CHAPTER 6

Returns to Human Capital in Germany: Review of the Empirical Literature

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1   Introduction

The positive link between educational attainment and individual earnings seems quite intuitive: the better-educated earn higher wages. On the other hand, schooling also entails costs in the form of foregone earnings while in education as well as direct expenses such as tuition fees. Therefore, engaging in education can be seen as an investment which aims at yielding a return in the form of increased future earnings. Assessing the amount of this return to education has been the object of numerous studies. This paper reviews and critically evaluates the empirical literature for Germany.

Most studies for Germany do not focus explicitly on the relationship between human capital and private earnings, but rather on the wage structure and its determinants as well as on wage inequality, e.g. across industrial sectors or between males and females. However, all studies of German earnings include indicators for educational attainment as explanatory variables. These studies are typically based on human capital theory and the estimation of earnings functions as proposed by Mincer (1974). Following this approach, individual earnings reflect labour productivity which is determined by previous investment in human capital; i.e., it is assumed that an individual's stock of human capital is an important determinant of his or her wage.

To test this hypothesis, an earnings function of the following form is typically estimated:

$$\ln w_i = \alpha + \beta \times Schooling_i + \gamma \times Experience_i + \delta \times Experience_i^2 + u_i$$

with $\ln w$ = log of gross hourly earnings

       Schooling = years of education

       Experience = years of labour market experience

       u = error term

       i = index for individual *i*.

The semi-loglinear specification of the earnings equations relates to some functional form assumptions underlying the theoretical derivation of Mincer's earnings function. More importantly, it also corresponds to the observed distribution of wages. While

the schooling variable proxies human capital acquired by formal education, labour market experience is a proxy for human capital acquired on-the-job. The inclusion of labour market experience in linear and quadratic form also relates to the particular derivation of Mincer's earnings function. The error term captures all factors other than schooling and labour market experience affecting individual wages. Typically, the error term is assumed to be uncorrelated with the human capital variables.

Given this assumption holds and assuming the wage equation is correctly specified, parameter estimates obtained by OLS yield unbiased estimates of average returns to an additional year of schooling and labour market experience, respectively. Despite this common basic approach, the studies pursue very different purposes and the implementation of this standard estimation varies accordingly. Moreover, the underlying assumptions may be violated in practice and the various studies based on this general approach differ in the way the standard Mincer earnings function is extended in order to account for this.

The next section briefly summarises the most important topics related to the returns to education covered in the studies reviewed here. Section 3 explains how these studies estimate individual returns to human capital, while Section 4 summarises their main results. Finally, Section 5 provides a critical assessment of the current state of knowledge on private returns to education in Germany.

2 Main topics related to returns to education covered by previous German studies

Some of the German studies focus on the returns on human capital, but most of them focus on the wage structure or the wage distribution with respect to industrial sector, firm or gender. In these studies, human capital indicators are treated as control variables rather than as of interest *per se*. In the following, these studies are briefly reviewed under the heading of their respective main focus.

Effect of education on earnings

Bellman, Reinberg and Tessaring (1994) analyse the impact of educational expansion on the distribution of personal income. Following a descriptive statistical analysis, they estimate the returns to education in the period 1976 to 1987 on the basis of standard Mincer earnings functions. Weißhuhn and Clement (1983) also analyse the distribution of earnings in connection with the qualification structure. Franz (1996) illustrates the human capital theory with an estimation of a Mincer function of the simplest form, in order to calculate the returns to education in terms of earnings. Steiner and Wagner (1996) analyse changes in earnings inequality in West Germany during the 1980s, with special emphasis on the role of human capital measured by formal skills and labour market experience.

Gender discrimination

Bellmann and Gerlach (1984) analyse gender differences in terms of wages and occupational positions. Gerlach (1987) focuses on the gender earnings gap and assesses the extent of wage discrimination taking marital status into account.

Sectoral distribution

Hübler and Gerlach (1990) analyse sectoral wage differences in West Germany and whether these wage differentials can be explained by efficiency wage considerations. The paper also analyses in detail how sector characteristics influence individuals' earnings. Dustman and van Soest (1998) analyse wage differentials between the public and the private sector as well as the determinants of sector selection. Much attention is paid to the specification of the model taking into account that some potential wage determinants, like sector of employment, hours worked or an individual's educational level, are simultaneously determined within a more general model.

Unobserved individual effects and selectivity

In addition to Dustman and van Soest (1998), whose paper is also concerned with selectivity bias with respect to individual self-selection between the private and the public sector, Wagner and Lorenz (1988, 1989) examine the influence of self-selection and unobservable indi-

vidual effects on earnings and conclude that these factors are important determinants of the earnings distribution.

3 Data sets, specification issues, and estimation procedures

Table 1 summarises the various German studies in terms of variables included, the period covered, data sets and the estimation method used. All studies in the table are based on Mincer-type earnings functions.

Departing from this summary table, the following sub-sections will provide additional details on data sets, definition of variables as well as specification and estimation issues.

3.1 Data sets

As can be seen from the table, the studies are not based on the same data sets. The main data sets used are the *Employment Statistics* of the Federal Labour Office and the *German Socio-Economic Panel.* In addition, less comprehensive data sets have been used in some of the studies.

The Employment Statistics of the Federal Labour Office (IABS)

Bellmann, Reinberg and Tessaring (1994) and Weißhuhn and Clement (1983) use data from the Employment Register of the Federal Labour Office, which is not generally available for research outside the Federal Labour Office or its research institute, the Institut für Arbeitsmarkt- und Berufsforschung (IAB). Recently, a 1% random sample of the Employment Statistics, known as IABS, has become available for research outside the Federal Labour Office. It currently covers the period 1975 to 1990; an update to 1995 is expected to become available for research soon.

The IABS contains information on employed persons covered by the social security system. Thus, it excludes the self-employed, civil servants and irregularly employed workers. Overall, the IABS represents about 80 per cent of the German workforce. It is an un-

Table 1.   Previous studies for Germany based on Min-cer-type earnings equations. Dependent vari-able: log earnings

	Bellmann, Reinberg & Tessaring (1994)	Bellmann & Gerlach (1984)	Dustmann & van Soest (1998)	Wagner & Lorenz (1988)	Wagner & Lorenz (1989)
Years/period	1976-87	1977-79	1984	1980-82, 84	1984-85
Estimation method	Cross-section	Simple pooling	Cross-section	Cross-section	Cross-section, simple pooling, fixed-effects, random-effects
Data set	Employ-ment register	MHH	GSOEP	Allbus (80, 82, 84) Bremen (81) GSOEP (84)	GSOEP
Variables included					
Years of educ.*	x	x		x	x
Levels of educ.*	x		x		
Age					
Age²					
Exp	x	x	x	x	x
Exp²	x	x	x	x	x
Tenure					x
Tenure²					
Region		x			
Firm size					x
Industry			x		
Occupational position		x	x		
Working time			x		
Family status			x		x
Sex**		x			
Social class		x			
Interaction dummies***					
Other					x
Correction for selectivity bias					

Table 1. (continued)

	Steiner & Wagner (1996)	Weißhuhn & Clement (1983)	Gerlach (1987)	Hübler & Gerlach (1990)	Franz (1996)
Years/period	1984,90	1974, 77, 78	1981	1981, 84	1984-93
Estimation method	Cross-section	Cross-section	Cross-section	Cross-section	Simple pooling
Data set	GSOEP, IABS	Employment register	Bremen	GSOEP (84), Bremen(81)	GSOEP
Variables included					
Years of educ.*		x	x	x	x
Levels of educ.*	x	x			x
Age				x	
Age²					
Exp	x	x	x	x	x
Exp²	x	x	x	x	x
Tenure			x	x	
Tenure²			x	x	
Region					
Firm size	x			x	
Industry	x	x		x	
Occupational position		x		x	
Working time		x		x	
Family status			x		
Sex**		x	x	x	
Social class					
Interaction dummies***	x				
Other	x	x	x	x	
Correction for selectivity bias	x				

Notes: * Those studies where both years and levels of education are ticked do not include the variables at the same time in the wage equation but alternatively.

   ** Either through a dummy variable in the earnings function or through separate regressions for men and women.

   *** Including education or experience.

balanced panel with about 200,000 observations per year. The IABS contains very reliable information on (daily) earnings, an indicator for part-time work, quite detailed information on education and vocational qualifications and some other individual characteristics, like sex, marital status and age, as well as some information on the employment structure, in particular industry, occupation and firm size.

The German Socio-Economic Panel

Wagner and Lorenz (1988, 1989) and Franz (1996) rely on data from the German Socio-Economic Panel (GSOEP). Both restrict their analyses to the sub-sample of (full-time only for Wagner and Lorenz) working German men. Steiner and Wagner (1998) compare earnings functions based on the GSOEP and on the IABS.

The GSOEP is a longitudinal household survey conducted on a yearly basis since 1984 (14 waves until 1997). In the first wave, some 12,000 individuals in about 6,000 households were interviewed. Initially the sample only referred to West Germany, but in 1990 the sample was extended to the former German Democratic Republic. Questions are asked at the individual as well as at the household level. Individual and household identifiers make it possible to track individuals over time. The GSOEP contains information on gross and net earnings, normal and actual hours of work, education, vocational qualification and training, household structure, and other variables relevant for individual labour market behaviour. In addition to questions referring to the month preceding the interview date, the GSOEP also collects retrospective information on an individual's previous labour force state and associated incomes. For instance, there is information on an individual's employment history over the entire life span from 15 to a maximum of 65 years. There is also information coded in calendar form with up to eleven labour force states, including full-time and part-time employment and unemployment, and a corresponding income calendar referring to each month in the year preceding the current interview.

Special data sets

Wagner and Lorenz (1988) also use the GSOEP, but compare the results with other data sets (Allbus, Bremen), which they do

not describe, for different years. Hübler and Gerlach (1990) compare the results coming from two data sets, the GSOEP for 1984 and the Bremen data set for 1981. Gerlach (1987) also uses the Bremen data set. This latter data set is a 10% random sample of all employed blue- and white-collar workers in the federal state of Bremen, excluding the self-employed. The sample size is about 6,000 employees. Bellmann and Gerlach (1984) use a data set collected by the Medical School Hannover (MHH) from 1977 to 1979 in Lower Saxony and Bremen, interviewing slightly less than 2,000 persons.

3.2 Definition of earnings and human capital variables

Differences in the definition of earnings and human capital variables used in the various studies described above is one obvious reason for differences in estimation results with respect to the returns to education and labour market experience. In this subsection, these differences are briefly described.

Earnings

Most studies use either (the log of) gross monthly or gross hourly earnings as the dependent variable, but there are also some studies based on net earnings. Bellmann, Reinberg and Tessaring (1994), Hübler and Gerlach (1990), Steiner and Wagner (1996), and Weißhuhn and Clement (1983) use gross monthly earnings, whereas Bellmann and Gerlach (1984), Gerlach (1987) and Wagner and Lorenz (1988, 1989) use net monthly earnings. Franz (1996) and Dustman and van Soest (1998) use gross hourly wages.

Education

Most studies use as the education variable completed years of education (schooling model), calculated by attaching an average number of years to several standardised education levels. This is the case in Bellmann and Gerlach (1984), Gerlach (1987), Hübler and Gerlach (1990), and Wagner and Lorenz (1988, 1989). Other studies, like Steiner and Wagner (1996) or Dustman and van Soest (1998) approximate an individual's educational and vocational

qualification by a set of dummy variables allowing for non-linear effects of the level of education. This specification also takes into account that, for a given completed educational/vocational degree, fewer rather than more years are considered as a positive signal in the German labour market. Another set of studies including Bellmann, Reinberg and Tessaring (1994), Franz (1996) and Weißhuhn and Clement (1983) use both measures of educational attainment in alternative specifications of the earnings function.

Labour market experience

Bellmann, Reinberg and Tessaring (1994), Wagner and Lorenz (1988, 1989), Bellmann and Gerlach (1984), Franz (1996), Gerlach (1987), Steiner and Wagner (1996), and Weißhuhn and Clement (1983) all approximate actual experience by potential experience, defined as age minus years of education minus the school entrance age (5 or 6 years). Periods of non-employment remain unaccounted for in those specifications. Only Hübler and Gerlach (1990) and Dustman and van Soest (1998) compute actual labour market experience from the retrospective data of the GSOEP, which takes work interruptions into account. Except for Weißhuhn and Clement (1983), who also include a cubic term in experience, the effect of the accumulation of general human capital is approximated by labour market experience and its square.

3.3   Methodological issues

The estimation techniques vary across the studies surveyed here. This sub-section presents the way the different studies deal with some typical problems arising in the estimation of earnings functions.

Unobserved heterogeneity

Unobserved individual heterogeneity leads to biased estimates of the returns to education if some unobserved factor is correlated with educational attainment or any other explanatory variable included in the earnings equation. For instance, intelligence or work motivation may have a direct positive influence on wages, which

we want to measure, or affect wages indirectly through its effects on educational attainment or labour market experience. Ignoring these indirect effects would lead to an upward bias in the estimated returns to education.

If the same individuals are interviewed repeatedly in different waves, i.e., if panel data are available, it is in principle possible to statistically control for these unobservable individual effects. Using panel data for German, Wagner and Lorenz (1989) estimate simple earnings equations and compare the results from cross-section estimation, simple pooling and random vs. fixed effects panel estimation. Typically, the estimates only using the individual variation over time, i.e. the fixed-effects estimates, yield lower returns to education than estimates based on the sample variation between individuals as well. The advantage of the fixed-effects estimator is that it does not require the assumption of individual effects being uncorrelated with the explanatory variables in the earnings equation. However, the problem with this estimator is that parameter estimates only use information on those individuals whose level of educational attainment has changed within the observation period. Given that educational attainment for most employed people with observed earnings does not change over time, the fixed-effects estimator relies on information of a very small group of people in the sample, which is often contaminated by measurement error.

Sample selection and endogeneity bias

Selectivity bias occurs when, given the set of exogenous explanatory variables, the expectation of the dependent variable differs from its expectation given these control variables and some other conditioning variable which typically represents some observed choice variable. In the context of the estimation of earnings functions, the individuals' decision to work or not will determine whether we observe their wages in our data. If the factors determining this decision were uncorrelated with the factors affecting individual wages we could simply ignore the fact that not all wages are observed. However, such an independence assumption is unlikely to hold in practice, especially for women, because women with higher market wages are probably more likely to participate in the labor force. Hence, employed women are a self-selected group whose wages may not be representative for those

of all women with given observed characteristics, which could bias estimated returns to education.

There are various ways to statistically control for potential selectivity bias. Following the standard two-step Heckman procedure, Steiner and Wagner (1996) correct for selectivity bias by including a correction term (the inverse Mills' ratio) obtained from a first-stage reduced form probit equation of labour force participation as an additional regressor in the second-stage estimation of the earnings function. This procedure requires the availabilty of some credible instruments, i.e. variables significantly affecting labour force participation but having no significant direct effect on earnings. In this study, marital status, number of children and other household income were chosen as such instruments. It turned out that, although the selectivity-correction term was statistically significant in most of the specifications, its inclusion in the second-step earnings equation had very little effect on the parameter estimates.

A related problem arising in the estimation of earnings equations relates to the endogeneity of some of the explanatory variables, in particular the human capital variables. Dustmann and van Soest (1998) deal extensively with this problem. They treat an individual's educational level, the choice between public and private sector, labour market experience and the number of weekly hours as potentially endogeneous variables and try to estimate the relationship between these variables within a simultaneous equation system by Maximum-Likelihood. Although ingenious, this approach faces the difficulty of finding credible instrumental variables to identify the parameters of interest other than by functional-form assumptions.

Sensitivity analyses

Estimation results depend on the specification of the earnings function, on the estimation method as well as on the data sets used. Therefore, it is worth examining whether the results are robust to alternative model specifications and data sets.

As already mentioned, Wagner and Lorenz (1989) test the robustness of results with respect to different estimation methods. Steiner and Wagner (1998) compare results from cross-section regressions on two different data sets (IABS and GSOEP). Hübler

and Gerlach (1990), who are interested in the sectoral distribution of wages, estimate earnings equations by sector. Weißhuhn and Clement (1983) analyse gender differences on the basis of OLS cross-section regressions of different specifications of the earnings function. Gerlach (1987) analyses gender differences in earnings on the basis of cross-section regressions of standard earnings functions estimated separately for married men, single men, married women and single women.

4   Results from previous studies for Germany

The estimation results of the studies presented are difficult to compare, since the data, the period considered, the specification and the estimation method are different. However, it is worth looking at the main results arising from the studies. This section reports the main estimation results as far as returns to education and to experience are concerned.

4.1   Returns to education

A distinction can be drawn between models using the years of schooling as a variable for education and those referring to educational levels, included as dummy variables in the earnings function. Table 2 presents the results of studies based on a schooling model (s.m.).

As the table shows, the estimates of returns to education range from 5 to 14% depending on the sample chosen, the specification and the estimation methods applied.

Few studies analyse changes in returns to schooling over time. The few studies with an intertemporal focus are restricted to the 1970s or 1980s, whereas there seems to be no study extending to the 1990s. Bellman, Reinberg and Tessaring (1994) study the longest time period and find constant returns to schooling at a level of about 6%. Weißhuhn and Clement (1983) find that within the period 1974 – 78 returns to education have slightly increased (decreased) for men (women). However, in their study the estimates

of returns to schooling are twice as high as in the study by Bell-mann, Reinberg and Tessaring (1994), which renders any comparison difficult. More research seems to be needed in this area.

Table 2.   **Returns to years of schooling (in %). Dependent variable: log earnings.**

	Years	Education			
Bellmann, Reinberg & Tessaring (1994)	1976	5.7			
	1977	5.9			
	1978	6.1			
	1979	6.0			
	1980	5.8			
	1981	5.8			
	1982	5.9			
	1983	6.1			
	1984	6.1			
	1985	6.1			
	1986	6.0			
	1987	5.9			
Bellmann & Gerlach (1984)	1977-79	Men 6.5		Women 12.8	
Wagner & Lorenz (1988)	1980	Allbus 9.4	Bremen	GSOEP	
	1981		8.0		
	1982	9.4			
	1984	9.4		7.2	
Wagner & Lorenz (1989)	1984-85	Pooled 6.6	FE –	RE 6.6	
Weißhuhn & Clement (1983)	1974	Men 13.1		Women 12.2	
	1977	13.6		11.7	
	1978	13.8		11.5	
Gerlach (1987)	1981	mm 7.3	sm 8.2	mf 5.6	sf 7.8
Franz (1996)	1984-93	7.2			

Notes: FE: fixed effects. RE: random effects. mm: married males. sm: single men. mf: married females. sf: single females.

The great majority of previous studies concentrates on the sub-sample of men. Differences between men and women have not led to very robust results so far. For instance, Bellmann and Gerlach (1984) find that returns to education are about twice as high for women as for men (12.8% vs. 6.5%). This result, however, is contradicted by the study of Weißhuhn and Clement (1983), who find much smaller gender differences: 13 – 14% for men and 11 – 12% for women. Gerlach (1987) also finds somewhat lower returns to education for women than for men, but at a much lower level than Weißhuhn and Clement. For example, for the sub-samples of married men and women, he estimates rates of return of 5.5% and 7%, respectively. In contrast, for

Table 3.   **Definition of educational levels**

	Bellmann. Reinberg & Tessaring (1994)	Dustman & van Soest (1998)	Steiner & Wagner (1998)	Franz (1996)	Weißhuhn & Clement (1983)
Level 1	High school	Basic schooling + apprentice-ship	Skilled	Inter-mediate school	High school
Level 2	Apprentice-ship + no high school degree	Intermediate schooling + apprentice-ship	Graduate	Technical high school	Vocational training
Level 3	Apprentice-ship + high school degree	High school / high school +apprentice-ship	-	High school	Higher specific school
Level 4	Higher specific school	Engineering school /higher specific school	-	Vocational training	University
Level 5	University	University	-	Vocational school	-
Level 6	-	-	-	Technical school	-
Level 7	-	-	-	Higher specific school	-
Level 8	-	-	-	University	-

single men and women the returns to schooling are about the same. These differing results obviously do not allow any clear conclusion to be drawn on the size of gender differences in returns to education. Here, too, more research seems needed.

Standard schooling models make the assumption that returns to education are linear in years of education. This perhaps restrictive assumption is not made in the dummy variable models (d.v.m.), where educational attainment is represented by a set of dummy variables. Table 3 summarises the definitions of educational dummies used in the studies surveyed here, where the respective category always refers to the highest educational degree obtained. The reference group, which is not indicated in the table, always refers to the lowest educational level.

On the basis of these definitions, returns to education by educational category estimated in the various studies are summarised in Table 4. For not too large returns, the reported numbers give the relative wage differentials (in per cent) between any of the education groups relative to the reference group of people with no completed educational degree.[1] Alternatively, the wage differential between any two educational levels is simply given by the difference of the respective returns reported in the table.

Given the differences in the definition of educational levels, these results are difficult to compare. At least, they all show quite unambiguously that the higher the level of education, the higher the returns in terms of earnings. One has to keep in mind, however, that years of labour market experience are likely to differ between educational levels. Taking this into account, it seems that the marginal return to education decreases with the level of education.

As to changes in returns to education over time, the estimates by Bellman, Reinberg and Tessaring (1994) show that they have increased for the higher educational groups (level 4 and level 5). As mentioned above, this result contradicts the observation by Weißhuhn and Clement (1983). For the period 1984 and 1990, Steiner and Wagner (1998) find slightly decreasing returns for the group with higher education in both data sets analysed.

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[1]   In a semi-loglinear earnings equation the exact wage differential is given by the exponent of the estimated parameter of the respective educational dummy variable.

Table 4. **Returns to schooling by level of education (in %). Dependent variable: log earnings**

	Years	Education				
Bellmann, Reinberg & Tessaring (1994)		Level 1	Level 2	Level 3	Level 4	Level 5
	1976	14.3	13.2	29.6	37.7	36.7
	1977	14.5	13.0	28.8	39.6	39.0
	1978	14.9	12.8	29.3	40.6	40.9
	1979	14.6	12.7	27.2	40.1	40.8
	1980	14.3	10.0	26.3	39.0	39.8
	1981	14.8	11.1	27.0	39.1	40.1
	1982	14.5	11.8	26.6	40.4	41.4
	1983	15.0	11.3	28.8	42.0	43.5
	1984	15.4	10.8	25.6	43.1	43.5
	1985	15.3	9.8	26.9	43.2	44.3
	1986	15.1	12.8	24.8	42.7	43.8
	1987	15.0	10.8	25.8	43.2	43.2

	Years		Level 1	Level 2	Level 3	Level 4	Level 5
Dustman & van Soest (1998)	1984	private	17.2	30.5	45.9	50.7	63.1
		public	27.1	61.3	83.7	90.1	100.3

		Level 1		Level 2	
		IABS	GSOEP	IABS	GSOEP
Steiner & Wagner (1998)	1984	8.9	18.9	45.7	62.4
	1990	9.5	16.9	37.5	59.3

		Lev.1	Lev.2	Lev.3	Lev.4	Lev.5	Lev.6	Lev.7	Lev.8
Franz (1996)	1984-93	17.1	26.8	24.9	11.3	16.9	27.8	35.6	45.3

		Level 1		Level 2		Level 3		Level 4	
		men	women	men	women	men	women	men	women
Weißhuhn & Clement (1983)	1974	8.9	15.6	7.1	7.1	54.2	39.7	57.5	60.3
	1977	10.3	14.6	8.2	7.3	48.3	36.2	52.6	52.5
	1978	9.6	14.4	7.7	7.0	48.7	35.2	51.5	51.3

As to sectoral and gender differences, Dustmann and van Soest (1998) find higher returns at all educational levels in the public compared to the private sector of the West German economy. Weißhuhn and Clement (1983) find that returns for women with a high school degree (Abitur) are higher than for men with the same educational background, whereas they do not find gender differences for the other educational levels (except for the very small group of women with "higher specialised education").

Table 5.   Returns to labour market experience (in %). Dependent variable: log earnings

	Years	Experience		Experience²	
Bellmann, Reinberg & Tessaring (1994)		s.m.	d.v.m	s.m.	d.v.m
	1976	1.8	1.8	-0.069	-0.069
	1977	1.9	1.9	-0.070	-0.069
	1978	1.9	1.9	-0.068	-0.067
	1979	1.9	1.9	-0.065	-0.064
	1980	1.9	1.9	-0.063	-0.062
	1981	1.9	1.9	-0.061	-0.061
	1982	1.9	1.9	-0.059	-0.059
	1983	1.9	1.9	-0.058	-0.058
	1984	2.0	2.0	-0.059	-0.058
	1985	2.0	2.0	-0.056	-0.056
	1986	2.0	2.0	-0.056	-0.055
	1987	2.1	2.1	-0.055	-0.055

	Years	Experience		Experience²	
Bellmann & Gerlach (1984)	1977-79	Men 4.5	Women 8.1	Men -0.11	Women -0.25

	Years	Experience			Experience²		
Wagner & Lorenz (1988)		Allbus	Bremen	GSOEP	Allbus	Bremen	GSOEP
	1980	4.5			-0.08		
	1981		4.2			-0.07	
	1982	4.3			-0.08		
	1984	3.8		4.1	-0.06		-0.08

	Years	Experience			Experience²		
Wagner & Lorenz (1989)	1984-85	Pooled 2.9	FE 3.6	RE 3.0	Pooled -0.062	FE -0.046	RE -0.063

	Years	Experience		Experience²	
Dustman & van Soest (1998)	1984	Private 1.3	Public 4.4	Private -0.03	Public -0.04

	Years	Experience		Experience²	
Steiner & Wagner (1998)		IABS	GSOEP	IABS	GSOEP
	1984	2.9	3.4	-4.7	-6.3
	1990	2.0	3.8	-2.9	-6.9

	Years	Experience s.m.		Experience d.v.m.		Experience² s.m.		Experience² d.v.m.	
Weißhuhn & Clement (1983)		m	f	m	f	m	f	m	f
	1974	4.0	12.1	3.6	10.2	-0.07	-0.09	-0.07	-0.07
	1977	4.4	13.5	3.9	10.9	-0.08	-0.09	-0.07	-0.07
	1978	4.5	13.4	4.0	10.6	-0.10	-0.09	-0.07	-0.07

	Years	Experience				Experience²			
Gerlach (1987)		mm	sm	mf	sf	mm	sm	mf	sf
	1981	3.0	8.2	2.4	6.5	-0.06	-0.02	-0.04	-0.01

	Years	Experience		Experience²	
Franz (1996)	1984-93	s.m. 4.7	d.v.m. 4.5	s.m. -0.07	d.v.m. -0.07

Notes: FE: fixed effects. RE: random effects. mm: married males, sm: single men, mf: married females. sf: single females, s.m.: schooling model, d.v.m.: dummy variable model.

4.2 Returns to experience

Table 5 presents the estimates for the experience variables in the earnings functions. In all studies, the linear experience term exhibits a positive sign and the quadratic term a negative sign, which implies the well-known concave shape of the earnings-experience curve. The results vary less than for education, since most of the coefficients for the experience term range between 2 and 4%.

Bellman, Reinberg and Tessaring (1994) find a slightly positive time trend over the 80s. This result is confirmed, at least for the end of the 1970s, by Weißhuhn and Clement (1983). Steiner and Wagner (1998), however, find a decrease in the experience coefficient between 1984 and 1990 (from 3% to 2%) using the IABS data set and a slight increase with data from the GSOEP. Weißhuhn and Clement (1983) obtain much higher coefficients for women than for men. This result is not confirmed by Gerlach (1987). In the latter study, the opposition is rather between married and single individuals, since the effect of experience on wages is much higher for single people. Steiner and Wagner (1996) show that earnings-experience profiles depend on the level of education: the higher the level, the steeper the experience-earnings profile, which is very flat for people with no completed educational or vocational degree.

5 Conclusions

There is not much systematic research focusing on the returns to human capital in Germany. Most existing studies use quite different specifications of the basic human capital variables, and differ with respect to included control variables, data sets and time periods covered as well as estimation methods. This makes it difficult to compare results between studies. Hence, no clear conclusions on the returns to human capital in Germany can be drawn on the basis of the existing literature, and there is a clear need for further research, especially in three areas:

- *methodological approach*: most studies are based on a simple version of the traditional Mincer earnings function and ignore

some important problems arising from potential selectivity bias, unobserved individual heterogeneity and the endogeneity of some of the basic human capital variables;

- *changes in returns to education over time*: it would be interesting to analyse whether returns have changed in Germany over time and, if so, how these changes can be explained (for instance, cohort effects, public policy change);

- *structural factors*: few studies analyse differences between groups, e.g. differences in returns by gender, between the public and private sector of the economy, and between natives and foreigners. Studies which focus e.g. on the gender wage differential have yielded no conclusive results so far.

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