether qualification has ended by the time of the interview. In this case, we set QSL= 1 or QBL= 1, respectively, denoting current participation in qualification. If we take the second approach, we estimate a third probit equation as described in equations 13 and 14 modelling the decision to participate in a qualification measure endogenously.

Heckman-Hotz-Preprogram Test

To control for a potential bias induced by selection into the training program, we create two dummy variables QSHH and QBHH for each type of qualification measure. Following the suggestion of Heckman and Hotz (1989) for their pre-program test (see section 3.2), we set QSHH=1 and QBHH=1 if a person participates in a qualification measure some time in the future and did not participate in the past. Thus, we are explicitly controlling for the selection bias before participation in qualification, i.e., before the start of a qualification measure. If the model has controlled properly for selection bias, the estimated coefficients of these regressors should not be significantly different from zero. On the other hand, if we estimate significant coefficients for QSHH and QBHH in the employment probit, we conclude that trainees are different from non-trainees with respect to their employment probabilities in a way which is unobservable for the econometrician. However, such a result raises the issue of endogeneity, which we will address in the following by instrumenting the QSHH and QBHH dummies.

5.2 Estimation Results

Our estimation results are shown in the appendix, tables 5 to 8. A detailed description of the variables from the LMM, which we use, is provided in the appendix, table 9. Table 5 summarizes our estimates for four specifications with participation in qualification assumed to be exogenous. Table 6 shows the findings of various specification tests for these models. Table 7 contrasts one further specification with exogenous qualification participation, with three specifications endogenizing qualification participation. For specification (8) displayed in table 7, the dummies QSHH and QBHH are instrumented to account for a potential endogeneity problem. Table 8 again displays the results of the corresponding specification tests. As a reference category for dummies we chose the following characteristics (if applicable): wave 1, male, unemployed, single, passed 8th/9th grade, no vocational training degree, no participation in a qualification measure during six waves.

Initial Condition and Employment Probits

For the employment probit, our general findings appear quite plausible and are discussed in the following. We found strong state dependence through lagged employment status, $E_{i,t-1}$, and a typical concave age profile with a peak at about age 37. Employment prospects for females are always significantly lower than for males. Our results also confirm the often alleged fact that employment prospects of unemployed women differ to a larger extent from those of unemployed men than reemployment prospects of employed women differ from those of employed men. Considering sector-specific (re-)employment prospects (specifications (5) to (8)), construction as well as the mainly state-owned enterprises of sector 7 (traffic, post, railways) offer consistently better employment chances relative to sector averages. In contrast, being employed in the commercial sector and other manufacturing seems to lower the individuals' (re-)employment prospects. The coefficients of occupational education also confirm conventional wisdom: the higher the occupational degree the better the labor market performance. As typical for Germany, craftsmen and master craftsmen (Facharbeiter and Meister) enjoy the best employment prospects of all. Since the schooling coefficients ("10th Grade" and "Abitur") are insignificant in specifications (1) to (6), we decided to omit these variables in specifications (7) and (8). Also, a stable pattern across all specifications is the diminishing impact of the random-effect over time. With almost no exception, individual heterogeneity shows an important effect on the employment probability in the first wave (November 1990) but its influence disappears completely until the sixth wave (November 1992). The hypothesis of constancy of the $\rho_{t,E}$ over the waves is rejected for all specifications, see tables 6 and 8. However, imposing this restriction did not appear to alter the results in any noticeable way (these estimation results are not presented here).

The temporary effect of qualification measures in a firm-external institution (QST) on the individual employment performance proves to be negative (not always significantly), but in the long run the effect (QSP) is not significantly different from zero. As the pre-program-test dummy QSHH is always negative, selection into these firm-external programs seems to coincide with relatively bad initial employment prospects. Thus, in addition to a long-run effect of about zero, firm-external qualification measures appear to be more successful than one would judge neglecting the effects of QSHH. This kind of

catching-up effect was also found empirically for public labor market policies in Austria, cf. Zweimüller/Winter-Ebmer (1994).

The pattern changes when looking at qualification measures in the firm (QB). The temporary employment effect (QBT) is significantly positive and relatively high. In the long run, however, the effect (QBL) is still positive but much lower. Along with a medium-size positive selection bias indicated by the pre-program-test variable QBHH, these qualification measures seem to improve the individuals' employment chances temporarily but reduce them in the long run (compared to the initial level).²¹

The pre-program-test variables QSHH and QBHH are significantly different from zero. Obviously our model specifications are not able to correctly control for the problem of selection bias. Endogenizing the participation decision with variables like occupational qualification, age or sex does not help either, since the QSHH- and QBHH-dummies do not become insignificant (see specifications (6) and (7)). We have experimented somewhat with instrumenting QSHH and QBHH, one representative result being displayed as specification (8).²² The coefficient estimates change a little but the qualitative result does not seem to alter relative to specifications without instrumenting these dummies. Therefore, we are somewhat confident that the results hold up within a more satisfactory treatment of participation in qualification. We performed a formal endogeneity test as in Flaig et al. (1993, p. 200), by including both the original and the instrumented dummies, QSHH and QBHH in specifications (7) and (8). Testing whether the two instrumented variables had zero coefficients resulted in a Durbin-Wu-Hausman test statistic of $\chi^2(2) = 0.38$.²³

The estimates for the initial condition probit exhibit quite plausible effects. Again we find a concave age profile with a peak at about age 38. The high intercept in connection with the coefficient estimates reflects that most people were employed in November 1989. There is no significant impact of the random effect, which could be interpreted such that people in the former GDR were employed irrespective of any unobservable heterogeneity. The other regressors show similar effects as in the dynamic employment probit discussed above.

Attrition Probit

In the attrition equation, all variables and the random effect are highly significant. We chose a very parsimonious specification for the attrition probit, since our estimation problem could otherwise easily become too large to be estimable. The results indicate that the propensity of retention is a concave function of age with a maximum at about 41 years.

²¹We also estimated specifications without the preprogram dummies QSHH and QBHH. These results are not presented in this paper, but available upon request. The estimated coefficients on QST, QSP, QBT, and QBP were basically the same as for the respective specification with the preprogram dummies.

²²The instruments are: various lags of employment status (if available), age, age squared, marital status, occupational qualification, and a number of variables obtained from interacting age, sex, sectoral employment, employment status, short-time work, marital status, and occupational qualification. We have not corrected the standard errors for the fact that two regressors are instrumented. Given the similarity of the results, we do not believe this to be a major problem for our interpretation.

²³Both instrumented variables had a t-statistic of 0.4. The complete estimates for this specification are not reported in the paper, but available upon request. For the Durbin-Wu-Hausman test, cf. Davidson and McKinnon (1993), p.390.

Attrition increases with time and females are more likely to attrit than males, however, the latter effect does not appear to be significant and the estimated coefficient is quite small in absolute value. Attrition depends very strongly upon the unobserved factor α_i , which is a very plausible result. Not controlling for attrition alters some coefficients in the employment equation (compare specifications (1) and (2)). A specification test whether the estimated coefficients of the employment probit of specifications (1) and (2) differ, gave a test statistic of $\chi^2(29) = 686.2$.²⁴ Thus, there is strong evidence that we have to control for attrition.

Participation in Qualification Probit

Whereas in specifications (1) to (5) training is taken as exogenous, we estimated a separate qualification probit for specifications (6) to (8). However, for computational limitations, we were not able to estimate separate probits for the two types of qualification measures considered in the employment probit. Participating in qualification is influenced negatively by the lagged employment status and exhibits the typical concave influence of age with a maximum at about age 32. Women have a slightly higher probability to participate than men and there is also a positive influence from higher occupational training which corresponds to the descriptive statistics in section 3.1. The estimated coefficients of the time dummies ($DU M_{W2}, \dots, DU M_{W6}$) show a significantly higher propensity for qualification during waves 2 to 6 relative to wave 1, however, no clear time trend is discernible. Also the random effect proves to be significant.

Contrasting specifications (5) and (6), we cannot find significant differences in the results of the employment probit ($\chi^2(42) = 44.9$).²⁵ Also the coefficients look very similar. This test result points to a redundancy of an extra qualification probit, however, the graphical simulation results depicted later in this section seem to indicate that estimating a separate qualification probit makes a difference.

Further Specification Tests

We performed further specification tests to evaluate the estimated specifications (1) to (8). The results of those tests are given in tables 6 and 8. For the employment probit, we tested for a linear time trend, which was rejected in all cases. Also, sector-specific effects of $E_{i,t-1}$ as well as wave-specific effects of $E_{i,t-1}$ (although the coefficients do not change by very much) proved to be necessary. We further performed a test whether a random-effect (RE) specification is necessary, where we contrast the coefficient estimates of the random-effect specification with the respective simple pooled probit without the random effect.²⁶

²⁴We tried a Durbin-Wu-Hausman test, assuming that under H_0 of no selectivity bias in the employment probit with regard to attrition, (2) should be the efficient estimation procedure. However, the difference of the variance-covariance matrices between (1) and (2) actually proved to be negative definite. Having observed this, we calculated the test statistic based on the inverse of the variance-covariance matrix for (1). Therefore, the number presented in the text should be a lower bound for the "true" test statistic which corroborates rejection of H_0 .

²⁵This is again a Durbin-Wu-Hausman test.

²⁶Again a Durbin-Wu-Hausman test. A simple Wald-test on the coefficients of the random effect is inappropriate, since the estimated model is not well specified under H_0 when all $\rho_{it,j}$ are zero. One should also note that the likelihood function is symmetric around the vector $\rho=0$.

The test is very intuitive, since we test whether allowing for an individual random effect (unobserved heterogeneity) has a significant effect on the estimated coefficients of interest. In general, the random-effect specification was confirmed except for specification (2) in which we did not control for panel mortality. The random effect was never significant in the initial condition probit.

Graphical Presentation of Simulated Employment Probabilities

To finish our presentation of the estimation results, we decided to illustrate some of the estimated specifications by means of some simulations. Based on specifications (5) to (8), the following figures 3 to 5 show the simulated employment probabilities for various types of workers who were employed in November 1989. We believe that these graphical illustrations allow for a much better evaluation of our estimation results since the coefficient estimates themselves do not translate easily into the corresponding effect on the fitted probabilities. We have chosen some typical scenarios to illustrate in particular the magnitude of the effect of participation in qualification.

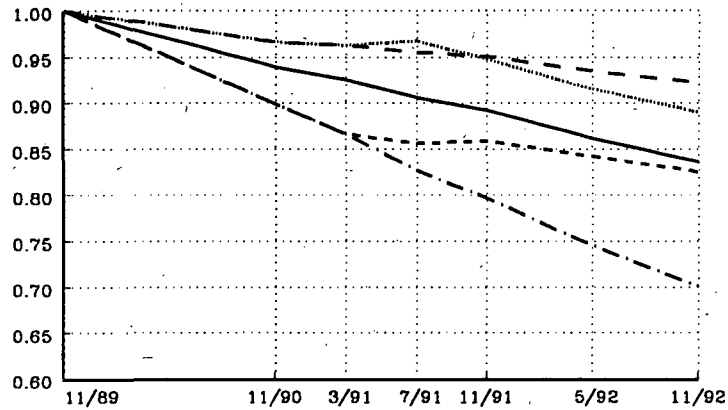
Each of the simulations displayed in the following figures allows for participation in the two types of qualification measures between the second and third wave. To be able to identify how the employment prospects of both groups of trainees would have been without their participation in qualification, we calculated their fictitious employment probabilities (lines (A) and (E) as named in the figure) by setting the pre-program-dummies, QBHH or QSHH, respectively, to be one throughout waves 1 to 6.

Without going into details, we would like to highlight the following aspects. The striking feature of all graphs in figures 3 to 5 is that people who participate in qualification outside of a firm (D and E) have considerably lower a priori employment prospects relative to the baseline "Without training" (C) and that participating in such a qualification measure enhances employment prospects considerably, see (D). In contrast, the effects of qualification within a firm (B) are quite small. However, the graphs also clearly show that workers participating in qualification within a firm (A and B) have a considerably higher a priori employment probability compared to the baseline (C). The graphs confirm that the estimated coefficients on the qualification dummies are not of a negligible magnitude.

Contrasting the various specifications, the graphs seem to suggest that endogenizing qualification – specifications (6) to (8) – appears to make a difference – relative to specification (5). Employment probabilities for females prove to be considerably smaller than those of males (figures 3 and 4), although the general pattern with respect to qualification is the same. Figure 5 also shows that it makes quite a difference, whether a worker started out in November 1989 in a "high employment" sector, e.g. Traffic, Post, Railways, or in a "low employment" sector, e.g. Commerce.²⁷

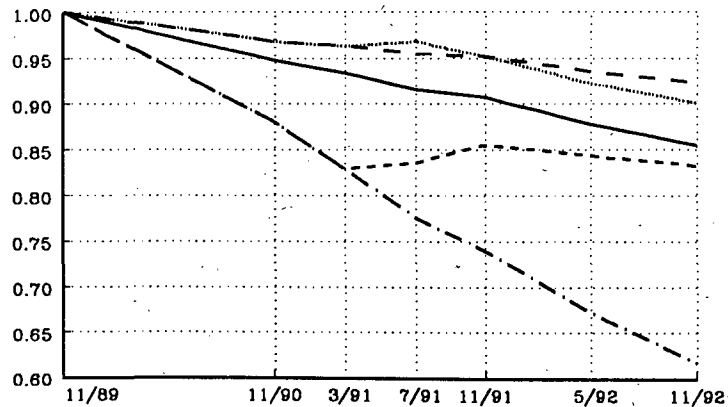
²⁷ For the simulations in figure 5, it was assumed that for an unemployed worker the employment probability in the next period would be the average across sectors. Therefore, we believe that our numbers rather underestimate the differences across sectors.

Employment Probabilities For Women
40 Years Old, Employed in 11/89, Married, All Sectors
Specification 5

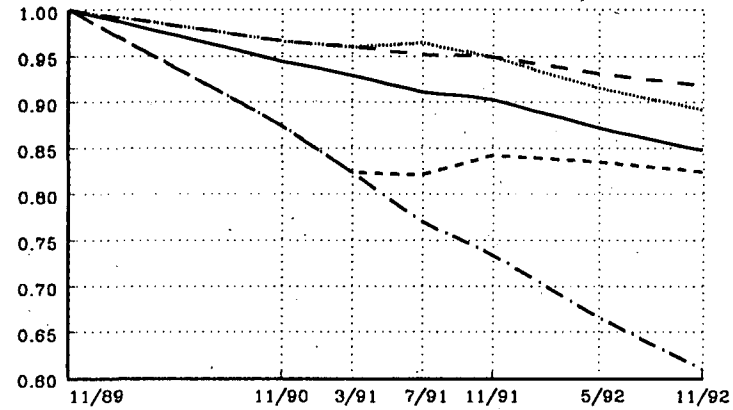


- - (A) 'Selected' For Training in the Firm But Never Actually Participating: $QBHH=1$ But $QBT=QBP=0$
- (B) Training in the Firm, Started in 7/91 and Finished in 7/91: $QBHH=1$ until 3/91, $QBT=1$ in 7/91, $QBP=1$ since 7/91
- (C) BASELINE CASE: Never Having Participated in Training: $QST=QSP=QSHH=QBT=QBP=QBHH=0$
- . - . (D) Training in an External Institution. Started in 3/91 and Finished in 7/91: $QSHH=1$ until 3/91, $QST=1$ in 7/91, $QSP=1$ since 7/91
- - - (E) 'Selected' For Training in an External Institution But Never Actually Participating: $QSHH=1$ But $QST=QSP=0$

Employment Probabilities For Women
40 Years Old, Employed in 11/89, Married, All Sectors
Specification 7



Employment Probabilities For Women
40 Years Old, Employed in 11/89, Married, All Sectors
Specification 6



Employment Probabilities For Women
40 Years Old, Employed in 11/89, Married, All Sectors
Specification 8

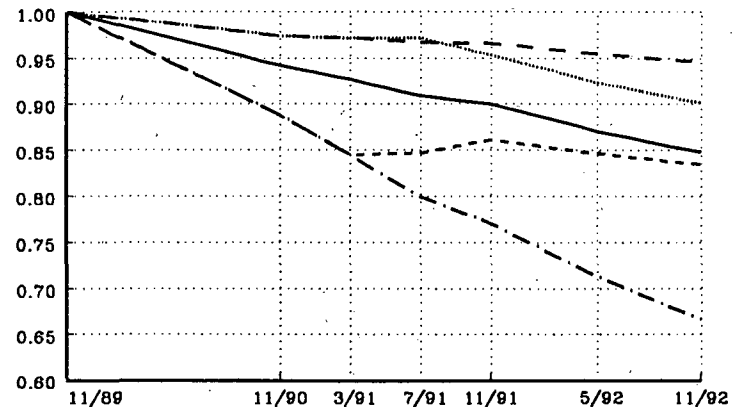
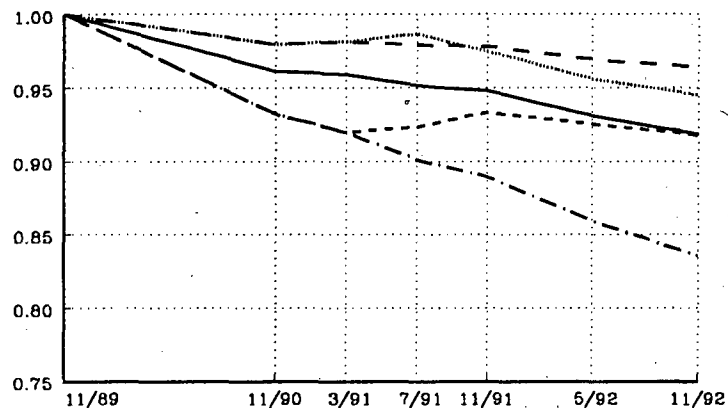
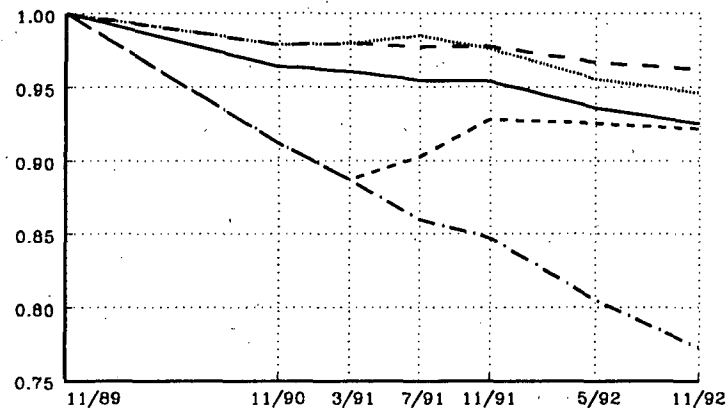


Figure 3: Simulation Results: Employment Probabilities For Women

Employment Probabilities For Men
40 Years Old, Employed in 11/89, Married, All Sectors
Specification 5

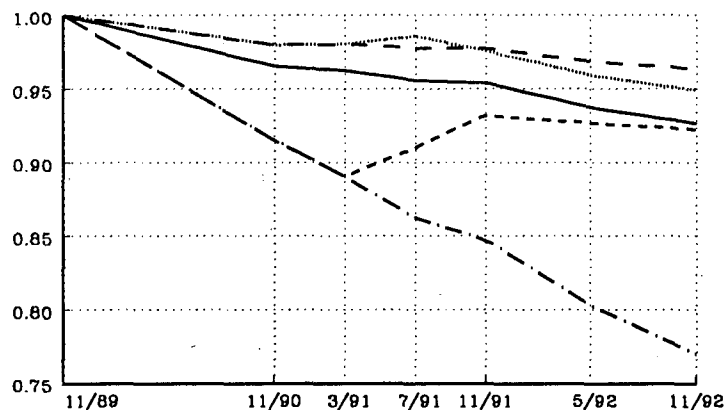


Employment Probabilities For Men
40 Years Old, Employed in 11/89, Married, All Sectors
Specification 6



- (A) 'Selected' For Training in the Firm But Never Actually Participating: $QBHH=1$ But $QBT=QBP=0$
 (B) Training in the Firm, Started in 7/91 and Finished in 7/91: $QBHH=1$ until 3/91, $QBT=1$ in 7/91, $QBP=1$ since 7/91
 — (C) BASELINE CASE: Never Having Participated in Training: $QST=QSP=QSHH=QBT=QBP=QBHH=0$
 - - - (D) Training in an External Institution, Started in 3/91 and Finished in 7/91: $QSHH=1$ until 3/91, $QST=1$ in 7/91, $QSP=1$ since 7/91
 - - - (E) 'Selected' For Training in an External Institution But Never Actually Participating: $QSHH=1$ But $QST=QSP=0$

Employment Probabilities For Men
40 Years Old, Employed in 11/89, Married, All Sectors
Specification 7



Employment Probabilities For Men
40 Years Old, Employed in 11/89, Married, All Sectors
Specification 8

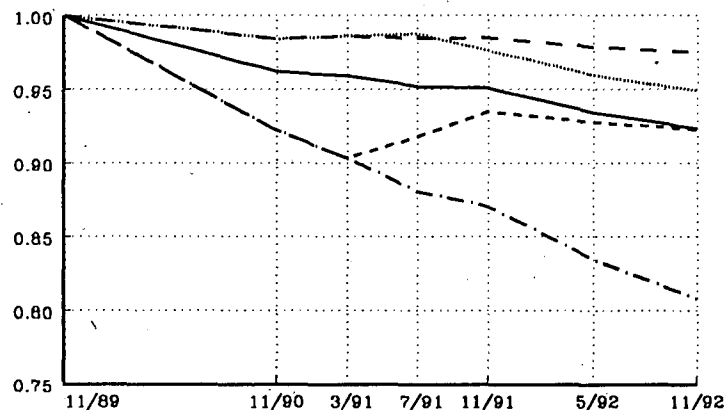
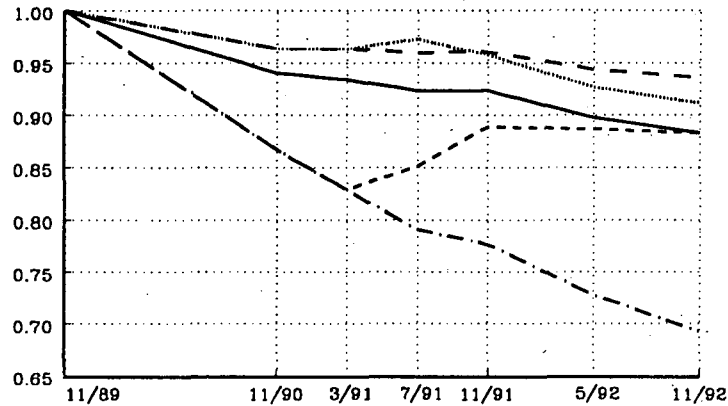
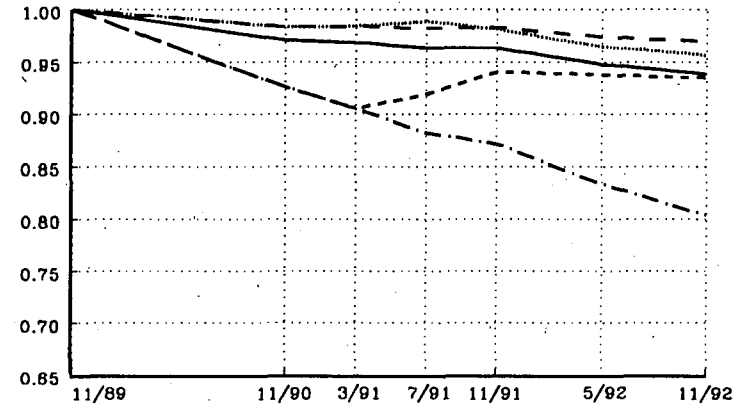


Figure 4: Simulation Results: Employment Probabilities For Men

Employment Probabilities For Men
40 Years Old, Employed in 11/89, Married,
Commerce, Specification 6

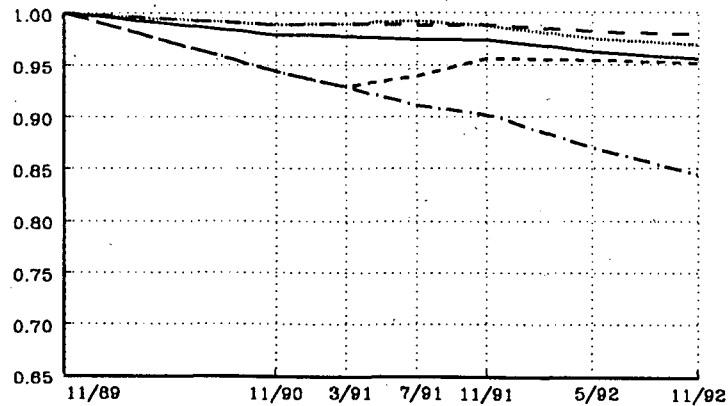


Employment Probabilities For Men
40 Years Old, Employed in 11/89, Married,
Construction, Specification 6



- (A) 'Selected' For Training in the Firm But Never Actually Participating: $QBHH=1$ But $QBT=QBP = 0$
- (B) Training in the Firm, Started in 7/91 and Finished in 7/91: $QBHH=1$ until 3/91, $QBT=1$ in 7/91. $QBP=1$ since 7/91
- (C) BASELINE CASE: Never Having Participated in Training: $QST=QSP=QSHH=QBT=QBP=QBHH = 0$
- - - (D) Training in an External Institution, Started in 3/91 and Finished in 7/91: $QSHH=1$ until 3/91, $QST=1$ in 7/91. $QSP=1$ since 7/91
- · - (E) 'Selected' For Training in an External Institution But Never Actually Participating: $QSHH=1$ But $QST=QSP = 0$

Employment Probabilities For Men
40 Years Old, Employed in 11/89, Married,
Traffic, Post, Railways, Specification 6



Employment Probabilities For Men
40 Years Old, Employed in 11/89, Married,
Metal and Electrics Manufacturing, Specification 6

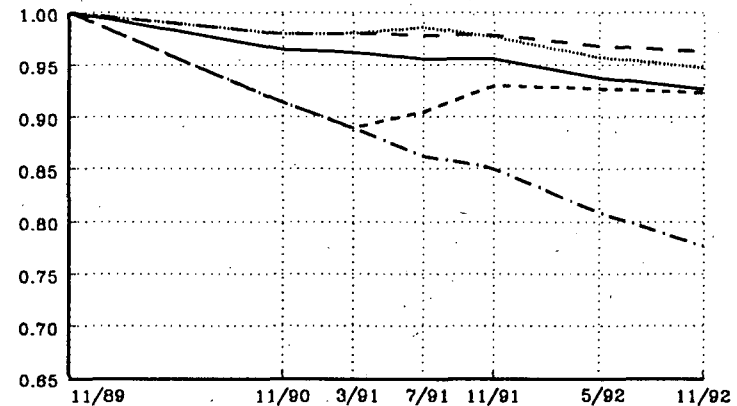


Figure 5: Simulation Results: Employment Probabilities in Different Sectors

6 Conclusions

In this paper, we estimated the impact of two different types of qualification measures on employment prospects in East Germany within a dynamic random-effects model. We controlled for panel mortality and for individual heterogeneity, and in three specifications, we treated the decision to participate in a qualification measure as endogenous. Furthermore, we tried to solve the problem of selection bias in a non-experimental setting by introducing a control variable representing the “pre-program test” as it was suggested by Heckman and Hotz (1989).

The results show that, compared to those who do not take part in a qualification measure, training outside of the own firm seems to worsen the participant’s employment chances in the short run. In the long run, there is no difference in the employment prospects between participants and non-participants. However, considering that people who start such a qualification measure seem to belong to a labor market group with very bad employment prospects (“negative selection”) as indicated by the selection-control variable QSHH, participating in the training program actually raised their position up to the average level in the long run, which reverses the result. People who participated in a training program within the firm enjoyed a very positive effect on their employment chances in the short run – relative to non-trainees. In the long run, this effect becomes smaller. Again, considering the type of persons participating in qualification within a firm reverses the results. In contrast to qualification measures in an external institution, measures within the firm seem to attract people with relatively good labor market prospects (“positive selection”) as shown by the coefficient of the selection-control variable QBHH. In the long run, the trainees’ employment prospects are not as good as they were before participating in the qualification measure. One may interpret this as a negative net effect of training within the firm, a finding one should, however, be very cautious about. Our findings seem robust with respect to instrumenting the pre-program-dummies which are plagued by a potential endogeneity problem.

The model estimated here reveals insights into the general dynamics of the East German labor market as well as on the effects of qualification measures on employment. However, these results have to be treated with some caution. The model does not completely control “endogenously” for selection bias which resulted in significant estimates of the coefficients of the preprogram dummies. One solution to this may be to improve the modelling of the endogenous qualification decision. It is further planned to extend the analysis by modelling the combined effects of training on employment and on earnings.

Appendix

Table 5: Estimation Results without Qualification Probit

Specification Variable	(1) Coeff. (t-stat)	(2) Coeff. (t-stat)	(3) Coeff. (t-stat)	(4) Coeff. (t-stat)
Initial condition:				
Intercept	1.3098 (3.3)	1.3797 (3.1)	1.3130 (3.4)	1.3131 (3.4)
Age/10	.6594 (3.0)	.7390 (3.1)	.6580 (3.1)	.6579 (3.1)
Age ² /100	-.0876 (3.3)	-.0971 (3.4)	-.0874 (3.4)	-.0874 (3.4)
Female	-.7830 (9.7)	-.8374 (8.5)	-.7830 (9.8)	-.7830 (9.8)
Teilfacharb.	.1174 (.7)	.1452 (.8)	.1173 (.7)	.1173 (.7)
Facharbeiter	.3129 (3.0)	.3275 (2.9)	.3118 (3.0)	.3118 (3.0)
Meister	.4125 (2.0)	.4091 (1.9)	.4108 (2.1)	.4108 (2.1)
Fachschule	.4621 (3.6)	.4702 (3.4)	.4604 (3.6)	.4604 (3.6)
University	.5480 (2.9)	.5406 (2.6)	.5462 (2.9)	.5461 (2.9)
10th Grade	.1622 (1.8)	.1643 (1.7)	.1622 (1.8)	.1622 (1.8)
Abitur/Fhrf.	-.0835 (.59)	-.1025 (.7)	-.0839 (.6)	-.0839 (.6)
Married	-.3078 (2.2)	-.3362 (2.2)	-.3074 (2.2)	-.3074 (2.2)
Divorced/ Separated	-.3309 (1.9)	-.3476 (1.9)	-.3295 (1.9)	-.3295 (1.9)
Widow(er)	.1718 (.67)	.1410 (.5)	.1726 (.7)	.1726 (.7)
$\rho_{0,E}$	-.0227 (.6)	.4196 (2.1)	-.0182 (.5)	-.0181 (.5)
Attrition Equation				
Intercept	-6.6437 (21.4)	—	-6.6513 (21.4)	-6.6582 (21.4)
Age/10	5.3669 (31.0)	—	5.3701 (31.0)	5.3739 (31.1)
Age ² /100	-.6568 (31.2)	—	-.6572 (31.2)	-.6576 (31.2)
Female	-.0589 (1.2)	—	-.0548 (1.1)	-.0555 (1.2)
Linear Trend	-1.2540 (50.0)	—	-1.2541 (50.0)	-1.2541 (50.0)
ρ_A	1.9331 (82.24)	—	1.9331 (82.3)	1.9333 (82.3)
Employment equation:				
Intercept	-3.1449 (16.2)	-2.4016 (5.4)	-2.6036 (12.1)	-2.6296 (12.2)
$E_{i,t-1}$	2.4319 (23.1)	1.7754 (3.8)	—	—
$E_{i,t-1} \times Trend$	-.1018 (2.1)	.1066 (.7)	—	—
$E_{i,t-1} \times DUM_{W1}$	—	—	1.7511 (14.7)	1.7866 (14.9)
$E_{i,t-1} \times DUM_{W2}$	—	—	2.3465 (27.0)	2.3804 (27.0)
$E_{i,t-1} \times DUM_{W3}$	—	—	2.2622 (27.8)	2.2918 (27.9)
$E_{i,t-1} \times DUM_{W4}$	—	—	2.1257 (27.5)	2.1402 (27.3)
$E_{i,t-1} \times DUM_{W5}$	—	—	1.8719 (23.8)	1.8789 (23.5)
$E_{i,t-1} \times DUM_{W6}$	—	—	2.0460 (27.1)	2.0321 (26.6)
Female	-.2540 (11.1)	-.3031 (7.3)	—	—
$E_{i,t-1} \times Female$	—	—	-.2276 (9.1)	-.2488 (9.2)
$(1 - E_{i,t-1}) \times Female$	—	—	-.4403 (7.6)	-.4569 (7.9)
Age/10	1.2683 (12.7)	1.3111 (7.6)	1.2688 (12.7)	1.3114 (13.1)
Age ² /100	-.1693 (13.7)	-.1750 (7.9)	-.1694 (13.7)	-.1757 (14.2)

Table 5: Estimation Results without Qualification Probit <continued>

Specification Variable	(1) Coeff. (t-stat)	(2) Coeff. (t-stat)	(3) Coeff. (t-stat)	(4) Coeff. (t-stat)
Employment equation <continued>:				
Teilfacharb.	.0220 (.3)	.0760 (.8)	.0195 (.3)	-.0029 (.0)
Facharbeiter	.2171 (4.3)	.3244 (4.1)	.2184 (4.3)	.2276 (4.5)
Meister	.3865 (5.9)	.5204 (5.2)	.3851 (5.9)	.4084 (6.2)
Fachschule	.4401 (7.7)	.6083 (5.7)	.4380 (7.7)	.3770 (6.6)
University	.4815 (6.8)	.6579 (5.5)	.4740 (6.7)	.3940 (5.5)
10th Grade	.0332 (1.0)	.0413 (1.1)	.0320 (1.0)	.0140 (.4)
Abitur/Fhrf.	.0275 (.6)	.0238 (.4)	.0268 (.5)	.0129 (.3)
Married	.0450 (1.2)	.0278 (.6)	.0512 (1.4)	.0571 (1.5)
Divorced/ Separated	-.1058 (2.1)	-.1679 (2.7)	-.1015 (2.0)	-.1078 (2.1)
Widow(er)	.0637 (.7)	.0478 (.4)	.0678 (.8)	.0917 (1.0)
DUM_{W2}	.1343 (3.1)	-.0479 (.1)	-.4505 (3.6)	-.4520 (3.6)
DUM_{W3}	.0386 (.7)	-.4144 (1.0)	-.4988 (4.0)	-.5008 (4.1)
DUM_{W4}	.0919 (1.3)	-.4740 (1.0)	-.3581 (2.8)	-.3536 (2.8)
DUM_{W5}	-.0289 (.3)	-.7687 (1.4)	-.3254 (2.5)	-.3121 (2.4)
DUM_{W6}	.0401 (.4)	-.8331 (1.4)	-.4186 (3.1)	-.4079 (3.0)
QSHH	-.3146 (8.0)	-.2705 (5.4)	-.3098 (7.9)	-.2971 (7.5)
QSL	-.7137 (18.6)	-.7922 (12.4)	-.7166 (18.5)	-.7333 (18.8)
QST	-.0864 (1.4)	-.0920 (1.3)	-.0843 (1.4)	-.0820 (1.3)
QSP	.0317 (.9)	.0203 (.5)	.0316 (.9)	.0233 (.6)
QBHH	.3402 (5.3)	.5034 (5.1)	.3409 (5.4)	.3041 (4.7)
QBL	.3149 (4.0)	.3375 (3.8)	.3117 (4.0)	.2953 (3.7)
QBT	.4484 (5.2)	.5437 (4.7)	.4542 (5.2)	.4540 (5.2)
QBP	.1513 (3.9)	.1917 (3.9)	.1489 (3.8)	.1320 (3.3)
$\rho_{E,1}$	.2946 (26.8)	.9435 (2.6)	.2839 (26.8)	.2781 (26.3)
$\rho_{E,2}$	.1835 (11.6)	.7747 (1.7)	.1802 (10.8)	.1813 (10.7)
$\rho_{E,3}$	.1887 (5.8)	.4336 (2.2)	.1873 (5.5)	.1859 (5.4)
$\rho_{E,4}$	.1882 (4.8)	.2871 (3.0)	.1917 (4.8)	.1895 (4.7)
$\rho_{E,5}$	.0681 (.9)	.0699 (.9)	.0827 (1.2)	.0662 (1.0)
$\rho_{E,6}$	-.0054 (.1)	.1108 (3.2)	-.0131 (.2)	-.0206 (.3)

Table 6: Test Results for Estimation without Qualification Probit

Specification	(1)	(2)	(3)	(4)
Number of individuals	8681	8681	8681	8681
Test of RE specification χ^2	188.4	25.2	185.1	2733.3
Degrees of freedom	48	43	53	61
Test of wave specific $\rho_E \chi^2(5)$	87.5	37.8	74.1	68.2
Test of linear time Trend $\chi^2(4)$	15.3	12.3	145.3	141.8
Test of wave specific effect of $E_{i,t-1} \chi^2(5)$	–	–	38.4	41.2
Test of sector specific effect of $E_{i,t-1} \chi^2(7)$	–	–	–	106.3
LOG-Likelihood	-30615.0	-9160.1	-30594.3	-30469.6

Table 7: Estimation Results with and without Qualification Probit

Specification Variable	(5) Coeff. (t-stat)	(6) Coeff. (t-stat)	(7) Coeff. (t-stat)	(8) ^o Coeff. (t-stat)
Initial condition:				
Intercept	1.3134 (3.4)	1.3267 (3.4)	1.5468 (4.1)	1.5432 (4.1)
Age/10	.6578 (3.1)	.6524 (3.0)	.5857 (2.7)	.5877 (2.7)
Age ² /100	-.0874 (3.4)	-.0867 (3.4)	-.0827 (3.2)	-.0830 (3.2)
Female	-.7830 (9.8)	-.7833 (9.8)	-.7875 (9.8)	-.7876 (9.8)
Teilfacharb.	.1173 (.7)	.1172 (.7)	.0874 (.5)	.0872 (.5)
Facharbeiter	.3117 (3.0)	.3074 (3.0)	.3653 (3.6)	.3658 (3.6)
Meister	.4107 (2.1)	.4039 (2.0)	.4756 (2.4)	.4763 (2.4)
Fachschule	.4603 (3.6)	.4534 (3.6)	.5120 (4.3)	.5127 (4.3)
University	.5460 (2.9)	.5382 (2.9)	.4531 (3.1)	.4542 (3.1)
10th Grade	.1622 (1.8)	.1621 (1.8)	—	—
Abitur/Fhrf.	-.0840 (.6)	-.0858 (.6)	—	—
Married	-.3073 (2.2)	-.3053 (2.2)	-.3043 (2.2)	-.3048 (2.2)
Divorced/ Separated	-.3294 (1.9)	-.3238 (1.9)	-.3101 (1.8)	-.3112 (1.8)
Widow(er)	.1726 (.7)	.1759 (.7)	.1991 (.8)	.1986 (.8)
$\rho_{0,E}$	-.0178 (.5)	.0010 (.0)	-.0054 (.2)	-.0079 (.2)
Attrition Equation				
Intercept	-6.6684 (21.5)	-6.6839 (21.5)	-6.7082 (21.6)	-6.6482 (21.5)
Age/10	5.3785 (31.1)	5.3823 (31.0)	5.3968 (31.2)	5.3667 (31.2)
Age ² /100	-.6581 (31.2)	-.6588 (31.2)	-.6605 (31.4)	-.6570 (31.3)
Female	-.0543 (1.1)	-.0514 (1.1)	-.0528 (1.1)	-.0534 (1.1)
Linear Trend	-1.2542 (50.0)	-1.2504 (49.8)	-1.2541 (50.0)	-1.2545 (50.0)
ρ_A	1.9334 (82.3)	1.9328 (80.9)	1.9332 (81.1)	1.9327 (81.7)
Qualification equation :				
Intercept	—	-2.7118 (11.6)	-2.7322 (11.7)	-2.7056 (11.6)
$E_{i,t-1}$	—	-.5509 (15.7)	-.5533 (15.7)	-.5479 (15.9)
Age/10	—	.8323 (7.0)	.8439 (7.1)	.8274 (7.0)
Age ² /100	—	-.1289 (8.7)	-.1304 (8.9)	-.1282 (8.7)
Female	—	.0626 (2.5)	.0629 (2.5)	.0636 (2.5)
Married	—	-.0067 (.2)	-.0074 (.2)	-.0079 (.2)
Divorced/ Separated	—	-.0730 (1.2)	-.0744 (1.3)	-.0760 (1.3)
Widow(er)	—	.0538 (.5)	.0546 (.5)	.0527 (.5)
Teilfacharb.	—	-.2704 (2.1)	-.2807 (2.2)	-.2805 (2.2)
Facharbeiter	—	.2894 (3.4)	.2893 (3.5)	.2907 (3.5)
Meister	—	.5701 (6.2)	.5734 (6.3)	.5748 (6.3)
Fachschule	—	.7062 (8.2)	.7057 (8.4)	.7069 (8.4)
University	—	.8976 (10.3)	.8992 (10.5)	.9008 (10.5)

^o Specification (8) corresponds to specification (7), except that the dummy variables QSHH and QBHH are instrumented to account for a potential endogeneity problem.

Table 7: Estimation Results with and without Qualification Probit <continued>

Specification Variable	(5) Coeff. (t-stat)	(6) Coeff. (t-stat)	(7) Coeff. (t-stat)	(8) ^o Coeff. (t-stat)
Qualification equation <continued>:				
DUM_{W2}	–	.2740 (8.8)	.2745 (8.8)	.2770 (8.9)
DUM_{W3}	–	.1698 (4.9)	.1704 (4.9)	.1728 (4.9)
DUM_{W4}	–	.3175 (9.2)	.3177 (9.2)	.3219 (9.3)
DUM_{W5}	–	.3051 (8.4)	.3068 (8.5)	.3116 (8.6)
DUM_{W6}	–	.0813 (2.0)	.0817 (2.1)	.0877 (2.2)
ρ_Q	–	.2368 (8.1)	.2365 (8.0)	.2262 (7.5)
Employment equation:				
Intercept	-2.6940 (12.5)	-2.8154 (12.1)	-3.2556 (16.0)	-3.1571 (15.7)
$E_{i,t-1}$	–	–	2.1777 (37.8)	2.1741 (36.7)
$E_{i,t-1} \times DUM_{W1}$	1.7332 (14.5)	1.7029 (13.7)	–	–
$E_{i,t-1} \times DUM_{W2}$	2.5122 (27.9)	2.4992 (25.8)	–	–
$E_{i,t-1} \times DUM_{W3}$	2.4573 (29.1)	2.4009 (26.6)	–	–
$E_{i,t-1} \times DUM_{W4}$	2.2729 (28.3)	2.2220 (25.1)	–	–
$E_{i,t-1} \times DUM_{W5}$	1.9782 (24.5)	1.8495 (20.8)	–	–
$E_{i,t-1} \times DUM_{W6}$	2.0841 (27.1)	2.0451 (24.6)	–	–
$E_{i,t-1} \times Female$	-.2220 (8.1)	-.2127 (7.2)	-.2070 (7.0)	-.2118 (7.0)
$(1 - E_{i,t-1}) \times Female$	-.4600 (8.0)	-.5060 (7.9)	-.4495 (7.2)	-.4399 (7.1)
$E_{i,t-1} \times Sec_2^{a,b}$	.0801 (1.6)	.0725 (1.3)	.0727 (1.3)	.0715 (1.3)
$E_{i,t-1} \times Sec_3^{a,c}$	.1142 (2.6)	.1006 (2.2)	.1039 (2.3)	.1076 (2.3)
$E_{i,t-1} \times Sec_4^{a,d}$	-.0132 (.4)	.0131 (.4)	.0112 (.3)	.0149 (.4)
$E_{i,t-1} \times Sec_5^{a,e}$	-.0693 (2.0)	-.0634 (1.8)	-.0675 (1.9)	-.0622 (1.7)
$E_{i,t-1} \times Sec_6^{a,f}$	-.2501 (7.4)	-.2482 (6.9)	-.2462 (6.9)	-.2432 (6.5)
$E_{i,t-1} \times Sec_7^{a,g}$	.2409 (4.3)	.2460 (4.2)	.2492 (4.2)	.2364 (3.9)
$E_{i,t-1} \times Sec_8^{a,h}$	-.0015 (.0)	.0260 (.3)	.0200 (.2)	.0013 (.0)
$E_{i,t-1} \times Sec_9^{a,i}$	.1145 (3.2)	.0694 (1.8)	.0678 (1.8)	.0698 (1.9)
$E_{i,t-1} \times Public$	.0561 (1.6)	.0530 (1.5)	.0589 (1.6)	.0654 (1.8)
$E_{i,t-1} \times Short$	-.6048 (18.2)	-.5697 (15.6)	-.5356 (15.1)	-.5333 (14.7)
Age/10	1.3503 (13.5)	1.4712 (13.3)	1.4747 (13.2)	1.3886 (12.1)
Age ² /100	-.1801 (14.6)	-.1981 (14.4)	-.1994 (14.4)	-.1873 (12.9)

^a Reference category: agriculture – Dummies are constructed such that coefficients sum up to zero.

^b sec2: mining, gas, energy

^c sec3: construction

^d sec4: metal and electrical manufacturing

^e sec5: other manufacturing

^f sec6: commerce

^g sec7: traffic, post, railways

^h sec8: banking, insurance

ⁱ sec9: other services

Table 7: Estimation Results with and without Qualification Probit <continued>

Specification Variable	(5) Coeff. (t-stat)	(6) Coeff. (t-stat)	(7) Coeff. (t-stat)	(8) ^o Coeff. (t-stat)
Employment equation <continued>:				
Teilfacharb.	.0111 (.2)	-.0005 (.0)	-.0101 (.1)	-.0018 (.0)
Facharbeiter	.2325 (4.5)	.2308 (4.3)	.2368 (4.4)	.2309 (4.2)
Meister	.3947 (5.9)	.3993 (5.6)	.4028 (5.8)	.3916 (5.3)
Fachschule	.3715 (6.5)	.3621 (5.9)	.3637 (6.1)	.3418 (5.1)
University	.3885 (5.4)	.4150 (5.3)	.4175 (6.2)	.3837 (5.1)
10th Grade	.0145 (.5)	.0289 (.8)	—	—
Abitur/Fhrf.	.0055 (.1)	.0060 (.1)	—	—
Married	.0414 (1.1)	.0479 (1.1)	.0511 (1.2)	.0472 (1.1)
Divorced/ Separated	-.1227 (2.4)	-.1281 (2.3)	-.1384 (2.4)	-.1436 (2.5)
Widow(er)	.0729 (.8)	.1254 (1.3)	.1198 (1.2)	.1162 (1.2)
DUM_{W2}	-.4542 (3.6)	-.5018 (3.9)	.2062 (5.0)	.2282 (5.6)
DUM_{W3}	-.5071 (4.1)	-.5006 (3.9)	.1162 (2.4)	.1477 (3.0)
DUM_{W4}	-.3544 (2.8)	-.3194 (2.5)	.1446 (2.5)	.1847 (2.9)
DUM_{W5}	-.3133 (2.4)	-.2643 (2.0)	-.0732 (.8)	-.0211 (.2)
DUM_{W6}	-.4126 (3.1)	-.4263 (3.1)	-.0809 (.9)	-.0221 (.2)
QSHH	-.2831 (7.1)	-.4664 (10.2)	-.4703 (10.3)	-.3684 (1.4)
QSL	-.7193 (18.3)	—	—	—
QST	-.0641 (1.0)	-.1103 (1.6)	-.0975 (1.4)	-.0741 (1.1)
QSP	.0224 (.6)	.0230 (.5)	.0249 (.5)	.0320 (.6)
QBHH	.2925 (4.5)	.2449 (3.3)	.2454 (3.3)	.3884 (1.0)
QBL	.2967 (3.7)	—	—	—
QBT	.4418 (5.0)	.3943 (4.2)	.3829 (4.1)	.3768 (4.1)
QBP	.1220 (3.1)	.1038 (2.3)	.1116 (2.5)	.1231 (2.5)
$\rho_{E,1}$	.2802 (26.3)	.3162 (22.1)	.3323 (22.2)	.2855 (27.2)
$\rho_{E,2}$	.1782 (10.0)	.2551 (13.5)	.2610 (14.5)	.2086 (14.8)
$\rho_{E,3}$	.1928 (5.5)	.2423 (6.8)	.2447 (7.6)	.1920 (6.2)
$\rho_{E,4}$	.1819 (4.4)	.2119 (4.9)	.2126 (5.2)	.1727 (4.2)
$\rho_{E,5}$	.0582 (.9)	.1094 (1.6)	.0896 (1.1)	.0585 (.7)
$\rho_{E,6}$	-.0173 (.2)	.0014 (.0)	-.0059 (.1)	-.0259 (.3)

Table 8: Test Results for Estimation with and without Qualification Probit

Specification	(5)	(6)	(7)	(8) ^o
Number of individuals	8681	8681	8751	8751
Test of RE specification χ^2	1209.5	1546.1	7757.5	1359.6
Degrees of freedom	63	79	70	70
Test of wave specific $\rho_E \chi^2(5)$	72.7	44.0	55.7	52.9
Test of linear time Trend $\chi^2(4)$	141.1	38.4	22.7	41.8
Test of wave specific effect of $E_{i,t-1} \chi^2(5)$	53.5	48.8	—	—
Test of sector specific effect of $E_{i,t-1} \chi^2(7)$	83.9	79.6	87.6	89.9
LOG-Likelihood	-30306.7	-39978.6	-40289.0	-40362.9

Table 9: Variable Definitions

Variable	Definition
<i>Dependent Variables:</i>	
$D_{it} \equiv Y_{it,A}$	1 if the whole set of variables used in the employment and qualification equations is available in each wave 0 otherwise
$E_{it} \equiv Y_{it,E}$	1 if person is employed or self-employed, 0 if person is unemployed (officially registered as well as not-registered), or participating in a qualification measure or Housewife or Househusband
$Q_{it} \equiv Y_{it,Q}$	1 if person is currently participating in training within the firm where the person is employed or in a qualification measure in an external institution ($QSL = 1$ or $QBL = 1$) 0 otherwise
Female	1 if female 0 if male
<i>Occupational Qualification: reference category = no occupational degree</i>	
Teilfacharbeiter	1 if person reports that his/her highest professional qualificational degree is "Teilfacharbeiter", which corresponds to having completed a partial apprenticeship 0 otherwise
Facharbeiter	1 if person reports that his/her highest professional qualificational degree is "Facharbeiter", which corresponds to having completed a full apprenticeship (craftsman) 0 otherwise
Meister	1 if person reports that his/her highest professional degree is "Meister" which is a master craftsman 0 otherwise
Fachschule	1 if person has a degree from a specialized vocational school 0 otherwise
University	1 if person has a university degree 0 otherwise
<i>Schooling: reference category = 9 years of schooling</i>	
10th Grade	1 if the person has completed 10 years of schooling 0 otherwise
Abitur/Fhrf.	1 if person has completed 12 or 13 years of schooling 0 otherwise
<i>Marital Status: reference category = unmarried</i>	
Married	1 if person is married 0 otherwise
Divorced/Separated	1 if person is divorced or separated 0 otherwise
Widow(er)	1 if person is a widow/widower 0 otherwise
$DUM_{w,t}$	wave dummies

Table 9: Variable Definitions <continued>

Variable (continued)	Definition (continued)
<i>Sectoral Employment: reference category = agriculture</i>	
$E_{i,t-1} * Sec_k$	<p>1 if person was employed at time of the last interview and working in sector k, with k equal to:</p> <p>2 mining, gas, energy</p> <p>3 construction</p> <p>4 metal and electrics</p> <p>5 other manufacturing</p> <p>6 commerce</p> <p>7 traffic, post, railways</p> <p>8 banking, insurances</p> <p>9 other services</p> <p>Dummies are constructed such that coefficients sum up to zero</p> <p>0 otherwise</p>
<i>Pre-Program-Test for Qualification:</i>	
QSHH	<p>1 if person will participate in a qualification measure in an external institution sometime in the future, has not done so before, and is not currently participating</p> <p>0 otherwise</p>
QBHH	<p>1 if person will participate in a qualification measure in the firm sometime in the future, has not done so before, and is not currently participating</p> <p>0 otherwise</p>
<i>Current Participation in Qualification:</i>	
QSL	<p>1 if person has not finished a qualification measure in an external institution since the previous interview but is currently participating in such a program or will finish such a program before the date of the next interview</p> <p>0 otherwise</p>
QBL	<p>1 if person has not finished a qualification measure in the firm since the previous interview but is currently participating in such a program or will finish such a program before the date of the next interview</p> <p>0 otherwise</p>
<i>Temporary Effect of Qualification:</i>	
QST	<p>1 if, since the previous interview, the person has finished a qualification measure in an external institution</p> <p>0 otherwise</p>
QBT	<p>1 if, since the previous interview, person has finished a qualification measure in the firm where person is employed</p> <p>0 otherwise</p>
<i>Permanent Effect of Qualification:</i>	
QSP	<p>1 if, sometime in the past, the person finished a qualification measure in an external institution</p> <p>0 otherwise</p>
QBP	<p>1 if, sometime in the past, the person finished a qualification measure in the firm where person was employed</p> <p>0 otherwise</p>

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