Discussion Paper

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Technological Change and Skill Obsolescence: The Case of German Apprenticeship Training

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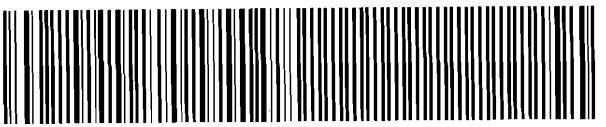

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by

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Abstract

The paper analyses the applicability of vocational training and the earnings of apprentices using survey data from West Germany in 1979, 1985/86 and 1991/92. The applicability has decreased remarkably between 1979 and 1991/92. The objective of the analysis is a survey-data-based assessment of the German apprenticeship system in a time of rapid technological change. The data sets used are the three available cross-sections of *Qualification and Career Surveys* commissioned by the Federal Institute for Vocational Training and the Research Institute of the Federal Labour Office. For each cross-section we estimate an ordered probit model testing demand (including technological progress) and supply-side factors affecting the applicability of what workers have learned during apprenticeship. Furthermore, we estimate earnings functions with the same specification, testing whether firm-specific and socio-economic factors have the same relevance for applicability and earnings. The results indicate that on-the-job investment in human capital has become more important relative to vocational training. Measures for improving the German dual vocational training system are suggested.

JEL-Classification: I21, J24, J62

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Summary

This paper analyses the applicability of German apprenticeship training and the earnings of apprentices with survey data from West Germany in 1979, 1985/86 and 1991/92. The applicability of the content of apprenticeship training has decreased remarkably between 1979 and 1991/92. The objective of the analysis is a survey-data-based assessment of the German apprenticeship system in a time of rapid technological change. The data sets used are the three available cross-sections of "Qualification and Career Surveys" commissioned by the Federal Institute for Vocational Training in Berlin and the Research Institute of the Federal Labour Office in Nürnberg. For each cross-section we estimated an ordered probit model testing demand and supply-side factors affecting the applicability of what the worker has learned during apprenticeship. Furthermore we estimate an earnings equation with the same specification, testing whether firm-specific and socio-economic factors have the same relevance for applicability and earnings.

The results of the econometric analyses show that the applicability decreases with job experience, which can be expected from human capital theory. But the decrease is more pronounced in 1991/92 in comparison to the earlier cross-sections, especially at the beginning of the worker's career. There is a growing discrepancy between the content of what workers learn during apprenticeship and what they need afterwards in their job. The diffusion of microelectronics is shown to be one factor in skill obsolescence. Furthermore, knowledge is mostly occupation-specific and to a lesser degree firm-specific. A change of occupation leads to a substantial reduction in the applicability of knowledge. There are, however, significant differences in the quality of training in the 30 groups of apprenticeship trades considered. Occupational mobility is highest in those occupations where the transfer of skills into other occupations is lowest. Periods of unemployment have a negative impact as well. The main discrepancy between the curriculum of training and the requirements in occupation stems from the demand side of the labour market.

The income-experience profile of earnings is concave, with the steepest part in the first six to ten years of experience. This pattern did not change between 1979 and 1992. While technological progress reduces applicability, earnings are positively affected. Occupational changes reduce applicability, but not earnings. Overall, the results indicate that in the period of rapid technological change between 1979 and 1992, on-the-job investment in human capital has become more important relative to apprenticeship training for workers with an apprenticeship degree. Policy measures for improving the German dual vocational training system are suggested. We propose a clearer division of the responsibilities within this dual system. While government should be responsible for improving theoretical instruction in the vocational schools, employers should be given more decision-making authority with regard to practical training, while holding to certain minimum standards.

Zusammenfassung

Zwischen 1979 und 1992 hat sich die Verwertbarkeit der Inhalte der Ausbildung im Dualen Berufsausbildungssystem verringert. In diesem Beitrag werden strukturelle Ursachen einer guten bzw. einer schlechten Verwertbarkeit im Verlauf des Berufslebens auf der Basis von Befragungen in den Jahren 1979, 1985/86 und 1991/92 (Bundesinstitut für Berufsbildung in Zusammenarbeit mit dem Institut für Arbeitsmarkt- und Berufsforschung) ökonometrisch untersucht. Darüberhinaus wird analysiert, welche Einkommensrelevanz die Ursachen haben. Ziel ist es, empirisch fundierte Grundlagen für die aktuelle wirtschaftspolitische Diskussion zur Reform des Systems der dualen Berufsausbildung im technischen und wirtschaftlichen Wandel bereitzustellen. Die Verwertbarkeit sinkt im Verlaufe des Berufslebens, wobei die Abnahme 1991/92 schneller als noch im Jahre 1979 vonstatten geht. Eine Ursache für die abnehmende Verwertbarkeit ist das Vordringen der Mikroelektronik. Die in der Ausbildung erworbenen Fähigkeiten sind in hohem Maße berufsspezifisch; ein beruflicher Wechsel führt entsprechend zu einer starken Abnahme der Verwertbarkeit. Dabei gibt es bedeutsame Qualitätsunterschiede in den 30 hier betrachteten Berufsgruppen. Nach einem Berufswechsel ist der Verfall der Verwertbarkeit in den Metall- und Elektrotechnikberufen am geringsten. Die berufliche Mobilität ist in den Berufen am höchsten, die bei einem Berufsweschel am wenigsten Wissen transferieren können. Perioden der Arbeitslosigkeit verringern die Verwertbarkeit. Insgesamt wird die Verwertbarkeit mehr von nachfrageseitigen als von angebotsseitigen Faktoren des Arbeitsmarktes bestimmt.

Im Verlaufe des Berufsleben steigt das Einkommen in den ersten sechs bis zehn Jahren relativ stark an. Danach verringert sich die Zunahme allmählich auf Null. Dieses Muster hat sich zwischen den Jahren 1979 und 1991/92 kaum verändert. Neue Technologien verringern die Verwertbarkeit am Arbeitsplatz, sie erhöhen allerdings das Einkommen um bis zu 10%. Ein Wechsel des Berufes reduziert die Verwertbarkeit in hohem Maße, hat aber keinen vergleichbaren Einfluß auf das Einkommen.

Die Analyse der Verwertbarkeit der Lehre im technischen Wandel deutet darauf hin, daß Investitionen in Humankapital während des Arbeitslebens relativ zur Ausbildung an Bedeutung gewonnen haben. Eine Ursache dieser Entwicklung ist die zunehmende Diskrepanz zwischen den Lehrinhalten und den Anforderungen des Berufslebens. Damit die Erstausbildung auch in Zukunft ihre wichtige Rolle behält, müssen die Ausbildungsinhalte schneller und besser den sich ändernden Anforderungen angepaßt werden. Um das zu erreichen, schlagen wir eine eindeutigere Regelung der Kompetenz im Dualen Berufsausbildungssystem an. Während der Staat sich der Verbesserung der Berufsschulen widmen sollte, sollten die Arbeitgeber bei Einhaltung gewisser Mindeststandards mehr Entscheidungsspielräume in der Lehre erhalten.

1 Introduction

The German apprenticeship system (dual vocational training system, DVTS) has gained considerable attention from both economic researchers and political leaders (cf. Steedman, 1993, White Paper on Education and Training, 1995). From an international perspective, the main question is whether the DVTS should be transferred to other countries. The main question from a national perspective is whether the DVTS still produces the skills necessary to cope with globalisation, information technologies and organisational change.

The DVTS, which has its legal foundation in the Vocational Training Act of 1969 (Berufsbildungsgesetz) is highly regarded in Germany. Skilled workers earn more and enjoy a higher societal status than do semi- and unskilled workers. Wage rates, further training opportunities and accident insurance depend on the completion of an apprenticeship. In the crafts sector, a completed apprenticeship is the springboard for a further career as a master and for self-employment in a crafts trade. The structure of the DVTS is partly responsible for low unemployment among German youths in comparison with other western industrialised countries. It is therefore understandable that every year the public's attention is directed to the ability of high-school graduates to obtain sufficient training positions.

Despite ist good reputation, there is evidence that the efficiency of the apprenticeship system is deteriorating. The Vocational Training Act states that young people can only be educated outside the school system according to the rules of the DVTS. It is criticised that young people are trained in skills which are not needed afterwards (Henninges, 1994). As a consequence, skilled workers find themselves unemployed or are forced to change occupation. It is also criticised that the contents of apprenticeship training quickly become obsolete due to technological change (Bunk et. al., 1991).

In 1991 about 72% of all German workers had been trained in the DVTS. Although the number of young people entering vocational training is declining, the DVTS remains quantitatively the most important form of training in Germany. Despite its importance, there is a lack of empirical evidence concerning the quality of training through the DVTS. In this paper, the quality of the DVTS will be analysed with individual survey data from 1979, 1985/86 and 1991/92 (BIBB/IAB surveys). The aim is to contribute to a better understanding of the factors affecting apprenticeship applicability and earnings as well as their evolution from 1979 to 1991/92.

A first econometric comparison of the applicability of apprenticeship training was undertaken by Pfeiffer and Blechinger (1995). This paper is an extension of our previous work. First, we discuss the institutional setting of the DVTS in light of

recent theoretical work in human capital. Second, we extend our former specification of the ordered probit models to include additional occupational mobility indicators. Finally, we compare the results of applicability tests with those of an earnings equation using the same specification of the explanatory variables. That is, we compare the impact of institutional details of the apprenticeship training, of firm-specific and socio-economic factors on applicability and earnings.

The structure of the German economy has changed significantly since the first survey in 1979. Specifically, we note the deep recession in 1981, the long period of growth through 1989 and the additional reunification-induced boom, which peaked in 1991. Furthermore, the widespread diffusion of microelectronics as a key technology took place in this period. This had a serious impact on working life and the demand for highly-qualified workers. Generally, technological progress has increased the need for better skilled workers (cf. Bartel and Sicherman, 1995; Blechinger and Pfeiffer, 1996). The rate at which workers have to acquire and apply new skills has increased. This has enhanced the demand for workers with better cognitive skills and is one reason for the increased demand for general education in Germany.

The paper is organized as follows: section two introduces some facts, institutional details and theory as well as empirical work on the DVTS; section three presents the data and the econometric model, the results of which are discussed in section four. Policy options for a reform of the DVTS are drawn in section five.

2 The German apprenticeship system

2.1 Facts and trends in the DVTS

In 1993, 67.8% of all West Germans aged 30 to 35 had an apprenticeship degree (Table 1). From 1976 to 1991, this share rose from 60.4% to 68.9%, but after 1991, it seems to have fallen slightly. The percentage of West Germans in the same age group with a university diploma rose steadily from 9.6% to 15.6%.

The educational background of apprentices has become more heterogeneous in the last ten years. In 1993, 34.2% of the apprentices had finished compulsory school successfully (9 years of schooling). 35.8% of the apprentices had an intermediate school qualification (10 years of schooling). Since 1984, the percentage of persons with a final degree (12 or 13 years of schooling) has risen from about 10% to 14%. This degree enables a person to enter the German university system. To enter apprenticeship one does not necessarily need to possess a school degree. In 1993, about 3.5% of all apprentices had not successfully finished compulsory schools (cf.

Berufsbildungsbericht, 1995). The others had some special intermediate school qualification.

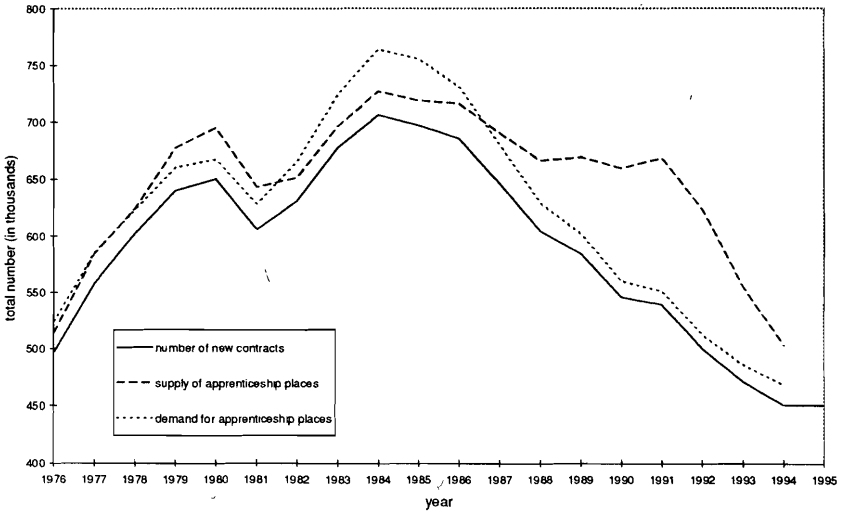
Table 1 Share of persons aged 30 to 35 with apprenticeship training or university degree in West Germany, 1976-1993

year	1993	1991	1989	1985	1982	1978	1976
apprenticeship training (incl. masters)	67.75	68.94	66.28	63.74	63.15	61.36	60.44
university degree (incl. technical university)	15.59	15.16	15.13	14.01	12.03	9.82	9.60

Source: Bildung im Zahlenspiegel, 1995, Statistisches Jahrbuch für die Bundesrepublik Deutschland, several volumes; 1991, 1993: own calculations based on the ZEW-70% sample of the German „Mikrozensus" 1991, 1993.

In 1994, West German firms offered 503,000 apprenticeship places, while 468,000 young people were seeking a training place (Berufsbildungsbericht, 1995). The number of new apprenticeship contracts totalled approximately 450,000. This figure declined steadily between 1985 and 1994 but appears to have stabilized from 1994 to 1995 (Figure 1).

Figure 1 Supply, demand and number of new apprenticeships contracts in West Germany, 1976 - 1995



Source: Berufsbildungsbericht (1995); Institut der Deutschen Wirtschaft (1996).

One important reason for the development of new contracts is demographic change. The total number of young people seeking an apprenticeship place has fallen since 1984 but now appears to be increasing again. If this trend continues, the number of potential entrants into the DVTS will rise further. On the other hand, the number of offers by private and public firms has declined since 1992 (cf. supply in Figure 1). For the stability of the German DVTS, it is important that supply increase to accomodate the demographic trend.

2.2 The institution DVTS

According to the Vocational Training Act of 1969 (in conjunction with the Crafts Regulation Act), firms are only allowed to train young people in one of 374 well-defined occupations (*Ausbildungsberufe*, Benner, 1995). In 1993, motor vehicle mechanics held rank 1 among men (8.4%) and doctor's receptionists ranked first among women (7.9%). 39.1% of men and 53.1% of women are trained in the ten most common occupations (Berufsbildungsbericht, 1995).

Any form of on-the-job training which does not conform to this law does not lead to an accepted occupational degree. Every occupation has its own training curriculum and educational standards, which are defined in a rather complex institutional manner. Training generally lasts between two and three and a half years, depending on the occupation, the economic sector and the educational qualification of the apprentice. In general, more schooling leads to a shorter training period, which usually ends with an examination. While the practical part of the training takes place in the firm, the more theoretical training takes place in vocational schools. This duality, which gives the system its name, is based on the idea of complementing the practicallity of on the job training with theoretical and classroom instruction. Vocational education is a compulsory part of the training system.

The aim of the DVTS is to produce skilled labour at a level below that of the university. Although apprentices are trained in one of 374 occupations, the training is designed to enable her or him to work on a wider range of occupational tasks. It is an explicit objective to train in an occupational way and not firm-specifically, so that the worker's knowledge is not worthless outside the firm. The main part of training time is spent in the training firm, usually three or four days per week.

Whereas firms cover the training costs, the government bears the cost of vocational schooling. In 1991, the federal government provided 3.8 billion German marks in training subsidies (Berufsbildungsbericht, 1995). Firms have to meet minimum educational requirements but are free to conduct further training in order to quickly respond to technological or organisational change. These minimum requirements are

costly and are one reason for the fact that only one-third of German firms participate in vocational training.

The rather complex institutional and legal details of the DVTS have been described elsewhere in more detail (cf. Benner, 1995; 1993, Shackleton, 1995 or Soskice, 1994). The most important issues of the DVTS are summarized in Table 2. While the central government is responsible for the minimum qualification requirements in firm training, the individual federal states are responsible for the schooling part of the DVTS. Vocational regulations exists for every occupation. Unions, employers, teachers and state officials participate in the design procedure, which is coordinated and transformed into law by the Federal Institute for Vocational Training in Berlin.

Table 2 The dual vocational system of training in Germany (DVTS)

Aim	skilled labour force below the university degree	
Component of training	Duality	
PLACE OF SCHOOLING	Apprenticeship firm	Vocational school
EDUCATOR	Vocational trainer	College teacher
PRIMARY DIDACTIC PRINCIPLE	Job-oriented approach	Theoretical approach
APPRENTICESHIP RULE	*training curriculum (Ausbildungsordnung)*	curriculum *(Lehrplan)*
CONSTITUTIONAL REGULATION	Fed.Government (§ 74 basic law)	*Länder* (§ 30, 70 basic law)
FINANCE (EXPLICIT COST)	Firm	Public sector
SUPERVISION	Chambers	*Länder*
COORDINATION	Coordinating Committe *(Koordinierungsausschuß)*	

Source: Gathered in part from Benner (1995) and Shackleton (1995).

The same institutions and interest groups are responsible for modernising existing occupational regulations. This is necessary due to new working procedures and technological and organisational change. Due to the different interest groups, the procedure is complex and can take a fairly long time. The complex network of the DVTS stems mainly from the pluralist division of competences in the German style of corporate capitalism (Chandler, 1990). On the one hand, it ensures that the interests of all participants in vocational training are considered. In an organised fashion, employers, unions and state officials meet regularly and discuss changing working conditions and skill requirements. In addition, they talk about training capacities and

the prospective number of training places for the next year. For instance, private enterprises have dedicated themselves to raising the number of training places about 10% each year through 1997 (press-release of the Federal Ministry of Education, Science, Research, and Technology from February 28, 1996).

On the other hand, the plurality of competences impedes necessary adjustments to changing economic structures and evolving job demands. Adaptations in the system require coordination of a large number of institutions and persons. Changes of educational regulations in individual occupational groups have been preceded in the past by long and tough discussions and negotiations.

2.3 Remarks on economic theory

After having described the institutional relationships, some remarks on economic theory will help to understand the functioning of the DVTS. Becker (1983) divided on-the-job investment in human capital into two parts: general and firm-specific training. While the former can be transferred between firms (marketable skills), the latter is useless outside the firm (non-marketable skills). Becker argued that in a competitive labour market the investment cost of marketable skills must be fully borne by workers.

From the institutional framework it is obvious that DVTS incorporates investment in general human capital as defined by Becker. Most of the training is occupation-specific. Education in vocational schools is more general, since mathematics and German are included as subjects. Apprentices are trained in key qualifications (marketable skills) to be able to adapt to technological and organisational change in many firms.

The question of why German firms participate in the DVTS has attained considerable attention from economists (cf. Franz and Soskice, 1994, Harhoff and Kane, 1994). "The answer is simply that they have an incentive [to provide any general training] wherever the demand price for training is at least as great as the supply price or cost of providing the training" (Becker, 1983:20, FN3). Workers have an incentive to participate because they receive higher wages subsequent to training. The incentive of workers to accept a lower wage during apprenticeship is reinforced by the fact that subsequent career paths and continuous training participation legally depends on an apprenticeship degree (Benner, 1995). The wages received by apprentices (which are negotiated between unions and employers) are approximately one-third of the wages of unskilled workers (Soskice, 1994).

The government carries the cost of vocational schooling and provides subsidies especially for small firms. Furthermore, investment in general skills might improve efficient use of specific skills (complementarity hypothesis of specific and general skills; Mincer, 1989). Training plans and the minimum standard of training are

provided by government institutions, whereby training firms can obtain advice free of charge. This reduces the training costs for firms.

Franz and Soskice (1994) calculate that the average net cost of training per worker amounted to about 12,300 DM in 1985. Training is especially common in large industrial firms and crafts sectors. In industry, net costs are above average. Asymmetric information concerning the productivity of workers and relatively high costs of training skilled workers from outside the firm for the company's specific needs can explain participation of large industrial firms in the DVTS. Furthermore, due to high regional mobility costs, resignation rates of workers are comparably low in Germany. According to Harhoff and Kane (1994), a firm is more likely to engage in training when the surrounding area possesses a small concentration of firms within the same industry.

There is a further argument relating to the German system of commitments between unions and employers as well as to potential policy threats. The DVTS is an integral part of workplace relationships in Germany. Following the Vocational Training Act of 1969, a further law to promote the supply of apprenticeship positions was established in 1976. The government was authorised to levy taxes on firms not offering training if there was not an excess supply of apprenticeship positions of at least 12,5% (*Berufsbildungsabgabe*, Franz and Soskice, 1994). This power was never exercised by the government and the law was abolished in 1980.

The majority of firms in West Germany does not provide vocational training places, although they employ trained workers. This sort of free-riding behaviour works as long as there are enough apprenticeship places offered by firms. If, however, not all young people willing to join the DVTS receive an offer, there is strong pressure from unions and the public on politicians for intervention. It is not very likely that the Vocational Training Act will be abolished. It is more likely that tax proposals for firms not supplying apprenticeship places or more regulation in times of crises will enter the political process (cf. Liesering et. al., 1994).

Hence, one might argue that, in the past, the firm's real net cost of training has been rather small. This argument is reinforced by the fact that, as a rule, industrial firms have established special departments for training. The dilution of such departments would be expensive, at least in the short and medium run. To summarise, the working of the DVTS is a good example of Becker's argument with respect to the provision of investment in general human capital in private firms. If all costs of not training are calculated, it becomes apparent that German firms and workers have incentives to invest in general training. Furthermore, the institutional setting reduces information and contracting costs, theoretically ensuring general and specific vocational training. One interesting question, therefore, is whether the cost of establishing and maintaining the DVTS is worthwhile from a welfare point of view. So far, we are not aware of a theoretical or empirical analysis of this question.

2.4 Survey of empirical studies of the DVTS

There is a broad literature addressing the reasons German firms participate in the DVTS. However, a comparable discussion of how well the DVTS adopts to changing needs and performs in practise is missing. This will be the focus of the current work.

The DVTS has been investigated in recent studies from several other perspectives. Harhoff and Kane (1994) find that wage profiles of German apprentices are fairly similar to those of US high school graduates (using the BIBB/IAB survey from 1985/86), although there is no comparable vocational training system in the US. This finding casts at least some doubt on the superiority of the German vocational training system in general.

Further investigations into the virtue of the DVTS deal with the issues of unemployment and overqualification of workers. Unemployment rates are higher the less skilled workers are. Unemployment rates for graduates of the DVTS amounted to 5% in 1993, compared to an average level of 6.1%, while only 3.4% of university graduates were unemployed (Velling and Pfeiffer, 1996). Between 24% (ditto) and 30% (Buttler and Tessaring, 1993) of DVTS graduates are overqualified for their work (compared to 8% for university graduates, Velling and Pfeiffer, 1996). According to Büchel (1994), who uses the German Socio-Economic Panel from 1984 to 1992, starting a job under the qualification level is like a trap. These workers have difficulties finding an adequate job afterwards. In the middle run, their earnings fall below the earnings of adequately qualified workers.

Another line of research is concerned with the wage position of apprentices relative to workers without any formal vocational or university degree. While Steiner et. al. (1994) find a worsening in the wage position between 1984 and 1992, Bellmann et. al. (1994) and Winkelmann (1994) estimated rather stable wage differentials. Büchel and Helberger (1995) find that graduates with an additional vocational training have a similar income to those without. Buechtemann et. al. (1993) find that the wage position of apprentices relative to graduates becomes worse with work experience. This finding is confirmed by Pfeiffer (1996) through use of the German *Mikrozensus 1991*. With this exception, all other wage studies mentioned above are based on the German Socio-Economic Panel.

Usually, no difference is made between the various occupations in the DVTS, although there is considerable heterogeneity concerning the quality of training as well as the actual work. Despite an equal training duration, expected wages after training differ significantly. These aspects will be taken into account in our own empirical work.

3 Data and econometric method

3.1 BIBB/IAB Data

The empirical study is based on three surveys of German workers, titled *Qualification and Career* from 1979 and 1985/86 (Zentralarchiv für empirische Sozialforschung, 1979, 1985/86) and *Profession and the Applicability of Vocational Training* from 1991/92 (Bundesinstitut für Berufsbildung, 1995). The collection is organized jointly by the *Bundesinstitut für Berufsbildung* (BIBB) and the *Institut für Arbeitsmarkt- und Berufsforschung der Bundesanstalt für Arbeit* (IAB). The data are processed and documented by the Central Archives for Social Research (ZA). Neither the BIBB, the IAB nor the ZA take any responsibility for the analysis or the interpretation of the data presented here.

The three cross-sections are methodologically comparable and representative for the Federal Republic of Germany. The latest survey (1991/92) expanded the sample to the eastern part of Germany. The objective of each survey is the supply of "differentiated actual data on workers in Germany, their qualification and working conditions" (Jansen and Stooß, 1993:4). The sample includes workers aged between 15 and 65 who work at least ten hours per week. While the first survey took place in 1979, the surveys of 1985 and 1991 were carried on until 1986 and 1992, respectively. The 1991/92 sample contains 34,277 persons (of which 23,476 are in West Germany). In 1985/86 and 1979 the respective numbers are 26,361 and 29,737 (cf. table 3). In 1991/92, foreigners were for the first time included in the analysis, amounting to five per cent of the sample group. Unemployed persons are included in both the 1979 and 1991/92 (East Germany only) surveys.

Table 3 Number of observations in the BIBB/IAB surveys and in the samples chosen

year	1979	1985/86	1991/92
BIBB/IAB (total)	29,734	26,361	23,476 (34.277[a])
sample	16,974 (57.1%)	15,092 (57.3%)	13,954 (59.4%)

Sample: West German wage workers and self-employed aged between 17 and 55, who have successfully completed an apprenticeship training within 35 years since the date of interview; own calculations based on BIBB/IAB surveys 1979, 1985/86, and 1991/92; [a] incl. East Germany.

The question of the applicability of vocational training is posed only to workers with an apprenticeship degree. To render the results comparable across the three cross-sections, our analysis is restricted to West German workers who once successfully completed an apprenticeship. Furthermore, we restrict age between 17 and 55 years and exclude workers whose apprenticeships finished more than 35 years ago. These

additional restrictions allow us to obtain a homogeneous sample for estimation. The applicability of apprenticeship in East Germany must be studied in light of the radical change of the economic system and thus requires a separate investigation.

According to these criteria,13,954 observations are noted in 1991/92, 15,092 in 1985/86, and 16,974 in 1979 (cf. table 3). In the descriptive and econometric analyses, the number of valid observations will differ due to missing values.

3.2 Applicability of apprenticeship training

All workers with completed apprenticeship training are asked the following question: "How much of the occupational knowledge and skills you acquired during apprenticeship can you still apply in your current work?" (Bundesinstitut für Berufsbildung, 1995, question 27). The answer can be: *very little or nothing at all*, *little*, *quite some*, *fairly much*, and *very much*. Table 4 shows the frequency of the answers in the three cross-sections. Three results are striking: less than 50 per cent of workers can apply *very much* of their original training. More importantly, during the 13 years under consideration, the percentage of answers in this category sank continuously from 47.5% to only 35.8%. This decrease corresponds to an increase in the categories *fairly much*, *quite some*, and *little*, while the frequencies in *very little* or *nothing at all* stayed rather constant over time.

Table 4 Applicability of apprenticeship in 1979, 1985/86 and 1991/92

year	sample	*very much*	*fairly much*	*quite some*	*little*	*nothing at all*
1979	16,735	7,942	3,049	2,212	1,176	2,356
		(47.5%)	(18.2%)	(13.2%)	(7.03%)	(14.1%)
1985/86	14,961	6,086	3,290	2,441	1,255	1,889
		(40.7%)	(22.0%)	(16.3%)	(8.39%)	(12.6%)
1991/92	13,626	4,881	3,003	2,468	1,328	1,946
		(35.8%)	(22.0%)	(18.1%)	(9.75%)	(14.3%)

Source: own calculations based on the BIBB/IAB surveys; sample see table 3.

The aim of the study is to investigate the determinants of these trends. Particular attention is drawn to the effects of the computer revolution. Furthermore, the explanatory variables are compared with the determinants explaining earnings in a second step using the same explanatory variables as the applicability analysis.

3.3 Remarks on the econometric model

The information on applicability is of a qualitative nature only. Since the categories are ordered in a natural sense from *very much* to *nothing at all,* we choose the ordered probit model (see Maddala, 1983) for the analysis of applicability. The three surveys do not constitute a panel. To keep the specification as flexible as possible, we estimate the ordered probit model for each cross-section separately.

There are pros and cons to the use of a subjective indicator for evaluating apprenticeship. The BIBB/IAB surveys contain considerable information on the structure of occupation and industry, training and the sociodemographic background. With the large number of individual observations it should be possible to distinguish the influence of structural determinants stemming from labour demand from unobserved factors, such as subjective attitudes or the societal and individual mood (cf. Lechner et. al., 1993).

Unfortunately, however, the question of applicability can be understood by workers in two ways. "Knowledge and skills acquired during apprenticeship" can either be interpreted more narrowly as the contents of the curriculum or more broadly in the sense of understanding and promotion of personal and cognitive capacities. This sort of ambiguity has to be taken into account when discussing the estimation results. It certainly would be interesting to add the employer's assessment of the individual worker's aptitude and skill to the analysis, but this information is missing. After all, only the worker can truly appreciate the value of his apprenticeship to his current occupational duties.

Our econometric model of apprenticeship applicability has a simple linear structure. We assume that there is a latent index of applicability which is a linear function of characteristics of the individual, the job, the firm and unobserved influences. We postulate the following relationship for every individual:

$$Y^* = \beta_1(1/\sqrt{PEXP}) + \beta_2(CHANGE*(1/\sqrt{PEXP})) + X\beta + \varepsilon \qquad (1)$$

where Y* is the latent index of applicability, PEXP measures potential work experience, CHANGE indicates occupational change during work, and X is a vector of explanatory variables including dummy variables for occupation and occupational change (see table A in the appendix). Other functional forms of experience were tested, but the hyperbolic form using square root of experience in the denominator seems to fit the data best. This can be seen from figure 2 below.

The interaction term between occupational change and experience allows for the possibility that changing occupation might not only result in a shift but also in a variation of the experience term. The variable ε comprises unobserved components on the supply and demand sides of the labour market. For example, it accounts for firms' corporate culture and individual and public mood or the psychological attitude of the workers at the time of the interview. It is assumed that personal or firm specific characteristics in the unobserved component are not specific to branches, profession and firm size. The main difference of this specification to our earlier one (cf. Pfeiffer and Blechinger, 1995) is the inclusion of additional occupational specific mobility indicators.

The index of applicability is not observed. Five categories of applicability are observed:

$$Y= \begin{array}{lll} \textit{very much} & \text{iff} & -\infty < Y^* \le c_1 \\ \textit{fairly much} & \text{iff} & c_1 < Y^* \le c_2 \\ \textit{quite some} & \text{iff} & c_2 < Y^* \le c_3 \\ \textit{little} & \text{iff} & c_3 < Y^* \le c_4 \\ \textit{nothing at all} & \text{iff} & c_4 < Y^* \le +\infty \end{array} \qquad (2)$$

$c_0,..,c_4$ are unobserved bounds identical for all individuals. Because of the ordinal structure of the model not all parameters can be identified. The usual normalisations are chosen: the variance of the error term is set equal to one and the lowest and highest boundaries are set to minus and plus infinity, respectively.

The earnings equation is specified in the standard semi-logarithmic form with log gross real earnings as the dependent variable:

$$\ln E = \alpha_0 + \alpha_1 PEXP + \alpha_2 PEXP^2 + \alpha_3 PEXP^3 + \alpha_4 PEXP^4 + X\alpha + u \qquad (3)$$

The definitions of X and PEXP are the same as before. In the BIBB/IAB data, earnings from work are recorded in up to 15 categories and fluctuate by DM 500. We take the mean of each category, deflate gross nominal income to get real income for the three cross-sections and estimate the earnings equations using ordinary least squares. We tested several values for the highest category, but the results were not sensitive to realistic values. With the exception of the functional form of experience and the interaction term between experience and mobility, the specification in the

earnings and applicability equations are the same. The earnings equation contains a quartic in the experience term.

Definition of symbols

Y^*	latent index of applicability
Y	observed categories of applicability
PEXP	potential work experience: age minus age at the end of apprenticeship
CHANGE	1: occupational change, 0 else
X	supply and demand side factors explaining applicability (30 occupational groups from apprenticeship, change of occupation for each of these groups, indicators of technological change and computer revolution, indicators of sectors, firm size, self-employment and white collar worker, firm size and sector of training firm, duration of training, not employed and unemployed, gender, indicators of general education and family status (for the exact definition see table A in the appendix)
ε	normally distributed error term, i.i.d.
$\beta_{1,2,..}\beta_{..}$	coefficients to be estimated
$\ln E$	natural logarithm of real gross earnings; deflated with the price index
u	error term, i.i.d.
$\alpha_{0,1,2,3,4,}\alpha$	coefficients to be estimated

3.4 Explanatory variables

The BIBB/IAB surveys provide a significant amount of interesting a priori information which helps to explane the degree of applicability. This relates to institutional details, firms and workers. Apart from some exceptions the same explanatory variables are obtained from all cross-sections. Table A in the appendix contains the names and definitions of the variables for the ordered probit and regression analysis while table B contains some descriptive statistics.

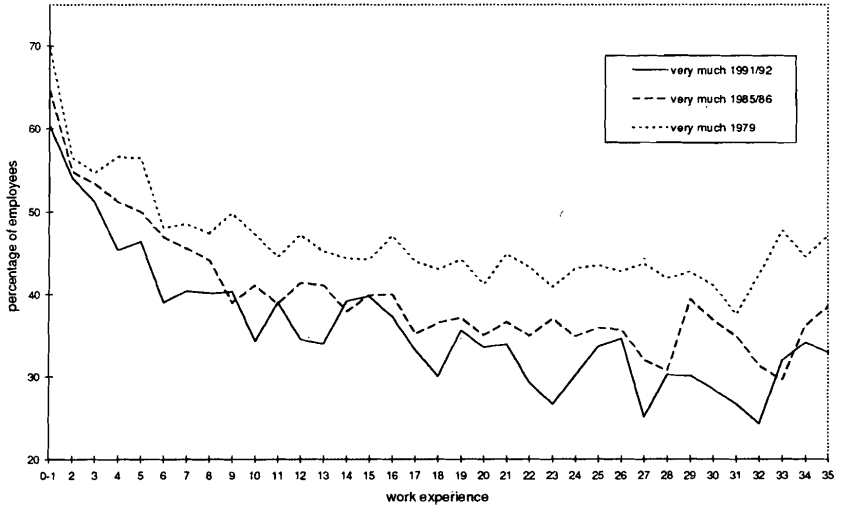
In order to simplify the presentation, we divide the determinants of applicability into four groups, reflecting institutional as well as supply- and demand-side factors in the labour market:

- work experience and unemployment
- apprenticeship trade, duration, mobility and characteristics of training firm
- technological change and characteristics of actual firm

- sociodemographic and other factors

The first group contains experience as well as indicators of occupation, the duration of apprenticeship, occupational and firm-specific mobility, firm size, and sector of the training firm. Due to economic, technological and organisational changes, applicability will depend on work experience. Experience is defined as the time after completion of apprenticeship. Furthermore, we included indicators of interruptions of work and times of unemployment. Figure 2 depicts the frequencies of answers in the category *very much* in relation to experience (since the exact time of the interview is unknown for the surveys in 1985/86 and 1991/92, we decided to assume 1986 and 1992; zero and one year of experience are combined into one group due to the small number of observations).

Figure 2 Applicability of apprenticeship training and work experience



Source: own calculations based on the BIBB/IAB surveys 1979, 1985/86, 1991/92; for the sample see table 3

The figure depicts two trends. First, at the beginning of the working career the frequency of answers in the category *very much* decreases considerably. In 1979, less than 50% of workers who had finished their training six years before could apply *very much* of their training. On the other hand the number was 70% for workers who had left apprenticeship training only one year before. After six years of experience the

further decrease slows down. Second, the frequencies of answers in the very good category of applicability in 1991/92 is lower in all experience groups than in 1985/86, which is again lower than in 1979 (with only one exception). In 1991/92, only 60% of those in their first year of employment could apply very much of their apprenticeship training. After six years of employment, the frequency value declines to 39%.

During their apprenticeship, workers acquire occupation-specific knowledge. Therefore it is necessary to control for occupations in the second group of variables. The percentage of transferable knowledge may vary between different occupations. For this reason, we test whether the presumed decline in applicability depends on the original occupation. Approximately one-third of workers with an apprenticeship degree changed occupation once while two-thirds changed employers in 1991/92 (cf. table 5). This indicates that a change of employer is less costly than a change of occupation in terms of skill obsolescence. The share of human capital that was acquired during apprenticeship is more important than the share of human capital specific to the employer that is lost when the employer is changed. Contrary to a commonly held view, however, fewer workers changed their occupation or employer in 1991/92 compared to 1979. Mobility has increased in Germany between 1985 and 1992, but is still lower than in 1979.

Table 5 Occupational and employer -specific mobility

year	change of occupation	change of employer	both
1979	6,115 (36.15%)	12,363 (73.68%)	5,937 (35.50%)
1985/86	4,409 (29.26%)	5,235 (64.76%)	3,640 (24.19%)
1991/92	4,490 (32.18%)	9,241 (66.73%)	3,979 (28.73%)

Source: own calcultions based on the BIBB/IAB surveys; see table 3 for sample.

Occupational change leads to a massive decline in the applicability of apprenticeship training. On average, 47.3% of those who did not change occupation can apply *very much* of the apprenticeship and only 10.2% apply *nothing at all* (in 1991/92). For those who changed occupation, the relation is reversed. Only 11.6% can apply *very much* and 53.4% can apply *nothing at all*.

There are differences in occupational mobility depending on the apprenticeship trade (cf. table 6). Apart from a few exceptions, the frequency of occupational change is fairly stable between 1979 and 1991/92. In the 1991/92 survey, occupational mobility in the textile, leather, mining and food professions is above average, while in the chemistry, office, health and organisation trades it is below average.

Table 6 Occupational structure, occupation-specific mobility and unemployment (in %)

year	1979		1985/86		1991/92		
trade	obs. (%)	mobil.	obs. (%)	mobil.	obs. (%)	mobil.	unempl
AGRICULT.	399 (2.37)	0.38	398 (2.67)	0.17	294 (2.15)	0.33	4.70
MINING	214 (1.27)	0.59	120 (0.80)	0.52	63 (0.46)	0.46	4.53
CHEMISTRY	79 (0.47)	0.35	94 (0.63)	0.19	81 (0.59)	0.23	4.18
PAPER PROD.	108 (0.64)	0.36	34 (0.23)	0.41	41 (0.30)	0.41	4.60
PRINTING	136 (0.81)	0.36	183 (1.23)	0.31	112 (0.82)	0.36	3.30
METAL WORKER	339 (2.02)	0.39	330 (2.21)	0.38	259 (1.89)	0.36	4.00
LOCKSMITH	3,294(19.6)	0.39	2,812(18.9)	0.32	2,31 (20.0)	0.38	4.98
ELECTRIC.	1,157(6.88)	0.30	1,092(7.32)	0.29	1,081(7.90)	0.31	4.78
TEXTILE	477 (2.84)	0.55	306 (2.05)	0.42	238 (1.74)	0.55	4.63
LEATHER	125 (0.74)	0.66	86 (0.58)	0.41	43 (0.31)	0.53	4.53
NUTRITION	740 (4.40)	0.47	556 (3.73)	0.37	478 (3.49)	0.46	4.62
CONSTRUCT.	815 (4.85)	0.37	671 (4.50)	0.26	553 (4.04)	0.33	5.64
DECORATOR	204 (1.21)	0.41	198 (1.33)	0.32	126 (0.92)	0.42	4.42
JOINER	537 (3.19)	0.44	408 (2.74)	0.34	339 (2.48)	0.33	5.19
PAINTER	374 (2.22)	0.40	302 (2.03)	0.28	276 (2.02)	0.37	4.96
DISPATCH.	443 (2.63)	0.31	545 (3.66)	0.24	35 (0.26)	0.31	4.97
TECHNIQUE	433 (2.57)	0.32	471 (3.16)	0.24	99 (0.72)	0.35	4.98
LAB ASSIST.	--[1]	--[1]	--[1]	--[1]	374 (2.73)	0.30	6.00
COMM OF GOODS	2,481(14.8)	0.37	2,112(14.2)	0.33	1,805(13.2)	0.34	4.95
COMM OF SERV.	717 (4.26)	0.25	848 (5.69)	0.21	733 (5.36)	0.20	4.07
OFFICE	2,13 (12.6)	0.25	1,848(12.4)	0.23	1,984(14.5)	0.23	4.94
TRAFFIC	290 (1.72)	0.29	197 (1.32)	0.30	160 (1.17)	0.29	4.35
SECURITY	--[2]	--[2]	--[2]	--[2]	52 (0.38)	0.25	5.06
ART	117 (0.70)	0.38	110 (0.74)	0.40	93 (0.68)	0.33	5.24
HEALTH	542 (3.22)	0.22	539 (3.61)	0.25	709 (5.18)	0.23	4.92
SOCIAL/CARE	--[3]	--[3]	--[3]	--[3]	165 (5.18)	0.24	4.13
COSMETIC.	376 (2.24)	0.37	359 (2.41)	0.32	352 (2.57)	0.36	4.19
CATERING	85 (0.51)	0.42	85 (0.57)	0.31	88 (0.64)	0.43	4.40
HOUSEHOLD	102 (0.61)	0.43	86 (0.58)	0.34	99 (0.72)	0.35	4.24
ENTREPREN.	120 (0.71)	0.26	121 (0.81)	0.21	215 (1.57)	0.17	4.57

Source: own calculations based on the BIBB/IAB surveys; see table 3 for sample; for definitions see table A in the appendix; obs.: observations; mobil: change of occupation in % of all workers with the resp. apprenticeship; unempl.: unemployment rates (own calculations based on the ZEW-70% sample of the German „Mikrozensus" 1991). 1 LAB ASSISTANT ⊂ TECHNIQUE. 2 SECURITY ⊂ TRAFFIC. 3 SOCIAL AND CARE ⊂ HEALTH.

The numbers hint at the restructuring of the German economy in the course of technological change. Vocational training is a means of specialisation with the inherent risk that the knowledge obtained will become obsolete. In this case, transferable knowledge such as key qualifications and cognitive skills can help workers to find a new job.

To assess applicability, it is necessary to differentiate between training firms. Table 7 and 8 illustrate the evolution of the number and percentage of workers in the sample with respect to the sector and firm size of the training firm in the three cross-sections. About one quarter of all workers were trained in industry. The percentage of workers trained in the craft sector declined from 38% in 1979 to 34% in 1991/92. Most workers have been trained in small or very small firms. Only 11% were trained in firms with more than 1,000 workers, although these firms employ nearly 30% of all workers in Germany. Almost 60 per cent of the workers who completed an apprenticeship did so in a firm with less than 50 employees. The share declined slightly between 1979 and 1991/92 and amounts to 57.2% in 1991/92. The highest decrease can be observed in the smallest firms, which employ less than 4 workers.

Table 7 Apprenticeship in the craft sector, industry and other sectors

year	craft sector (%)	industry (%)	others (%)
1979	6,289 (37.71%)	4,052 (24.30%)	6,316 (37.99%)
1985/86	5,107 (35.36%)	3,387 (23.45%)	5,949 (41.19%)
1991/92	4,586 (33.64%)	3,380 (24.79%)	5,666 (41.56%)

Source: own calculations based on the BIBB/IAB surveys; see table 3 for sample.

The length of training varies between one and three and a half years. The majority of workers has been trained for three years (in 1991/92 about 60%, in 1985/86 about 70%, cf. table B in the appendix). The quality of apprenticeship training is also dependent on vocational schooling, the academic complement to firm training and the other part of the DVTS. Unfortunately, however, there exists no direct information on this issue. Since vocational schooling is the responsibility of the German states, we include a set of dummy variables for the eleven German states (which is contained in group four). These, however, are the states where workers live at the time of the interview, not at the time of their vocational training. 28% of workers with an apprenticeship degree changed their living place on job-related reasons in 1991/92, but on the basis of the BIBB/IAB data it is not possible to identify regional mobility between states. The information on regional mobility is contained only in the 1991/92 survey and is not contained in our final analysis since it turns out to be insignificant.

Table 8 Apprenticeship training and firm size

firm size (employees)	1979	1985/86	1991/92
1- 4	2,439 (14.7%)	2,183 (14.54%)	1,271 (9.49%)
5- 9	3,489 (21.03%)	2,150 (14.32%)	2,606 (19.47%)
10- 49	4,350 (26.22%)	3,695 (24.60%)	3,781 (28.25%)
50- 99	1,431 (8.63%)	1,625 (10.82%)	1,413 (10.56%)
100-499	2,344 (14.13%)	2,783 (18.53%)	2,187 (16.34%)
500-999	778 (4.69%)	816 (5.43%)	687 (5.13%)
1.000 and more	1,760 (10.61%)	1,766 (11.76%)	1,441 (10.76%)

Source: own calculations based on the BIBB/IAB surveys; see table 3 for sample.

The third group of explanatory variables contains indicators of technological change at the workplace as well as indicators of the firm and actual work status. Workers are asked whether they work with a personal computer (PC), whether they work as programmers (PROGRAM) or whether their job requires any use of computers (not necessarily personal computers, COMPUTER). For the1979 survey, the item personal computer was not yet included in the questionnaire, yet in 1991/92 nearly 21% of the workers used one (cf. table 9). This rapid diffusion of personal computers at the workplace seems to indicate the degree of technological change which has taken place in the last decades (Krueger, 1993). The three indicators are mutually compatible. 79.6% of those occupied with programming jobs declare that they are faced with computers in their job. For those using a PC, the corresponding share is 71.3%.

Table 9 Technological change and the computer revolution

year	1979	1985/86	1991/92
COMPUTER	1,050 (6.43%)	2,519 (16.69%)	4,389 (31.45%)
PROGRAM	333 (1.98%)	1,697 (11.24%)	3,079 (22.07%)
PC	-	515 (3.41%)	2,893 (20.73%)
R&DINTENSIV	2,514 (50.93%)	3,260 (62.26%)	3,514 (68.34%)

Source: own calculations based on the BIBB/IAB surveys; see table 3 for sample.

Furthermore, a dummy variable captures research and development intensive industrial sectors (the classification is taken from Legler et. al., 1992). They consist of

firms from the chemical, mechanical engineering, and electrical industries. The overall share of workers with apprenticeship training increased from 50.9% to 68.3% in these innovative industries.

Applicability may depend on further characteristics of the workplace. Competition and technological change lead to changes in the demand for different skills, which may vary according to sector and firm size. Production processes in large firms are more complex and need more specialised human capital than those in small firms. Working conditions in the crafts sector, for instance, with its high focus on service, are different from those in retail trade and industry. We also include information on the work status of the worker. Self-employed workers define their work on their own and are responsible for the whole business process, not only parts of the production process. Therefore, we hypothesise higher applicability of apprenticeship training for self-employed workers and for employees with a better work status.

The fourth group of explanatory variables emcompasses sociodemographic characteristics of the individual. They include gender, family status and indicators of schooling before apprenticeship training. A better general education might improve the applicability of apprenticeship training, since general and specific human capital are said to be complements (Mincer, 1989). Interruptions of employment might lower the applicability of apprenticeship training. We suggest that an interruption due to a lay-off and a time of unemployment leads to a larger decline in the applicability of apprenticeship training.

4 Results

4.1 Overview

The applicability and earnings equation are estimated separately for each of the three cross-sections. The results are summarised in tables C and D (see Appendix). Table C contains the estimated coefficients and standard errors of the explanatory variables for the ordered probit analysis. The significance of the coefficients is indicated by # (1% level), + (5% level) and * (10% level), respectively. Coefficients that are significant at the one per cent level are viewed as strongly significant, while all others are considered to possess weak significance. A positive sign indicates a positive impact on applicability and earnings. The explanatory power of the ordered probit models, measured with the pseudo R^2 from McFadden, is fairly constant across the three cross-sections. The value of 0.14 is consistent with comparable econometric studies.

The earnings equations explain between 40% (1979 and 1985/86) and 46% (1991/92) of the variation of individual earnings (see table D in the Appendix). This is also consistent with comparable econometric earnings studies using cross-sections. While the estimated coefficients of the earnings equation in the three cross-sections can be directly compared, this is not possible for the ordered probit estimates due to the ordinal structure of the answers relating to applicability. Since we are mainly interested in a qualitative assessment of the German DVTS, we can, however, compare the significance of the explanatory variables as well as the relative magnitude of the estimated coefficients in relation to the estimated bounds of the ordered probit model in each cross-section.

4.2 Applicability and earnings

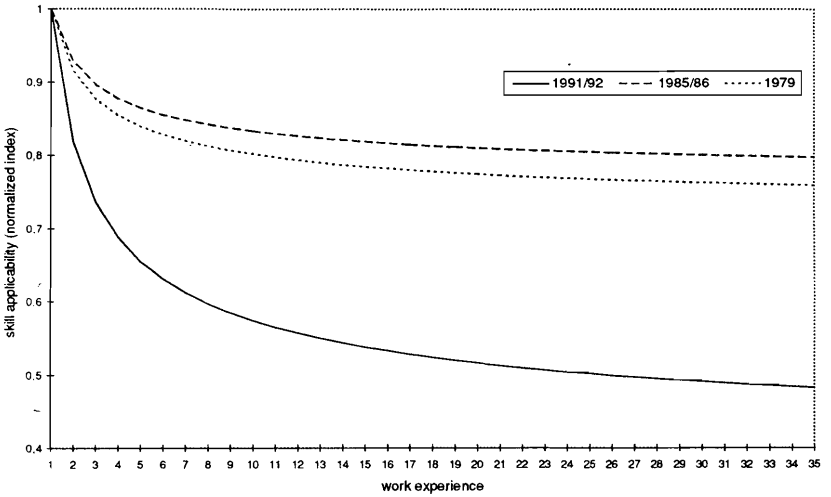
4.2.1 Work experience and unemployment

Applicability of apprenticeship training decreases with work experience at a diminishing rate. The coefficient of $1/\sqrt{PEXP}$ is significantly positive in all three cross-sections. More importantly, the coefficient is about twice as high in absolute value in 1991/92 as in 1985/86 and 1979. If coefficients are comparable, the estimates imply a faster decline of applicability in 1991/92. The decline of applicability is particularly striking in the first working phase, directly after completion of apprenticeship training and the beginning of work. The effect is depicted graphically in figure 3, which shows the estimated index of applicability for the three cross-sections.

The beginning of the index is normalised to one for every cross-section. The figure demonstrates the stronger curvature in 1991/92 compared to the earlier cross-sections. It was stated above that coefficients are not directly comparable between cross-sections. We can nevertheless state the importance of this effect since other coefficients, notably those pertaining to actual firm size, are nearly identical in numerical value. Relative to the impact of firm size, work experience diminishes the applicability of apprenticeship training in 1991/92 more than in the periods before.

The reason for the declining applicability is not obvious from the estimates. By and large, it relates to the influx of new workers into the work-force between 1985 and 1992. For them the rate of skill obsolescence from vocational training is faster than that of earlier DVTS graduates. There are several possible reasons for this finding. Although left to future research, unobserved changes in working conditions caused by the onset of the information era, which are not controlled for in our model, are among the prominent candidates.

Figure 3 Estimated index of skills applicability of West German apprentices



Source: calculations based on ordered probit models, table C.

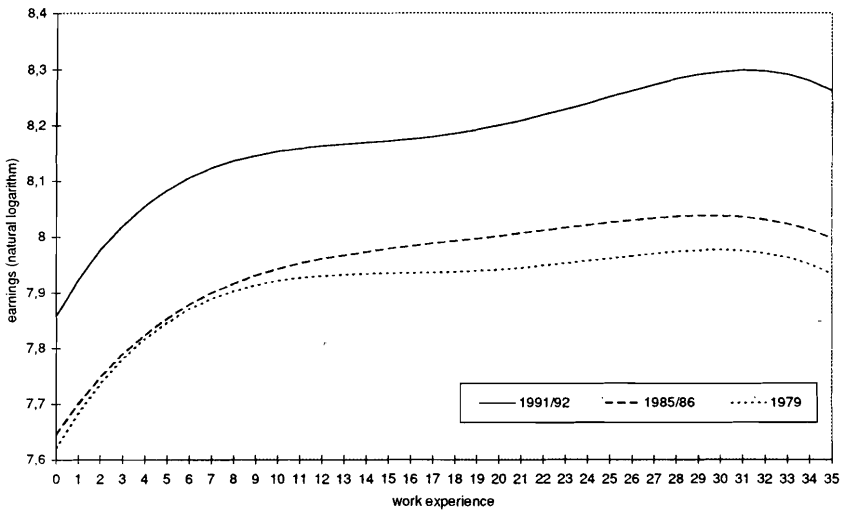
While applicability diminishes with experience, earnings rise. The quartic term in experience fits the data better than the usual quadratic function. A quadratic function would lead to an underestimation of earnings growth early in the working career and would furthermore suggest earnings to decline in the later working career. This is best seen graphically. Figure 4 depicts estimated earnings profiles. In every cross-section the interception has been calculated for a worker with comparable characteristics. The structure of earnings profiles is similar throughout the three periods considered, although in the 1991/92 cross-section, earnings growth after 20 years of work experience is higher than in the other two surveys. In all three cross-sections, earnings growth is strongest in the first 6 years of work experience and tends to flatten afterwards.

The earnings profile is concave with a maximum at about 32 years. A quadratic function would fit the maximum much earlier at about 25 years of work experience. A comparison of the estimated values for 1991/92 and 1985/86 for a pseudo sample of workers (say workers with work experience between 20 and 25 years in 1985/86 and 26 to 31 years in 1991/92) shows that individual earnings of German workers have not declined with work experience in the period studied, although cross-section estimates suggest a decline (for a deeper analysis of this issue, see Klevmarken, 1993). The estimated earnings of workers with an apprenticeship degree do not differ

very much between 1979 and 1985/86. During this time, real wages did not rise because of the German recession, which lasted from 1979 until 1983.

Interruptions of work (INTERRUPTION), particularly periods of unemployment (UNEMPLOYED), lead to a significantly diminishing applicability. After a time of unemployment reentering probably leads to jobs allowing for less utilization of skills obtained through apprenticeship training. These jobs are perhaps more inadequate. Earnings are negatively affected by the frequency of unemployment, which can be seen in part as a consequence of lacking work experience (see Mincer and Ofek, 1982). Removal from the work force reduces gross earnings by 11.8% and frequency of unemployment reduces earnings by an additional 9.2% in 1991/92.

Figure 4 **Estimated experience- earnings profiles of West German apprentices**



Source: calculations based on the earnings functions (table D); the intercept is calculated for a male locksmith who is not married, has been trained in industry, works in a large industrial firm and uses computers.

4.2.2 Apprenticeship trade, duration, mobility and characteristics of training firm

There is heterogeneity in the different occupations. In every equation we included dummy variables from 30 different occupational groups. Relative to apprenticeship training preparing for office-work, there are certain trades with better applicability in

each cross-section analysis. These include apprenticeship training for the metal working (METAL WORKER) and electrical engineering (ELECTRICIAN), construction (CONSTRUCTION), health care (HEALTH), nutrition (NUTRITION) and catering industries (CATERING).

Quantitatively, the most important factor explaining poor applicability is occupational mobility. For each of the 30 groups of apprenticeship trades, we ask whether actual work is so different from the training that, in the view of the worker, an occupational change has occurred (in all tables this is indicated by (I) after the occupational group). Occupational mobility leads to a large reduction in applicability, which is not surprising, remembering the occupation-specific knowledge of vocational training.

The quantitative importance of occupational change can be demonstrated by examining the differences of two threshold values (see table C in the Appendix). If a coefficient is larger than one of the differences, the partial influence of this factor is of comparatively great importance for good or bad applicability. This is the case in all three cross-sections for variables of occupation-specific changes. Again, there is heterogeneity between apprenticeship trades. The reduction of applicability is below average for metal workers and electricians, in the traffic industry, and in some service sectors, while in mining, agriculture, nutrition and housing it is above average.

From these figures it is not possible to directly assess the relative quality of training in different trades, because occupational mobility can result in a more or less different occupation. The disparity between training and actual work can be large or small, helping to explain part of the difference in the applicability reduction. Some groups are more heterogeneous than others, and occupational regulation has been changed in some occupations and not in others. On the other hand, however, key qualifications play an important role in the curricula of frequently chosen apprenticeship trades, such as metal working and electrical work.

To illustrate the impact of an occupational change, we calculate probabilities for the five various degrees of applicability following a specific occupational change for a representative locksmith. We distinguish between several years of experience. Table 10 shows that the probability of poor applicability rises, while the probability of maintaining a very good applicability drastically decreases with experience.

Knowledge generated from the German DVTS is to a high degree occupation-specific. Knowledge can be transferred easily between employers if occupation is not changed. A change of employer (CHANGE OF EMPLOYER) had no measurable impact on applicability in 1991/92, although in the former cross-sections a modest impact is observed. There is, however, a plant specific component of vocational training, which is significantly positive in all three cross-sections (ALWAYS IN TRAINING FIRM, UP TO 5 YEARS). Workers who stayed in the plant in which they were trained can apply more of their training than do movers. This result indicates that workers interpret

„applicability" in terms of contents rather than substance. After a change of occupation, only very little of the contents of training can be further applied.

The interaction term between occupational change and experience (CHANGE * 1√PEXP) is insignificant. Since the term was significant in our earlier specification (Pfeiffer and Blechinger, 1995), it captured in effect the experience dependent on occupational mobility in the different occupational groups.

Table 10 Change in the probability of good or bad applicability in relation to occupational change and work experience

professional experience	*nothing at all*	*little*	*quit some*	*fairly much*	*very much*
5 years	0.335	0.113	-0.012	-0.114	-0.327
10 years	0.345	0.102	-0.007	-0.149	-0.303
15 years	0.347	0.096	-0.001	-0.152	-0.290
20 years	0.348	0.093	-0.005	-0.153	-0.283
25 years	0.349	0.094	-0.008	-0.158	-0.277
30 years	0.348	0.096	-0.010	-0.160	-0.270
35 years	0.350	0.091	-0.012	-0.159	-0.271

Source: calculations based upon the ordered probit model for 1991/92, see table C; the change in the probability is calculated for a male locksmith who is married and has been trained in the craft sector, works in the industry and uses computers in a medium/large firm.

The length of vocational training has a positive impact on applicability. In the reform discussion in Germany it is sometimes argued that apprenticeship training is too long relative to training in other countries. This is said to create a competitive disadvantage. Our estimates show, however, that a shorter apprenticeship lowers applicability, especially in the 1991/92 cross-section.

How important are observed characteristics of the training firm for the applicability of apprenticeship training? We find that, by and large, firm size as well as sector are unimportant in explaining applicability. Although it is said that the quality of apprenticeship is especially high in large firms (cf. Franz and Soskice, 1994), this has seemingly no impact on applicability. In the 1991/92 survey, those workers who got their apprenticeship degree outside the traditional route (NONNORM) exhibited a better applicability than their colleagues from firms.

What about the effect on earnings? There are differences in the earnings equation coefficients between occupational groups and occupation-specific mobility, but the

picture is more diffuse than in the applicability equation, especially when considering all three cross-sections. Since there is no obvious relationship between the coefficients in the applicability and earnings equations, we estimated Spearman's rank correlation between the two sets of coefficients, including apprenticeship trades and occupation-specific mobility, respectively. In 1991/92, the relationship between a good applicability and higher earnings in an apprenticeship trade (and after changing occupation) is positive. The rank correlation coefficient between the occupational groups is 0.43 (significantly different from 0 at the 2.14% level) and between the occupation-specific mobility coefficients 0.31 (significant different from 0 at the 9.08% level). In 1985/86 and 1979 there is no significant rank correlation between these parameter estimates.

The results of the earnings equation indicate that training in the DVTS, although occupation-specific, helps workers in other occupations as well. It contains transferable human capital, which is one of the goals of the DVTS. And the better the apprenticeship, the higher the earnings in a specific occupation following an occupational change.

The signs of the impact of training duration and training outside the norm on the applicability and earnings equations are the same. The sector of the training firm has no measurable impact on earnings. Firm size, on the other hand, has a positive impact. Training in a large firm (more than 1,000 employees), for instance, enhances earnings by 6.1% compared to training in a firm with 10 to 99 employees. This can be interpreted as evidence for quality differences in DVTS with respect to the size of firms, although the impact is moderate and only measured in 1991/92. In contrast to applicability, there is no plant-specific impact on earnings. Continuation of work in the training plant enhances applicability but not earnings. Changing employers leaves applicability unaffected but increases earnings, for instance by 2.3% in the 1991/92 survey.

According to Entorf (1995), the qualification mismatch in the German labour market has risen since the 1970s and has contributed to the rise in unemployment. The decline in individual applicability of vocational training is just another view of this rise in inappropriate qualifications. The contents of vocational training and the demand for skills diverge. We are therefore interested in determining whether there exists a relationship between unemployment in occupational groups and the applicability of vocational training. We tested this relation computing Spearman's rank correlation coefficient between the unemployment rates in the 30 occupational groups (cf. table 6 above) and the estimated coefficients of occupation-specific mobility in 1991/92 (see table C in the Appendix). According to the test results, there is no rank correlation between these variables. The only significant correlation we find is between the rank of the estimated coefficients and the rank of the rates of occupation-specific mobility (-0.62, significant at the 0.3% level). The greater the decline in applicability after a change in occupation, the higher occupation-specific

mobility rates are. This is still another view of the qualification mismatch. Occupational mobility is highest in those occupations where skill tranferability into other occupations is lowest.

4.2.3 Technological change and firm characteristics

The hypothesis that technological change leads to accelerated skill obsolescence cannot be rejected. As demonstrated by the 500% increase in the use of personal computers between 1985/86 and 1991/92, the computer revolution is one reason for the observed decline in the applicability of apprenticeship training. Because the partial effects of PC, COMPUTER, PROGRAM are not well-established in every cross-section, joint tests for the three indicators are performed. The hypothesis of joint insignificance is strongly rejected (the tests are available on request). Those who work with computers, terminals, or screens, as well as those who program or work with personal computers apply less of their apprenticeship training relative to colleagues who do not use these tools.

The coefficients vary between cross-sections. While the partial effect for working with a personal computer was significantly negative in 1985/86, the coefficient is insignificant in 1991/92. This points to the increased use of personal computers in the DVTS. The content of apprenticeship training appears to adapt to new processes and technologies, although with a time-lag.

In our earlier work, the negative impact of the computer revolution was quantitatively even more important than in the current study. This result was in part affected by the missing occupation-specific mobility indicators. It is likely that workers in newly emerging jobs are equipped with modern technology like personal computers. Occupational change, which often leads workers into such new jobs, is therefore the most important factor in reducing applicability. As can be seen from tables 5 and 6, occupational change has not increased between 1979 and 1991, so the rise in skill obsolescence cannot be explained by a rise in occupational mobility.

Self-employed workers (SELF-EMPLOYED) can apply their training better than employees; the impact is, however, only significant in 1991/92. The self-employed choose the field of activity on their own; that is, they are engaged in activities in which they have comparative advantages, some of them stemming from vocational training. For a similar reason, higher-status workers exhibit greater applicability than their lower-status colleagues.

Applicability decreases significantly with firm size (1-4 EMPLOYEES, etc.). This result is stable in all three cross-sections, the estimated coefficients are quantitatively very similar. Work in large firms is more specialised, and therefore only a smaller part of apprenticeship-based knowledge can be applied by workers. The percentage of

workers in very small firms has declined since 1979 (table 8), a fact which has contributed to the declining applicability of apprenticeship training.

Applicability is highest in the craft sector (CRAFT), where small firms dominate. The coefficient is significantly positive in all three surveys, although the impact seems to have decreased over time. More students are trained than are demanded in the craft sector (Henninges, 1991). There is practically no influx of skilled workers from outside the craft sector. The high applicability has to be seen as a consequence of the Craft Regulation Act, according to which the activities of a craft firm are defined and restricted to only a few trades. A butcher, for instance, is not allowed to engage in the baker's trade unless he has also been trained as a baker and therefore can obtain the necessary permission. Firms' activities correspond to a large extent to occupations related to craft sector apprenticeships. Hence, institutional regulations explain the higher applicability of apprenticeship in the craft sector.

What about earnings? In contrast to the decreasing applicability of apprenticeship training, the computer revolution has significantly increased earnings. In 1991/92, workers using a personal computer earned 9% more than their colleagues without one, an increase from the 1985/86 figure of 7.4%. The earnings impact of working with computers in a more general sense (COMPUTER) was 11.3% in 1985/86, but by 1991/92 had decreased to its 1979 level of 5.7%. The diffusion of microelectronics has increased the demand for workers capable of handling the new technology. Despite the same measurable human capital, there is a positive wage differential for those working with new technologies (as was first investigated by Krueger, 1993). The structure of the differentials between COMPUTER, PROGRAM and PC changed in favour of PC between 1985/86 and 1991/92. This reflects the steep rise in the diffusion of personal computers at the workplace, while the spread of computers in general has slowed down.

The positive wage differentials may be caused by unobserved characteristics of workers who choose to work with computers. In this case the differential might be biased (presumably upwards) due to self-selection. It is beyond the scope of this paper to investigate self-selection issues in earnings equations. For our work, it is important to note that the correlation of technological progress to applicability is negative while it is positive to earnings. On-the-job investment in human capital has contributed to the earnings differential. A qualitative variable representing information on continuous training is insignificant in both equations. This indicates the importance of informal on-the job investment at the workplace.

The earnings of self-employed workers and wage workers with a higher work status in the firm are significantly higher than those of other wage workers. These coefficients may also be biased due to self-selection. For a more thorough discussion of self-employment and wage work, see Pfeiffer (1994). The coefficients have the same sign in the earnings and applicability equation. This is not the case with firm

size, which significantly increases earnings but decreases applicability. A better applicability of apprenticeship training in small firms corresponds to lower earnings (for instance, in 1991/92, wages in a firm with up to 5 employees were about 27% lower than in a firm with more than 1,000 employees). Higher wages in large firms compensate for a more specialised and disciplined work (cf. Schmidt, 1995) where the applicability of apprenticeship training is lower than in smaller firms.

4.2.4 Sociodemographic and other factors

There is no evidence for a gender-specific influence on the applicability of apprenticeship training (WOMAN) in any of the three surveys. Whether or not the worker is living together with a partner (PARTNER) likewise does not affect applicability. It is interesting to note that the share of women in the sample increased between 1979 and 1991/92 from 28 per cent to 35 per cent. This reflects the increasing qualifications of women. If the partner is working (PARTNER IN WORK), applicability is lower in the 1991/92 survey, although the coefficient is small.

The effect of schooling on applicability is statistically significant, but only in 1991/92. The sort of school degree does not matter. In 1991/92, those without a formal degree could apply less than their colleagues who successfully completed 9 years of schooling. Of course, information on schooling is rather sparse in the BIBB/IAB data. It would be interesting to know more about the quality of education and personal performance in the schools. Given the available information, we have to conclude that supply-side factors like schooling, gender and family status contribute to a good or bad applicability, but the quantitative impact is rather small. It is rather the demand side of the labour market which better explains the extent of applicability and skill obsolescence.

The last set of explanatory variables are the German federal states, which are jointly significant in the ordered probit model. Workers in Rhineland-Palatinate exhibit better apprenticeship applicability than workers in Northrhine-Westfalia in all three cross-sections. As stated earlier, the results allow no statement about the quality of vocational schools (for which the federal states are responsible) because we do not know whether the worker moved to another state after completing the apprenticeship.

What about earnings? The coefficient for WOMAN is highest in 1991/92. The value of -0.39 reflects different working hours and perhaps different labour market experience. If the partner is also employed, earnings are lower by about 6.6%. Earnings are different between states, reflecting the German system of sector- and region-specific wage negotiation.

Schooling significantly improves earnings. Although the wage differential between those successfully finishing 9 years of schooling and those not finishing school is statistically insignificant, earnings differentials tend to rise with school degree. The

differential relative to 9 years of schooling amounted to 22% for those who completed 13 years of schooling, to 16.9% for those who completed 12 years of schooling and to 9% for those who completed 10 years of schooling in the 1991/92 cross-section. General education and general human capital enhances career opportunities and earnings for workers with an apprenticeship degree. This is most likely due to the higher share of cognitive skills and key qualifications associated with general education.

5 Economic Policy Implications

This paper analyses the applicability of vocational training and individual earnings for West German workers with an apprenticeship degree using the three available BIBB/IAB surveys from 1979, 1985/86 and 1991/92. There are two central results.

First, applicability of vocational training received in the DVTS has decreased between 1979 and 1991/92. The discrepancies between vocational training and the skills demanded by firms has grown. In our econometric model, we tested the relevance of institutional as well as firm-, workplace- and worker-related characteristics for the applicability of training. The computer revolution is one factor responsible for the rise in skill obsolescence. By and large, the analysis suggests that demand-side factors are much more important than supply-side factors. Furthermore, apprenticeship trades are seen to affect applicability. The results derived from individual survey data are in line with evidence from recent macroeconometric work showing that the qualification mismatch in the German labour market has steadily increased since 1970.

Second, on-the-job investment in human capital has become more important relative to vocational training. As a result, recent technological and economic developments have contributed to a decrease in the relevance of apprenticeship training and a relative increase in learning and training on the job.

The two results are not really different but rather two faces of the same coin: the quality of the DVTS in Germany has decreased in the last 20 years due to technological change. The result is surprising, since private and public firms are an integral part of vocational training in the DVTS. Since these are the same firms that contribute to the development of new technology, one would expect them to provide their workers with the skills necessary to meet this technological challenge. However, this does not seem to be the case.

Following Timmermann (1988), in the DVTS framework, firms seem to have incentives to train workers in vocational qualifications which are not needed afterwards. According to our own results, furthermore, applicability of apprenticeship training has declined for most of the 30 groups of occupations investigated. Considerable attention has been paid to the reasons for investment by German firms in transferable human capital. Our results might shed some further light on this question. Although training is occupation- rather than firm-specific (as is the aim of the DVTS), the amount of transferable knowledge has declined. The decline can be observed by workers of all experience groups and is especially important for those who entered the labour force in 1985/86.

The negative trend in the applicability of apprenticeship training should be taken seriously by politicians. This is true, in our opinion, despite the fact that the analysis suffers from several problems. The first is the ambiguity of the subjective indicator of applicability, which can only be improved when the questions become more precise in future surveys. Second, certain important explanatory variables such as school performance and the quality of vocational schooling, to mention just a few, are missing. Third, the quality of apprenticeship training differs considerably between trades and sectors. The intervals at which apprenticeship regulations are updated also vary according to trade. Therefore, it may not be sufficient to include occupation and occupation-specific mobility indicators in the applicability equation; a seperate equation for each occupation may better reflect this difference. Finally, our analysis ends with 1991/92 data. Since then, regulations have been renewed and new legal qualifications have been established. Furthermore, the time allowed for restructuring a curriculum or defining qualifications has recently been fixed to one and two years, respectively (press-release of the Federal Ministry of Education, Science, Research and Technology from July 5th ,1995).

The future will show if such measures help to close the gap between technological and economic change and the contents of apprenticeship. Our analysis suggests that reforms aimed at the administrative and organisational acceleration of decision-making are not sufficient. They can only be successful if substantial reforms follow. One must not underestimate the danger that ensues from the large delay between the investment in vocational training and its applicability throughout working life.

The complexity of the DVTS, however, with its bureacracy and pluralistic division of competences and responsibilities between firms, unions, federal and local states, makes reform difficult. What seems to be clear is that pressure on politicians will rise when the number of training places fail to meet the demand for these positions.

What might reformatory measures look like? One option is the relative appreciation of continued training in comparison to vocational training (for an analysis of continued training and technological progress, see. Pfeiffer and Brade, 1995). In general, continued training is privately financed and not subject to governmental

regulations (cf. Buttler, 1994 and Weiss, 1994; an exception is a retraining of the unemployed, which is financed by the Federal Labour Office). According to our results, a shortening of the length of apprenticeship training alone would rather decrease applicability.

The quality of training differs between occupations. The high theoretical standards are not always implemented in reality. Vocational trainers, for instance, are often insufficiently educated. About 18.4% of all workers provide instruction to others in their company; 47% of them, however, do not have any formal authorisation to do so (own calculation based on BIBB/IAB data 1991/92).

Improving training in the firms and enhancing the share of key qualifications (which has been suggested by Biederweiden, 1994; Bunk et. al., 1991; Mertens, 1974; the new curriculum for metal workers and electricians, incidentally, contains more key qualification, Borch and Weißmann, 1995), however, impose additional costs. Since vocational training lacking firm-specific content is unattractive to firms, such a strategy will have limitations; i.e., the firm's incentive to train decreases. The DVTS can only succeed if firms can impart business-specific knowledge.

Therefore, the government should improve the theoretical part of training in vocational schools, since general and specific education tend to complement each other. Furthermore, a clearer division between the responsibilities in the DVTS might overcome institutional sclerosis (M. Olson). Assuming that the government improves vocational schools, firms could be given more responsibility for the content of apprenticeship training, within the boundaries of some minimum standards. In such a DVTS, firms, vocational schools and individuals might be more flexible to react to economic and technological change.

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Appendix: Definition of explanatory variables and descriptive statistics

Table A Definitions of explanatory variables

variable	definition
	Group one: work experience and unemployment
PEXP	potential work experience/10
1/√PEXP	1/square root of potential work experience (= age of living - age of completion of apprenticeship training)
1/√PEXP*CHANGE	[1/square root of potential work experience] * CHANGE (CHANGE = 1 if the employee has changed occupation according to his own opinion, 0: otherwise)
INTERRUPTION	1: job layoff for at least 1 year, 0: otherwise
UNEMPLOYED	1: since the beginning of 1990 the employee has been unemployed once or several times, 0: otherwise
	Group two: apprenticeship trade, duration, mobility and characteristics of training firm
	apprenticeship trade
AGRICULTURE	1: crop grower, animal producer, fishery worker, 0: otherwise
MINING	1: miner, 0: otherwise
CHEMISTRY	1: chemical worker, ceramics worker, glass-maker, 0: otherwise
PAPER PRODUCING	1: paper producer, paper processor, wood processor/wood worker, and related professions, 0: otherwise
PRINTING	1: printer, 0: otherwise
METAL WORKER	1: metal producer, metal worker, other metal professions, 0: otherwise
LOCKSMITH	1: locksmith, mechanic, and related professions, 0: otherwise
ELECTRICIAN	1: electrician, 0: otherwise
TEXTILE	1: textile and clothing professions, 0: otherwise
LEATHER	1: leather producer, leather and fur processor, 0: otherwise
NUTRITION	1: food professions, 0: otherwise
CONSTRUCTION	1: construction professions, 0: otherwise
DECORATOR	1: interior decorator, upholsterer, 0: otherwise
JOINER	1: carpenter, model maker, 0: otherwise
PAINTER	1: painter, varnisher, and related professions, 0: otherwise
DISPATCHING	1: quality controller, engineer and related professions, store supervisor, storage or transport worker, 0: otherwise
TECHNIQUE	1: technician, 0: otherwise

Table A, Con't

variable	definition
LAB ASSISTANT	1991/92:1: special technician, 0: otherwise (1985/86 and 1979 included in TECHNIQUE)
COMMERCE. OF GOOD	1: merchants, 0: otherwise
COMMERCE OF SERV.	1: merchants of services and related professions, 0: otherwise
OFFICE	1: office workers and clerical assistants, 0: otherwise (reference category)
TRAFFIC	1: traffic professions, 0: otherwise
SECURITY	1991/92: 1: security professions, 0: otherwise (1985/86 and 1979 included in TRAFFIC)
ART	1: writing professions, artistic professions, 0: otherwise
HEALTH	1: health services, 0: otherwise
SOCIAL AND CARE	1991/92: 1: nursing, social and educational professions 0: otherwise (1985/86 and 1979 included in HEALTH)
COSMETICIAN	1: personal hygiene, 0: otherwise
CATERING	1: catering, 0: otherwise
HOUSEHOLD	1: domestic professions, cleaning professions, 0: otherwise
ENTREPRENEUR	1: entrepreneurs, organisers, auditors, accountants, and data processing workers, 0: otherwise
	occupational mobility (I)
AGRICULTURE(I), ... , ENTREPRENEUR(I)	occupation-specific mobility; PROFESSION(I)$_i$=PROFESSION$_i$*CHANGE, i=1,...30 (27) in 1991/92 (1985/86 and 1979) (e.g.: AGRICULTURE(I)=AGRICULTUR*CHANGE)
	firm size and sector of training firm/ duration of training and employer mobility
1- 9 EMPLOYEES	1: staff: 1-9, 0: otherwise
10- 90 EMPLOYEES	1: staff: 10-99, 0: otherwise
100-999 EMPLOYEES	1: staff:100-999, 0: otherwise
1000+ EMPLOYEES	1: staff: more than 1.000 , 0: otherwise (reference category)
INDUSTRY	1: firm is part of industry, 0: otherwise
CRAFT	1: firm is part of craft, 0: otherwise
COMMERCE	1: firm is part of commerce, 0: otherwise
PUBLIC	1: firm is part of public sector, 0: otherwise
OTHERWISE	1: firm is part of another sector, 0: otherwise (reference category)
LENGTH 1 YEAR	1991/92 1: length of apprenticeship up to 1 year, 0: otherwise; due to few observations in 1985/86 and in 1979 the information is summed up in LENGTH1_5 YEARS

Table A, Con't

variable	definition
LENGTH 1_5 YEARS	1991/92 1: length of apprenticeship of up to 1.5 years, 0: otherwise; 1985/86, 1979 1: length of apprenticeship: 1.5 or 1.75 years, 0: otherwise
LENGTH 2 YEARS	1: length of apprenticeship of up to 2 years, 0: otherwise
LENGTH 2_5 YEARS	1991/92 1: length of apprenticeship of up to 2.5 years, 0: otherwise; 1985/86, 1979 1: length of apprenticeship 2.5 or 2.75 years, 0: otherwise
LENGTH 3 YEARS	1: length of apprenticeship up to 3 years, 0: otherwise (reference category)
LENGTH>3 YEARS	1991/92 1: length of apprenticeship more than 3 years, 0: otherwise; 1985/86, 1979 1: length of training: 3.5 years, 0: otherwise
NONNORM	1: vocational school/training off the job, completion of apprenticeship training after retraining, examination after several years of labour market experience,awarded completion of apprenticeship training with GDR-regulation, 0: normal completion of apprenticeship training
CHANGE OF EMPLOYER	1:has changed employers, 0: otherwise
ALWAYS IN TRAINING FIRM	1: still employed in the apprenticeship firm, 0: otherwise
UP TO 5 YEARS	1: leaving the apprenticeship firm within 5 years, 0: otherwise
Group three: technological change and characteristics of actual firm	
technological change/ firm characteristics and professional position	
COMPUTER	1: deployment of labour : computer, electronic data-processing, equipment/terminal, screen, processor, 0: otherwise
PROGRAM	1. programming activity, 0: otherwise
PC	1: deployment of labour: PC, 0: otherwise
R&DINTENS	1: firm is part of the chemical, electrotechnics, precision engineering, steel-, machine- or automobile construction industries, etc., 0: otherwise
work status/ firm size and sector of actual firm	
SELF-EMPLOYED	1: self-employed, 0: otherwise
HIGH PROFESSION	1: foreman, master, employee with managing activities, senior official, 0: otherwise
1- 4 EMPLOYEES	1: staff: 1-4, 0: otherwise
5- 9 EMPLOYEES	1: staff: 5-9, 0: otherwise
10- 49 EMPLOYEES	1: staff: 10-49, 0: otherwise
50- 99 EMPLOYEES	1: staff: 50-99, 0: otherwise
100-499 EMPLOYEES	1: staff: 100-499, 0: otherwise

Table A, Con't

variable	definition
500-999 EMPLOYEES	1: staff: 500-999, 0: otherwise
1000 + EMPLOYEES	1: staff: more than 1.000, 0: otherwise (reference category)
INDUSTRY	1: industrial firm, 0: otherwise
CRAFT	1: craft-sector firm, 0: otherwise
COMMERCE	1: commercial firm, 0: otherwise
PUBLIC	1: public sector firm, 0: otherwise
OTHERWISE	1: firm is in another sector, 0: otherwise (reference category)
	Group four: sociodemographic and other variables
WOMAN	1: female, 0: male
PARTNER	1: partner, 0: no partner
PARTNER IN WORK	1: partner employed, 0: otherwise
WITHOUT SCHOOL DEGREE	1: no completion of school, 0: otherwise
9 YEARS OF SCHOOLING	1: 9 years of schooling, 0: otherwise (reference category)
10 YEARS OF SCHOOLING	1: 10 years of schooling, 0: otherwise
12 YEARS OF SCHOOLING	1: 12 years of schooling, 0: otherwise
13 YEARS OF SCHOOLING	1: 13 years of schooling, 0: otherwise
RETRAIN	1: continuos training, 0 otherwise
FEDERAL STATES	Schleswig-Holstein, Hamburg, Bremen, Niedersachsen, Berlin-West, Nordrhein-Westfalen (Reference category), Hessen, Rheinland-Pfalz, Saarland, Baden-Württemberg, Bayern

Definitions according to the BIBB/IAB surveys, 1979, 1985/86, 1991/92.

Table B **Descriptive statistics of the explanatory variables used in the applicability analysis and the mean value of applicability for indicator variables**

year	1991/92	1985/86	1979
variable	mean (applicability)	mean (applicability)	mean (applicability)
Group one: work experience and unemployment			
$1/\sqrt{PEXP}$	0.289	0.317	0.319
$1/\sqrt{PEXP}$ *CHANGE	0.814	0.765	0.099
INTERRUPTION	0.361 (2.35)	--[a]	--[a]
UNEMPLOYED	0.059 (2.18)	--[b]	--[b]
Group two: apprenticeship trade, duration, mobility and training firm characteristics			
apprenticeship trade			
AGRICULTURE	0.022 (2.51)	0.025 (3.03)	0.022 (2.66)
MINING	0.005 (2.22)	0.008 (2.07)	0.013 (1.99)
CHEMISTRY	0.006 (2.83)	0.006 (2.87)	0.004 (2.72)
PAPER PRODUCING	0.003 (2.12)	0.002 (2.53)	0.007 (2.48)
PRINTING	0.008 (2.39)	0.013 (2.61)	0.008 (2.86)
METAL WORKER	0.019 (2.49)	0.022 (2.42)	0.022 (2.71)
LOCKSMITH	0.201 (2.64)	0.191 (2.79)	0.200 (2.90)
ELECTRICIAN	0.078 (2.62)	0.074 (2.81)	0.069 (3.01)
TEXTILE	0.018 (1.75)	0.021 (2.24)	0.029 (2.24)
LEATHER	0.003 (1.68)	0.006 (2.37)	0.008 (1.58)
NUTRITION	0.035 (2.14)	0.038 (2.55)	0.044 (2.33)
CONSTRUCTION	0.041 (2.64)	0.046 (2.90)	0.499 (2.90)
DECORATOR	0.010 (2.25)	0.014 (2.73)	0.013 (2.81)
JOINER	0.025 (2.59)	0.028 (2.72)	0.034 (2.68)
PAINTER	0.021 (2.48)	0.021 (2.84)	0.023 (2.78)
DISPATCHING	0.003 (2.38)	0.033 (2.69)	0.026 (2.96)
TECHNIQUE	0.007 (2.52)	0.032 (2.73)	0.025 (2.72)
LAB ASSISTANT	0.027 (2.42)	--[c]	--[c]
COMM. OF GOODS	0.137 (2.36)	0.145 (2.44)	0.147 (2.63)
COMMERCE OF SERV.	0.054 (2.80)	0.059 (2.91)	0.042 (3.10)
TRAFFIC	0.011 (2.33)	0.012 (2.72)	0.015 (2.83)
SECURITY	0.004 (2.65)	--[d]	--[d]
ART	0.006 (2.49)	0.007 (2.45)	0.007 (2.81)
HEALTH	0.051 (2.97)	0.031 (3.03)	0.029 (3.27)

Table B, Con't

year	1991/92	1985/86	1979
variable	mean (applicability)	mean (applicability)	mean (applicability)
SOCIAL AND CARE	0.010 (2.79)	--[e]	--[e]
COSMETICS	0.026 (2.37)	0.024 (2.56)	0.022 (2.65)
CATERING	0.006 (2.66)	0.006 (2.55)	0.005 (2.65)
HOUSEHOLD	0.006 (2.07)	0.004 (2.58)	0.005 (2.56)
ENTREPRENEUR	0.015 (3.12)	0.008 (3.14)	0.007 (3.18)
	occupation-specific mobility		
AGRICULTURE(I)	0.008 (0.96)	0.005 (1.28)	0.009 (1.09)
MINING(I)	0.002 (1)	0.004 (1.08)	0.008 (1.09)
CHEMISTRY(I)	0.001 (1.33)	0.001 (1.28)	0.001 (1.36)
PAPER PRODUC.(I)	0.001 (0.88)	0.001 (1.28)	0.002 (1.46)
PRINTING(I)	0.003 (1.15)	0.004 (1.58)	0.003 (2.35)
METAL WORKER(I)	0.007 (1.46)	0.008 (1.18)	0.009 (1.73)
LOCKSMITH(I)	0.075 (1.81)	0.060 (1.83)	0.078 (2.11)
ELECTRICIAN(I)	0.024 (1.73)	0.021 (1.84)	0.020 (2.09)
TEXTILE(I)	0.010 (0.70)	0.009 (0.85)	0.016 (1.32)
LEATHER(I)	0.002 (0.79)	0.002 (0.91)	0.005 (0.61)
NUTRITION(I)	0.016 (0.76)	0.013 (0.98)	0.021 (1.01)
CONSTRUCTION(I)	0.013 (1.20)	0.012 (1.42)	0.018 (1.84)
DECORATOR(I)	0.004 (0.77)	0.004 (1.15)	0.005 (1.62)
JOINER(I)	0.008 (1.48)	0.009 (1.57)	0.014 (1.63)
PAINTER(I)	0.008 (1.03)	0.006 (1.28)	0.009 (1.60)
DISPATCHING(I)	0.001 (2)	0.007 (1.74)	0.008 (2.27)
TECHNIQUE(I)	0.002 (1.63)	0.007 (1.61)	0.008 (1.78)
LAB ASSISTANT(I)	0.008 (1.12)	--[c]	--[c]
COMM. OF GOOD(I)	0.046 (1.33)	0.047 (1.38)	0.056 (1.71)
COMM. OF SERV.(I)	0.011 (1.82)	0.012 (1.83)	0.010 (2.09)
OFFICE(I)	0.032 (1.75)	0.027 (1.83)	0.032 (2.04)
TRAFFIC(I)	0.003 (1.34)	0.004 (1.58)	0.005 (1.69)
SECURITY(I)	0.001 (1.5)	--[d]	--[d]
ART(I)	0.002 (1.59)	0.003 (1.18)	0.003 (1.82)
HEALTH(I)	0.012 (1.67)	0.008 (1.73)	0.008 (2.08)
SOCIAL AND CARE(I)	0.003 (1.51)	--[e]	--[e]

Table B, Con't

year	1991/92	1985/86	1979
variable	mean (applicability)	mean (applicability)	mean (applicability)
COSMETICS(I)	0.010 (0.57)	0.008 (0.62)	0.008 (0.76)
CATERING (I)	0.002 (1.44)	0.002 (0.81)	0.002 (1.2)
HOUSEHOLD(I)	0.002 (1.09)	0.002 (1.66)	0.002 (1.60)
ENTREPRENEUR(I)	0.002 (2.5)	0.002 (1.93)	0.002 (2.32)
firm size and sector of training firm/ duration of training and employer mobility			
1-9 EMPLOYEES	0.291 (2.51)	0.338 (2.68)	0.354 (2.71)
10-99 EMPLOYEES	0.389 (2.61)	0.376 (2.76)	0.348 (2.84)
100-999 EMPLOYEES	0.215 (2.57)	0.189 (2.68)	0.189 (2.81)
INDUSTRY	0.251 (2.51)	0.236 (2.50)	0.249 (2.73)
CRAFT	0.343 (2.52)	0.355 (3.37)	0.384 (2.75)
COMMERCE	0.168 (2.48)	0.170 (2.67)	0.158 (2.69)
PUBLIC	0.113 (2.77)	0.893 (2.26)	--[f]
LENGHT 1 YEAR	0.006 (1.97)	--[g]	--[g]
LENGHT 1_5 YEARS	0.008 (2.20)	0.016 (2.63)	0.072 (2.60)
LENGHT 2 YEARS	0.114 (2.40)	0.078 (2.69)	0.066 (2.82)
LENGHT 2_5 YEARS	0.108 (2.60)	0.046 (2.86)	0.050 (2.90)
LENGHT>3 YEARS	0.165 (2.59)	0.162 (2.81)	0.180 (2.89)
NOTNORM	0.079 (2.64)	--[h]	--[h]
CHANGE OF EMPLOY.	0.665 (2.30)	0.635 (2.41)	0.736 (2.51)
ALWAYS IN TRAIN. FIRM	0.243 (3.22)	0.305 (3.37)	0.265 (3.51)
UP TO 5 YEARS	0.461 (2.40)	0.594 (2.40)	--[i]
Group three: technological change and characteristics of actual firm			
technological change/ firm characteristics and professional position			
COMPUTER	0.315 (2.41)	0.197 (2.57)	0.063 (2.60)
PROGRAM	0.220 (2.37)	0.116 (2.52)	0.020 (2.50)
PC	0.208 (2.42)	0.034 (2.33)	--[k]
R&DINTENS	0.254 (2.55)	0.221 (2.78)	0.163 (2.72)
work status/ firm size and sector of actual firm			
SELF-EMPLOYED	0.069 (2.74)	0.095 (2.81)	0.074 (2.98)
HIGH PROFESSION	0.225 (2.50)	0.180 (1.37)	0.213 (2.90)
1-4 EMPLOYEES	0.106 (2.78)	0.141 (2.81)	0.120 (3.02)

Table B, Con't

year	1991/92	1985/86	1979
variable	mean (applicability)	mean (applicability)	mean (applicability)
5-9 EMPLOYEES	0.129 (2.95)	0.145 (3.12)	0.113 (3.18)
10-49 EMPLOYEES	0.241 (2.72)	0.250 (2.82)	0.227 (3.00)
50-99 EMPLOYEES	0.108 (2.48)	0.107 (2.60)	0.106 (2.73)
100-499 EMPLOYEES	0.198 (2.38)	0.187 (2.48)	0.189 (2.57)
500-999 EMPLOYEES	0.065 (2.34)	0.054 (2.42)	0.071 (2.56)
INDUSTRY	0.284 (2.33)	0.254 (2.49)	0.301 (2.66)
CRAFT	0.207 (3.11)	0.227 (3.37)	0.216 (3.39)
COMMERCE	0.162 (2.57)	0.152 (2.67)	0.151 (2.88)
PUBLIC	0.207 (2.28)	0.182 (2.26)	--[f]
Group four: sociodemographic and other factors			
WOMAN	0.353 (2.54)	0.298 (2.64)	0.277 (2.78)
PARTNER	0.809 (2.50)	0.710 (2.63)	0.711 (2.70)
PARTNER IN WORK	0.455 (2.46)	0.447 (2.64)	0.382 (2.70)
WITHOUT SCHOOL DEGREE	0.006 (2.17)	0.007 (2.56)	--[m]
10 YEARS OF SCHOOL	0.340 (2.66)	0.301 (2.83)	0.239 (2.91)
12 YEARS OF SCHOOL	0.052 (2.44)	0.041 (2.46)	0.022 (2.51)
13 YEARS OF SCHOOL	0.059 (2.53)	0.056 (2.58)	0.030 (2.55)

Source: see table 3 for sample; all variables with the exception of experience are indicator variables; descriptive statistics of the earnings equation are available on request; they are not very different from the presented statistics; applicability: 0 "*nothing at all*", 1 "*little*", 2 "*quite some*", 3 "*fairly much*", 4 "*very much*"; the numbers in brackets are the mean values of the index when the variables take the value 1. [a] The question of job interruption is not contained in the 1985/86 and 1979 surveys. [b] The question of unemployment is not contained in the questionnaires for 1985/86 and 1979. [c] LAB ASSISTANT ⊂ TECHNIQUE. [D] SECURITY ⊂ TRAFFIC. [E] SOCIAL AND CARE ⊂ HEALTH. [f] PUBLIC is part of the reference category in 1979. [g] LENGTH1 is contained in LENGTH 1_5 YEARS in 1985/86 and 1979. [h] There is no difference between normal and abnormal apprenticeship training in 1985/86 and 1979. [l] UP TO 5 is the reference group of ALWAYS IN TRAINING FIRM in the cross-section of 1979. [k] The variable for PC use is not contained in the 1979 survey. [m] Persons without completion of school are part of the reference group.

Table C Ordered probit analysis: skill obsolescence of German apprentices

year	1991/92		1985/86		1979	
variable	coeff.	std.-error	coeff.	std.-error	coeff.	std.-error
Group one: work experience and unemployment						
1/√PEXP	0.623#	0.087	0.245#	0.075	0.291#	0.078
1/√PEXP *CHANGE	-0.290	0.186	0.061	0.163	0.110	0.143
INTERRUPTION	-0.041*	0.022	--[a]	--[a]	--[a]	--[a]
UNEMPLOYED	-0.113#	0.043	--[b]	--[b]	-0.086+	0.036
Group two: apprenticeship trade, duration, mobility and training firm characteristics						
apprenticeship trade						
AGRICULTURE	0.201+	0.095	0.432#	0.086	0.567#	0.108
MINING	0.441+	0.222	0.119	0.163	0.146	0.147
CHEMISTRY	0.332+	0.155	0.273*	0.145	0.262	0.198
PAPER PRODUCING	-0.127	0.238	0.272	0.265	-0.042	0.155
PRINTING	0.048	0.138	0.048	0.109	0.018	0.140
METAL WORKER	0.233+	0.099	0.364#	0.093	0.347#	0.100
LOCKSMITH	0.147#	0.050	0.211#	0.052	0.251#	0.055
ELECTRICIAN	0.114+	0.058	0.200#	0.061	0.322#	0.068
TEXTILE	0.136	0.116	0.246+	0.125	0.189*	0.099
LEATHER	-0.304	0.255	0.411+	0.201	0.206	0.214
NUTRITION	0.379#	0.088	0.403#	0.080	0.306#	0.085
CONSTRUCTION	0.280#	0.078	0.305#	0.104	0.325#	0.117
DECORATOR	0.042	0.144	0.313+	0.127	0.296+	0.144
JOINER	0.034	0.089	0.206+	0.088	0.293#	0.090
PAINTER	0.290#	0.102	0.343#	0.099	0.306#	0.105
DISPATCHING	-0.248	0.212	0.073	0.067	0.190+	0.082
TECHNIQUE	0.245	0.152	0.181	0.073	0.096	0.084
LAB ASSISTANT	0.166+	0.078	--[c]	--[c]	--[c]	--[c]
COMM. OF GOODS	-0.083	0.053	-0.006	0.055	0.051	0.061
COMM. OF SERVICE	0.168#	0.061	0.154+	0.061	0.330#	0.071
TRAFFIC	-0.108	0.117	0.097	0.113	0.145	0.107
SECURITY	0.139	0.201	--[d]	--[d]	--[d]	--[d]
ART	0.053	0.160	0.531#	0.160	0.267*	0.162
HEALTH	0.501#	0.066	0.521#	0.083	0.765#	0.093
SOCIAL AND CARE	0.203*	0.123	--[e]	--[e]	--[e]	--[e]

Table C, Con't

year	1991/92		1985/86		1979	
variable	coeff.	std.-error	coeff.	std.-error	coeff.	std.-error
COSMETICIAN	0.299#	0.096	0.290#	0.096	0.519#	0.116
CATERING	0.795#	0.196	0.413+	0.167	0.799#	0.231
HOUSEHOLD	-0.038	0.161	0.204	0.194	0.298	0.199
ENTREPRENEUR	0.384#	0.094	0.592#	0.138	0.498#	0.156
	occupation-specific mobility					
AGRICULTURE(I)	-1.646#	0.151	-1.648#	0.166	-2.094#	0.149
MINING(I)	-1.870#	0.315	-1.329#	0.224	-1.653#	0.182
CHEMISTRY(I)	-1.367#	0.318	-2.066#	0.346	-1.220#	0.314
PAPER(I)	-1.368#	0.371	-1.447#	0.406	-1.101#	0.244
PRINTING(I)	-1.289#	0.227	-1.029#	0.184	-0.610#	0.220
METAL WORK.(I)	-1.171#	0.154	-1.663#	0.140	-1.250#	0.141
LOCKSMITH(I)	-0.834#	0.066	-0.958#	0.065	-0.903#	0.060
ELECTRICIAN(I)	-0.871#	0.089	-0.961#	0.090	-0.922#	0.091
TEXTILE(I)	-1.777#	0.159	-1.937#	0.151	-1.448#	0.123
LEATHER(I)	-1.312#	0.360	-1.909#	0.294	-2.215#	0.263
NUTRITION(I)	-2.065#	0.124	-1.871#	0.120	-1.838#	0.110
CONSTRUCTION(I)	-1.506#	0.118	-1.318#	0.114	-1.198#	0.101
DECORATOR(I)	-1.876#	0.230	-1.664#	0.191	-1.240#	0.184
JOINER(I)	-1.086#	0.142	-1.166#	0.130	-1.365#	0.117
PAINTER(I)	-1.709#	0.156	-1.448#	0.160	-1.369#	0.143
DISPATCHING(I)	-0.406	0.364	-0.909#	0.128	-0.747#	0.133
TECHNIQUE(I)	-0.945#	0.250	-1.227#	0.134	-0.958#	0.137
LAB ASSISTANT(I)	-1.424#	0.138	--[c]	--[c]	--[c]	--[c]
COMM.OFGOOD(I)	-1.020#	0.075	-1.069#	0.072	-0.936#	0.069
COMM.OF SERV.(I)	-0.839#	0.113	-1.001#	0.105	-1.078#	0.116
OFFICE(I)	-0.685#	0.078	-0.758#	0.080	-0.715#	0.076
TRAFFIC(I)	-0.902#	0.209	-1.241#	0.190	-1.215#	0.175
SECURITY(I)	-0.979#	0.366	--[b]	--[b]	--[b]	--[b]
ART(I)	--0.893#	0.257	-1.925#	0.242	-1.108#	0.246
HEALTH(I)	-1.304#	0.116	-1.433#	0.138	-1.452#	0.144
SOCIAL AND CARE(I)	-1.181#	0.224	--[e]	--[e]	--[e]	--[e]
COSMETICIAN (I)	-2.188#	0.153	-2.101#	0.159	-2.255#	0.165

Table C, Con't

year	1991/92		1985/86		1979	
variable	coeff.	std.-error	coeff.	std.-error	coeff.	std.-error
CATERING (I)	-1.853#	0.277	-2.260#	0.304	-2.293#	0.317
HOUSEHOLD(I)	-1.295#	0.263	-1.164#	0.301	-1.371#	0.281
ENTREPRENEUR(I)	-0.636#	0.228	-1.320#	0.251	-1.241#	0.273
firm size and sector of training firm/ duration of training and employer mobility						
1-9 EMPLOYEES	0.052	0.046	-0.054	0.046	-0.029	0.044
10-99 EMPLOYEES	0.082+	0.041	0.010	0.042	0.012	0.040
100-999 EMPLOYEES	0.037	0.040	0.003	0.041	-0.019	0.040
INDUSTRY	0.030	0.051	-0.161#	0.049	-0.142#	0.041
CRAFT	-0.042	0.050	-0.217#	0.048	-0.130#	0.043
COMMERCE	0.058	0.056	-0.148#	0.053	-0.169#	0.052
PUBLIC	0.051	0.054	-0.022	0.053	--[f]	--[f]
LENGTH 1 YEAR	-0.119	0.122	--[g]	--[g]	--[g]	--[g]
LENGTH 1_5 YEARS	-0.255+	0.108	0.242+	0.114	-0.007	0.049
LENGTH 2 YEARS	-0.088#	0.033	-0.025	0.043	-0.031	0.048
LENGTH 2_5 YEARS	-0.075+	0.033	-0.059	0.095	-0.035	0.107
LENGTH >3 YEARS	0.035	0.030	0.103#	0.036	-0.012	0.038
NOTNORM	0.179#	0.038	--[h]	--[h]	--[h]	--[h]
CHANGE OF EMPLOY.	0.018	0.033	0.134#	0.033	0.276#	0.060
ALWAYS IN TRAIN.FIRM	0.460#	0.038	0.490#	0.046	0.665#	0.059
UP TO 5 YEARS	0.156#	0.024	-0.067+	0.033	--[i]	--[i]
Group three: technological change and characteristics of actual firm						
technological change/ firm characteristics and professional position						
COMPUTER	-0.060+	0.027	-0.010	0.032	-0.146#	0.044
PROGRAM	-0.107#	0.029	-0.006	0.038	-0.029	0.073
PC	-0.039	0.028	-0.184#	0.054	--[k]	--[k]
R&DINTENS	-0.026	0.032	-0.030	0.032	-0.113	0.033
work status/ firm size and sector of actual firm						
SELF-EMPLOYED	0.199#	0.050	0.056	0.043	0.079	0.048
HIGH PROFESSION	0.069#	0.026	0.086#	0.027	0.180#	0.027
1-4 EMPLOYEES	0.348#	0.053	0.303#	0.051	0.362#	0.049
5-9 EMPLOYEES	0.301#	0.046	0.277#	0.047	0.325#	0.046
10-49 EMPLOYEES	0.223#	0.038	0.186#	0.041	0.244#	0.037

Table C, Con't

year	1991/92		1985/86		1979	
variable	coeff.	std.-error	coeff.	std.-error	coeff.	std.-error
50-99 EMPLOYEES	0.121#	0.042	0.114+	0.045	0.170#	0.041
100-499 EMPLOYEES	0.107#	0.036	0.063	0.039	0.095#	0.035
500-999 EMPLOYEES	0.082*	0.047	0.023	0.051	0.073	0.045
INDUSTRY	-0.007	0.047	0.070	0.043	0.247#	0.033
CRAFT	0.315#	0.046	0.535#	0.043	0.516#	0.037
COMMERCE	0.098+	0.045	0.147#	0.041	0.272#	0.037
PUBLIC	-0.062	0.043	-0.129#	0.039	--[f]	--[f]
Group four: sociodemographic and other factors						
WOMAN	-0.031	0.030	-0.044	0.029	-0.043	0.031
PARTNER	-0.018	0.029	-0.020	0.029	0.064+	0.030
PARTNER IN WORK	-0.055+	0.023	0.029	0.025	0.012	0.026
WITHOUT SCHOOL DEGREE	-0.254+	0.126	0.054	0.118	--[m]	--[m]
10 YEARS OF SCHOOL	0.004	0.025	0.047*	0.024	0.010	0.026
12 YEARS OF SCHOOL	-0.004	0.048	-0.091*	0.050	-0.271#	0.066
13 YEARS OF SCHOOL	-0.002	0.047	-0.075	0.046	-0.294#	0.059
FEDERAL STATES χ^2	34.00# (11 categories)		47.44# (11 categories)		29.51# (11 categories)	
LITTLE	-1.014	0.087	-1.191	0.087	-0.766	0.091
QUITE SOME	-0.519	0.087	-0.704	0.086	-0.374	0.091
FAIRLY MUCH	0.152	0.086	-0.042	0.086	0.182	0.091
VERY MUCH	0.857	0.087	0.660	0.086	0.781	0.091
OBSERVATIONS	13,038		13,647		13,808	
-LOG LIKELIHOOD	17,037.3		17,101.5		16,592.3	
McFADDENS PSEUDO R^2	0.137		0.142		0.142	

Source: see table 3 for sample; for exact definitions and descriptive statistics of variables, compare table A and B in the appendix; # significant at the 1% level, * significant at the 5% level, + significant at the 10% level. Footnotes cf. table B

Table D Regression analysis: earnings of German apprentices

year	1991/92		1985/86		1979	
variable	coeff.	std.-error	coeff.	std.-error	coeff.	std.-error
Group one: work experience and unemployment						
PEXP	0.697#	0,089	0,595#	0,080	0,682#	0,060
PEXP ^{2}	-0.600#	0,096	-0,422#	0,090	-0,549#	0,071
PEXP ^{3}	0.228#	0,039	0,142#	0,038	0,192#	0,032
PEXP ^{4}	-0.030#	0,005	-0,018#	0,005	-0,024#	0,005
INTERRUPTION	-0.118#	0.008	--[a]	--[a]	--[a]	--[a]
UNEMPLOYED	-0.092#	0.016	--[b]	--[b]	-0.068#	0.012
Group two: apprenticeship trade, duration, mobility and training firm characteristics						
apprenticeship trade						
AGRICULTURE	-0.199#	0.035	-0.204#	0.031	-0.232#	0.032
MINING	-0.009	0.073	0.062	0.062	-0.078*	0.047
CHEMISTRY	-0.019	0.056	0.032	0.052	-0.047	0.063
PAPER PRODUCING	-0.171*	0.093	0.058	0.095	0.034	0.053
PRINTING	0.092*	0.053	0.065	0.041	-0.012	0.046
METAL WORKER	-0.017	0.037	-0.031	0.035	-0.123#	0.033
LOCKSMITH	-0.034*	0.019	-0.036*	0.019	-0.067#	0.018
ELECTRICIAN	-0.078#	0.022	-0.034	0.023	-0.079#	0.023
TEXTILE	-0.067	0.043	-0.159#	0.045	-0.096#	0.032
LEATHER	-0.198+	0.093	-0.049	0.066	-0.123*	0.066
NUTRITION	-0.047	0.031	-0.028	0.029	-0.081#	0.026
CONSTRUCTION	0.015	0.028	-0.006	0.037	-0.071*	0.037
DECORATOR	0.035	0.052	-0.007	0.047	-0.070	0.044
JOINER	-0.006	0.033	-0.069+	0.032	-0.096#	0.028
PAINTER	0.005	0.036	-0.0344	0.035	-0.109#	0.032
DISPATCHING	-0.157+	0.079	-0.087#	0.027	-0.004	0.028
TECHNIQUE	-0.051	0.054	0.020	0.027	-0.014	0.028
LAB ASSISTANT	0.048	0.029	--[c]	--[c]	--[c]	--[c]
COMM. OF GOODS	-0.063#	0.020	-0.045+	0.021	-0.033	0.021
COMMERCE OF SERV.	0.065#	0.023	0.024	0.023	0.046+	0.023
TRAFFIC	-0.057	0.043	0.010	0.042	-0.068+	0.035
SECURITY	-0.041	0.073	--[d]	--[d]	--[d]	--[d]
ART	0.054	0.061	0.035	0.056	-0.052	0.050

Table D, Con't

year	1991/92		1985/86		1979	
variable	coeff.	std.-error	coeff.	std.-error	coeff.	std.-error
HEALTH	0.075#	0.023	0.107#	0.030	0.087#	0.027
SOCIAL AND CARE	0.065	0.044	--[e]	--[e]	--[e]	--[e]
COSMETICS	-0.069+	0.033	-0.139#	0.034	-0.112#	0.032
CATERING	0.061	0.060	-0.019	0.059	-0.022	0.065
HOUSEHOLD	-0.084	0.062	-0.268#	0.076	-0.095	0.067
ENTREPRENEUR	-0.006	0.034	0.038	0.049	0.019	0.048
	occupation-specific mobility					
AGRICULTURE(I)	0.115+	0.053	0.112*	0.058	0.160#	0.046
MINING(I)	-0.106	0.107	-0.059	0.084	-0.059	0.060
CHEMISTRY(I)	-0.038	0.112	-0.193	0.125	0.036	0.107
PAPER PRODUC(I)	0.185	0.142	-0.022	0.162	-0.056	0.087
PRINTING(I)	0.004	0.083	-0.061	0.069	-0.055	0.077
METAL WORK(I)	-0.016	0.055	0.056	0.051	0.031	0.047
LOCKSMITH(I)	0.026	0.175	0.022	0.019	0.043#	0.016
ELECTRICIAN(I)	0.056+	0.028	0.010	0.030	0.062+	0.029
TEXTILE(I)	-0.153#	0.054	-0.060	0.051	-0.111#	0.040
LEATHER(I)	0.238*	0.130	-0.038	0.098	-0.075	0.081
NUTRITION(I)	-0.023	0.039	-0.019	0.040	0.009	0.032
CONSTRUCTION(I)	-0.070*	0.039	-0.052	0.039	-0.024	0.032
DECORATOR(I)	-0.049	0.076	-0.116*	0.069	0.001	0.060
JOINER(I)	-0.056	0.050	0.004	0.047	0.028	0.037
PAINTER(I)	-0.083	0.052	0.008	0.057	0.048	0.046
DISPATCHING(I)	0.225	0.141	-0.081	0.050	-0.049	0.045
TECHNIQUE(I)	0.014	0.090	-0.143#	0.049	-0.135#	0.045
LAB ASSISTANT(I)	-0.085*	0.048	--[c]	--[c]	--[c]	--[c]
COMM. OF GOOD(I)	-0.032	0.022	-0.042*	0.022	-0.043+	0.019
COMM. OF SERV.(I)	-0.081+	0.040	-0.073*	0.038	-0.140#	0.037
OFFICE(I)	-0.030	0.023	-0.050+	0.025	-0.041*	0.022
TRAFFIC(I)	0.060	0.076	-0.070	0.071	-0.027	0.057
SECURITY(I)	-0.136	0.134	--[d]	--[d]	--[d]	--[d]
ART(I)	-0.094	0.099	-0.217+	0.087	0.033	0.080
HEALTH(I)	-0.178#	0.038	-0.189#	0.050	-0.078*	0.044

Table D, Con't

year	1991/92		1985/86		1979	
variable	coeff.	std.-error	coeff.	std.-error	coeff.	std.-error
SOCIAL AND CARE(I)	-0.075	0.080	--[e]	--[e]	--[e]	--[e]
COSMETICS(I)	-0.140#	0.048	-0.821	0.051	-0.069	0.048
CATERING (I)	0.054	0.094	-0.102	0.108	-0.014	0.097
HOUSEHOLD(I)	-0.238+	0.097	-0.298+	0.116	-0.084	0.096
ENTREPRENEUR(I)	0.133	0.083	-0.076	0.093	-0.089	0.090
firm size and sector of training firm/ duration of training and employer mobility						
1-9 EMPLOYEES	-0.049#	0.017	-0.044*	0.017	-0.009	0.015
10-99 EMPLOYEES	-0.061#	0.016	-0.023	0.016	-0.007	0.014
100-999 EMPLOYEES	-0.031+	0.015	-0.016	0.016	0.008	0.014
INDUSTRY	-0.031	0.019	-0.020	0.019	0.013	0.014
CRAFT	0.014	0.019	0.010	0.018	0.007	0.015
COMMERCE	-0.020	0.021	-0.017	0.020	-0.003	0.018
PUBLIC	-0.022	0.020	-0.032	0.020	--[f]	--[f]
LENGHT 1 YEAR	-0.082*	0.046	--[g]	--[g]	--[g]	--[g]
LENGHT 1_5 YEARS	-0.062	0.041	-0.003	0.041	-0.001	0.017
LENGHT 2 YEARS	-0.038#	0.012	-0.071#	0.016	-0.038+	0.016
LENGHT 2_5 YEARS	-0.005	0.012	0.040	0.034	0.035	0.034
LENGHT>3 YEARS	0.008	0.011	0.013	0.013	-0.014	0.013
NOTNORM	0.089#	0.014	--[h]	--[h]	--[h]	--[h]
CHANGE OF EMPLOY.	0.023*	0.012	0.022*	0.013	0.069#	0.019
ALWAYS IN TRAIN.FIRM	0.012	0.014	0.030*	0.018	0.036*	0.019
UP TO 5 YEARS	0.009	0.009	-0.002	0.013	--[i]	--[i]
Group three: technological change and characteristics of actual firm						
technological change/ firm characteristics and professional position						
COMPUTER	0.057#	0.010	0.113#	0.013	0.057#	0.015
PROGRAM	0.033#	0.011	-0.011	0.014	-0.008	0.025
PC	0.090#	0.011	0.074#	0.021	--[k]	--[k]
R&DINTENS	0.017	0.012	-0.008	0.012	0.005	0.011
work status/ firm size and sector of actual firm						
SELF-EMPLOYED	0.524#	0.020	0.487#	0.017	0.514#	0.016
HIGH PROFESSION	0.276#	0.010	0.252#	0.010	0.203#	0.009
1-4 EMPLOYEES	-0.272#	0.019	-0.189#	0.019	-0.208#	0.016

Table D, Con't

year	1991/92		1985/86		1979	
variable	coeff.	std.-error	coeff.	std.-error	coeff.	std.-error
5-9 EMPLOYEES	-0.144#	0.017	-0.101#	0.018	-0.081#	0.015
10-49 EMPLOYEES	-0.089#	0.014	-0.067#	0.015	-0.066#	0.013
50-99 EMPLOYEES	-0.050#	0.016	-0.035+	0.017	-0.064#	0.014
100-499 EMPLOYEES	-0.030#	0.014	-0.049#	0.015	-0.025+	0.012
500-999 EMPLOYEES	-0.011	0.018	$-1*10^{-4}$	0.020	-0.028*	0.016
INDUSTRY	0.064#	0.018	0.044#	0.016	0.029+	0.011
CRAFT	$3*10^{-4}$	0.017	-0.028*	0.016	-0.014	0.013
COMMERCE	0.010	0.017	-0.018	0.016	-0.030+	0.013
PUBLIC	-0.021	0.016	-0.040#	0.015	--[f]	--[f]
Group four: sociodemographic and other factors						
WOMAN	-0.386#	0.011	-0.332#	0.011	-0.357#	0.011
PARTNER	-0.015	0.011	0.056#	0.011	0.041#	0.010
PARTNER IN WORK	-0.066#	0.008	-0.077#	0.010	-0.073#	0.009
WITHOUT SCHOOL DEGREE	-0.014	0.046	0.058	0.045	--[m]	--[m]
10 YEARS OF SCHOOL	0.090#	0.009	0.091#	0.009	0.093#	0.009
12 YEARS OF SCHOOL	0.169#	0.018	0.106#	0.020	0.168#	0.023
13 YEARS OF SCHOOL	0.222#	0.018	0.123#	0.018	0.232#	0.021
FEDERAL STATES χ^2	2.49# (11 categories)		5.74# (11 categories)		15.60# (11 categories)	
CONSTANT	7.882#	0.040	7.579#	0.038	7.413#	0.031
OBSERVATIONS	11,652		12,041		13,246	
F-TEST (D.O.F)	86,79#	11,536	75,90#	11,935	86,76#	13,144
ADJUSTED R2	0.459		0.395		0.395	

Source: see table 3 for sample; for exact definitions and descriptive statistics of variables, compare table A and B in the appendix; # significant at the 1% level, * significant at the 5% level, + significant at the 10% level. Footnotes cf. table B.