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and educational funding

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**Abstract:** This paper analyses the determinants of participation in higher education in West Germany. In particular, the role of social origin as well as of expectations regarding the labour market outcome of a higher education degree and of public educational policy are examined. The estimations are based on a model of utility maximisation, where the decision to enrol in one of several educational tracks of different levels is determined by the expected ratio of marginal cost to marginal return for the different enrolment alternatives given some observed characteristics. The model is estimated empirically on the basis of GSOEP and regional data. The results show that the probability of enrolment in higher education is mainly influenced by social origin. Parental education and occupational position, in particular, are essential. However, the enrolment probability also depends on labour market return expectations. In particular, the absolute level of the personal unemployment risk, rather than the reduction of the unemployment risk to be expected from higher education, is a strong incentive to pursue higher education. The expected return to education in terms of wages also affects educational decisions significantly. A higher propensity to be out of work or employed part-time proved to go along with a lower probability of being enrolled in higher education significantly. Also public policy is found to have an influence on enrolments. In particular, extending the coverage of public financial support in the form of BAföG seems to be more efficient in increasing enrolments than increasing the amount of BAföG granted. The extent of the repayable part of the financial aid has a dampening, though limited, influence on enrolments.

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## **Non technical summary**

This paper analyses the determinants of participation in higher education in West Germany. The estimations are based on a model of utility maximisation, in which the decision to attend one of several educational tracks of different levels is determined by the expected ratio of marginal cost to marginal return for the different enrolment alternatives, given some observed characteristics. The model is estimated empirically on the basis of GSOEP and regional data. The analysis concentrates on the impact on the enrolment probability of social origin, expectations regarding the labour market outcome of higher education and of public educational funding. The results were quantified in a simulation exercise of the impact of changes in selected variables on the enrolment threshold and on the enrolment probability itself.

The results show that the probability of enrolment in higher education is strongly influenced by social origin. Parental education and occupational position, in particular, are essential. Moreover, there seems to be evidence for financial constraints binding participation in higher education, which a priori legitimate policies of financial support of education.

Even though family background seems to be the main determinant of participation in higher education, the enrolment probability also depends on labour market return expectations. Thus, this seems to accord with the human capital theory. The results are based on measures of labour market expectations obtained by running out-of-sample predictions of life-cycle wages, unemployment risk and labour market participation, given some personal characteristics. The absolute level of the personal unemployment risk, more than the unemployment risk reduction resulting from a higher educational degree, appears to be a strong incentive to pursue higher education. The expected return to education in terms of life-cycle wages affects educational decisions significantly, whereas the level of expected wages proves insignificant. A higher propensity to be employed part-time and even more to be out of work proved to reduce the utility of higher education and is thus accompanied with a lower probability of being enrolled in higher education.

The results concerning the impact of public policy variables give an idea of the possible effectiveness of public policy in influencing enrolments in tertiary education. Whereas the overall level of public expenditure for each student engaged in tertiary education did not prove to have a significant impact, there seems to be evidence that policy measures more specifically directed to the potential students have an impact. In particular, the simulation using the estimation results shows that, at the same financial costs, extending the coverage of public financial support in the form of BAföG is expected to be more efficient in increasing enrolments than increasing the amount of BAföG granted. The extent of the repayable part of the financial aid, conversely, has a dampening, though limited, influence on enrolments.

## 1. Introduction

In Germany, as in most other industrialised countries, the average level of education attained by the population has increased steadily over the past thirty years. This phenomenon has been encouraged by public policy, since raising the educational attainment of the population is commonly viewed as a way of promoting both economic and social development. Typically, the raise of educational attainment may be the result of a quantitative expansion of participation in education or of a qualitative improvement of human capital acquisition for those persons enrolled in education. This paper deals with the former aspect and focuses more specifically on the issue of participation in tertiary education in West Germany.

Analysing the factors influencing educational participation may be of interest to policy makers for several reasons. First, being aware of the way some variables affect educational decisions gives a hint on the possible impact which observed changes in those variables may have on the future qualification structure of the population and consequently on future labour market developments. Second, this might also help to find out the extent to which public policy is likely to influence educational participation and thus improve the efficiency of the allocation of resources. Moreover, if the empirical evidence on the determinants of educational decisions available so far mostly concerns the link between social origin and educational choices or outcomes, very few studies, and this is particularly true for Germany, also examine the impact of economic considerations on schooling decisions. This is rather surprising considering that one of the main objectives of educational policy for the past decades has been to provide financial incentives to youngsters to enrol in education, e.g. through financial support to enrollees from poorer social backgrounds. For such policies to prove efficient, however, youngsters' educational choices need to respond to some extent to costs considerations when making their educational choices. Moreover, on a more academic level, it is rather astonishing that, though a large number of studies is based on the human capital theory, the main assumption of this theory - that individuals make their educational decisions by weighting the costs and the returns they expect from education - has very rarely been examined empirically.

Therefore, this paper aims at investigating the main factors affecting participation in education, paying special attention on the impact of economic incentives. The study focuses on tertiary education and addresses the following issues: (i) How determining is social background in explaining enrolment decisions? (ii) To what extent are enrolments influenced by the expected labour market returns? (iii) To what extent may public funding influence educational choices? The paper is organised as follows. After a presentation of previous research related to this topic in section 2, the modelling framework for the analysis is outlined in section 3. Section 4 motivates the choice and the definition of the variables. Section 5 presents the results of the analysis, and section 6 the results of simulation of changes in selected variables and their impact on enrolment probabilities. Finally, section 7 concludes.

## 2. Previous related empirical evidence

Most economic and sociological research focuses on the link between social origin and educational outcomes. Empirical evidence is rather unanimous in stating a positive correlation between family background and own educational achievement (Goux and Maurin 1998a and 1998b, Blossfeld 1993, Gang and Zimmermann 2000, Bogess 1998, Manski et al. 1992 to name a few).

However, various other factors can be considered influencing preferences and abilities and thus educational decisions. According to the human capital theory, educational choices may be assimilated to investment decisions where rational individuals decide on the optimal amount of education they wish to acquire so as to maximise the net return to education. As a matter of fact, additional schooling is expected to generate benefits in terms of enhanced future earnings, but also to entail costs: direct costs as well as opportunity costs resulting from delayed entry into the labour market<sup>1</sup>. The human capital theory has provided the base for a large number of studies, in particular on the determinants of the wage structure or on the returns to education (see a survey of the empirical literature on this topic for Germany in Lauer and Steiner 1999). In spite of this, this basic assumption of the human capital theory, namely that people's educational decisions are the result of a maximisation calculus of net return has rarely been tested empirically and no clear evidence emerges from the literature.

Few studies investigate the role of return expectations on educational decisions. However, the few studies which do generally tend to confirm the theory, even though the approaches adopted and the entities observed are very different and do not provide for any real comparison. Goux and Maurin (1999), for instance, find out for France that neglecting the income expectations of students results in overestimating the impact of social background on educational achievement. Kodde (1988) integrates future income, foregone earnings, overall unemployment and education-specific employment opportunities in a model of demand for education and tests the model on a sample of Dutch high school graduates. The estimations show that both monetary arguments and employment prospects influence the demand for education. The latter is also confirmed by Mingat and Tan (1998), who find out, on the basis of aggregate data, that college enrolment rates are sensitive to unemployment and economic conditions. Wilson et al. (2000) focussed explicitly on the extent to which American youth's high school graduation decision responds to economic incentives, in particular to expected income return associated with graduating relative to dropping out. The results suggest that youths appear to be more likely to opt for graduating from high school when expected returns from additional schooling increase. Gianelli and Monfardini (2000) analyse the effects of expected earnings and local markets conditions on the behaviour of high school graduates, whereby the decision to either remain in the parental home or form a new household is modelled jointly with the decision to work or to invest in further education. Finally, Merz and Schimmelpfennig (1999) examine the career choices of German high

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<sup>1</sup> In Germany, educational provision is generally free of charge. Thus, the largest component of the costs of education is the opportunity cost of children's time diverted from labour market participation.

school graduates. Here again, these studies find evidence that high school graduates' decisions are, at least partially, based on economic motives.

Another branch of recent empirical literature is concerned with the impact of financial variables such as the costs of education and the availability of financial resources on the demand for education. The positive correlation between family income and schooling attainment is well-documented for the United States (e.g. Solon (1992), Hill and Duncan (1987)) and has been widely interpreted as evidence of credit constraints, thus providing empirical support for public policies of financial support. Shea (2000) as well as Cameron and Heckman (1998), however, contest the causal nature of this link, arguing that not parental income per se generates higher children' achievement, but rather learning ability, whereas the commonly observed income effect only reflects the correlation between parental income and parental ability, which, in turn, is correlated with children ability. Consequently, policies designed to induce college attendance by raising family income would essentially result in attracting substantially less able people. Neither do Cameron and Taber (2000) find any evidence of credit constraints. For Great Britain, Chevalier and Lanot (1999) find a rather limited direct effect of family income on child's schooling, even though they do point out the existence of some short-term financial constraints which are likely to induce pupils from poorer backgrounds to exit the education system earlier than their ability would have predicted. Some other studies are more directly concerned with the impact of public policy on educational attendance. Schultz (1988), for instance, examines the relationship between the expansion of public schools expenditure and aggregate enrolments for about 90 countries. More recently, Hilmer (1998) examines the effect of post-secondary fees on the college attendance decision of high school graduates.

On the whole, very little empirical research is available at this stage for Germany, and the empirical evidence for other countries is mostly concerned with one particular aspect of the issue, typically the role of family background. Recent developments in economic research, however, tend to grant more importance to the analysis of the role of economic incentives on educational choices. Thus, there seems to be a need for a more comprehensive analysis of the determinants of educational decisions, particularly for Germany. This is the aim of this paper, in which the effects of social background, return expectations and public policy on enrolment decisions are jointly examined.

### **3. Methodological approach**

Analysing the determinants of educational decisions is subject to some conceptual difficulties, which explains that different approaches have been adopted in the empirical research and that no clear evidence emerges from the literature. As a matter of fact, final educational attainment is the result of a sequential process during which a certain number of decisions are made at different points in time. In order to investigate the determinants of final educational achievement, some assumptions must be made with respect to the point in time in which decisions are made and where some identified factors are supposed to exert an influence on educational decisions. This difficulty has been circumvented in different ways in empirical research. A widespread approach has been to concentrate the analysis on time-invariant factors only, typically the family background

the individual grew up in, which eliminates the need to make any assumption of this sort. The drawback of this approach is that it cannot account for the potential impact of economic considerations such as labour market conditions or the availability of educational grants.

Another approach, widely adopted, consists in decomposing the educational career into a finite number of sequences and concentrate the analysis on one or several particular stage of the educational process, e.g. the transition from high school to university or to employment. This approach enables one to also consider the impact of labour market conditions or some other time-varying factor at the time of the transition observed. One problem is that at each prior stage of the educational career, only the fittest students have been selected for grade progression. Therefore, the sample of students observed at one particular stage is not random: it is subject to a selectivity bias due to the sequential selection during the educational process (see Cameron and Heckman 1998). For instance, if the completion of a high school degree is a condition for being eligible for tertiary level studies, part of the decision to enrol in higher education has been made at previous stages of the educational career. Thus, focussing on the selected sample of high school graduates eligible for higher education and on their decision to enrol or not to enrol in higher education may not be really informative with regard to the determinants of educational achievement, and is problematic to analyse practically due to a very small number of high school graduates each year in the GSOEP data and their very unbalanced career choice<sup>2</sup>.

Here, the approach consists in analysing the probability of being enrolled in higher education at the typical age at which people intending to complete tertiary level studies should be enrolled in tertiary education, irrespective of their previous educational career. Thus, not the probability that an individual successfully completes a specific transition from one level to the next is examined, but the probability that the individual has successfully completed all previous transitions until the last one observed. This approach was chosen for several reasons. First, this is the variable policy-makers typically look at to assess the extent of educational expansion, namely the proportion of an age group being enrolled in education, rather than the proportion of eligible students actually completing tertiary education. Second, in the extent to which drop-out from university can be neglected, this approach gives information on the probability that an individual, given a certain number of characteristics, finally achieves a tertiary level degree. Finally, analysing the probability to be enrolled in higher education at a specific point in time rather than final educational attainment enables to also consider the impact of economic variables in addition to that of individual factors. However, one has to be aware that this approach does not make it possible to distinguish really between the impact of the explanatory variables at the current time and at previous stages of the educational process. Instead, it should be understood as the cumulated impact of the considered variables on an individual educational career up to the point in time observed, with some variables exerting a stronger influence at earlier stages (possibly family background) and other variables affecting more strongly later educational decisions (possibly labour market considerations).

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<sup>2</sup> In Germany, the overwhelming majority of high school graduates complete tertiary education.

For the analysis, we formulate a model of utility maximisation similar to that of Cameron and Heckman (1998). More formally, let us suppose that any individual has the possibility of attending one of  $k$  educational tracks  $E_i, i \in \{0 \dots k\}$  of increasing levels. Let  $E_{i^*}$ , where  $i^* \in \{0 \dots k\}$ , be the educational level the individual would ideally like to attend. In practice, the desired level of education attended is not observable, but the actual decision of the student  $E_i$ , i.e. the educational level  $i$  actually attended, can be observed. Of course, this decision relates to the desired  $E_{i^*}$ .

The individual is assumed to opt for the attendance decision which, given his endowment, personal characteristics and any other relevant factors, maximises his utility, the latter being defined in terms of expected net returns, i.e. the difference between expected returns and expected costs of attending each of the educational tracks  $E_i$ . Thus, the optimal education level attended by any individual with given a vector of characteristics  $x$  is given by:

$$\text{Max}_{i \in \{0 \dots k\}} r(E_i / x) - c(E_i / x) \quad (1)$$

where  $r$  denotes the expected return and  $c$  the expected cost associated with the attendance of educational track  $E_i$ . It is assumed that both the returns and the costs are positive and increase with the education level. The cost and return functions are assumed to be of the following form:

$$\begin{aligned} r(E_i / x) &= r(E_i) \mathbf{j}_r(x) \mathbf{e}_r \\ c(E_i / x) &= c(E_i) \mathbf{j}_c(x) \mathbf{e}_c \end{aligned} \quad (2)$$

where  $\mathbf{j}_r(x)$  is a positive function defining the effects of the observed characteristics on the expected returns to education and  $\mathbf{e}_r$  is a random variable accounting for the effect of unobserved individual heterogeneity on the expected returns<sup>3</sup>. Similarly,  $\mathbf{j}_c(x)$  is a positive function which defines the effects of the observed characteristics on the expected costs of education and  $\mathbf{e}_c$  is a positive random variable representing unobserved individual heterogeneity. Thus, the observed characteristics as well as the unobserved individual heterogeneity are allowed to affect the expected returns and the expected costs in different ways<sup>4</sup>. However, the personal shifters  $\mathbf{j}_r, \mathbf{j}_c, \mathbf{e}_r$  and  $\mathbf{e}_c$  are assumed not to depend on the specific education level. Without loss of generality, it is

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<sup>3</sup> Due to the multiplicative structure of the model,  $\mathbf{j}_r(x) > 1$  (resp.  $< 1$ ) implies that the observed characteristics of an individual, taken together, increases (resp. decreases) the return expectations. Similarly,  $\mathbf{e}_r > 1$  (resp.  $< 1$ ) means that the unobserved individual characteristics increase (resp. decrease) the return expectations.

<sup>4</sup> A high learning ability, for instance, a typical unobserved factor, might reduce the cost of educational investment, but not increase to the same extent the return to educational investments, since the way the acquired knowledge is „transformed“ into wages depends on another type of ability.



assumed that  $E(\mathbf{e}_r) = E(\mathbf{e}_c) = 1$ , i.e. unobserved heterogeneity has on average a neutral effect on the return as well as on the cost expectations.

The optimal educational decision  $E_{i^*}$  is such that the net return is maximised, i.e. the net return associated with  $E_{i^*}$  must be positive and at least as large as the net return at the next lower education level  $E_{i^*-1}$  and at the next higher education level  $E_{i^*+1}$ :

$$\begin{aligned} r(E_{i^*})\mathbf{j}_r(x)\mathbf{e}_r - c(E_{i^*})\mathbf{j}_c(x)\mathbf{e}_c &\geq 0 \\ r(E_{i^*})\mathbf{j}_r(x)\mathbf{e}_r - c(E_{i^*})\mathbf{j}_c(x)\mathbf{e}_c &\geq r(E_{i^*-1})\mathbf{j}_r(x)\mathbf{e}_r - c(E_{i^*-1})\mathbf{j}_c(x)\mathbf{e}_c \\ r(E_{i^*})\mathbf{j}_r(x)\mathbf{e}_r - c(E_{i^*})\mathbf{j}_c(x)\mathbf{e}_c &\geq r(E_{i^*+1})\mathbf{j}_r(x)\mathbf{e}_r - c(E_{i^*+1})\mathbf{j}_c(x)\mathbf{e}_c \end{aligned} \quad (3)$$

This is equivalent to:

$$\begin{aligned} \mathbf{j}_c(x)\mathbf{e}_c \left[ r(E_{i^*}) \cdot \frac{\mathbf{j}_r(x)\mathbf{e}_r}{\mathbf{j}_c(x)\mathbf{e}_c} - c(E_{i^*}) \right] &\geq 0 \\ \mathbf{j}_c(x)\mathbf{e}_c \left[ r(E_{i^*}) \cdot \frac{\mathbf{j}_r(x)\mathbf{e}_r}{\mathbf{j}_c(x)\mathbf{e}_c} - c(E_{i^*}) \right] &\geq \mathbf{j}_c(x)\mathbf{e}_c \left[ r(E_{i^*-1}) \cdot \frac{\mathbf{j}_r(x)\mathbf{e}_r}{\mathbf{j}_c(x)\mathbf{e}_c} - c(E_{i^*-1}) \right] \\ \mathbf{j}_c(x)\mathbf{e}_c \left[ r(E_{i^*}) \cdot \frac{\mathbf{j}_r(x)\mathbf{e}_r}{\mathbf{j}_c(x)\mathbf{e}_c} - c(E_{i^*}) \right] &\geq \mathbf{j}_c(x)\mathbf{e}_c \left[ r(E_{i^*+1}) \cdot \frac{\mathbf{j}_r(x)\mathbf{e}_r}{\mathbf{j}_c(x)\mathbf{e}_c} - c(E_{i^*+1}) \right] \end{aligned} \quad (4)$$

Let us define  $\mathbf{j}(x) = \frac{\mathbf{j}_r(x)}{\mathbf{j}_c(x)}$  and  $\mathbf{e} = \frac{\mathbf{e}_r}{\mathbf{e}_c}$ .

$\mathbf{j}(x)$  measures the net impact of observed characteristics  $x$  and  $\mathbf{e}$  the net effect of unobserved individual heterogeneity on the expected relation of returns to costs.

Since  $\mathbf{e}_r > 0$  and  $\mathbf{e}_c > 0$ ,  $\mathbf{e} > 0$ ,  $\mathbf{j}_r(x) > 0$  and  $\mathbf{j}_c(x) > 0$ , one obtains after simplification:

$$\begin{aligned} r(E_{i^*})\mathbf{j}(x)\mathbf{e} - c(E_{i^*}) &\geq 0 \\ r(E_{i^*})\mathbf{j}(x)\mathbf{e} - c(E_{i^*}) &\geq r(E_{i^*-1})\mathbf{j}(x)\mathbf{e} - c(E_{i^*-1}) \\ r(E_{i^*})\mathbf{j}(x)\mathbf{e} - c(E_{i^*}) &\geq r(E_{i^*+1})\mathbf{j}(x)\mathbf{e} - c(E_{i^*+1}) \end{aligned} \quad (5)$$

or 
$$\mathbf{e} \geq \frac{c(E_{i^*})}{r(E_{i^*})\mathbf{j}(x)} > 0$$

$$\frac{c(E_{i^*}) - c(E_{i^*-1})}{r(E_{i^*}) - r(E_{i^*-1})} \cdot \frac{1}{\mathbf{j}(x)} \leq \mathbf{e} \leq \frac{c(E_{i^*+1}) - c(E_{i^*})}{r(E_{i^*+1}) - r(E_{i^*})} \cdot \frac{1}{\mathbf{j}(x)}$$

(6)

Thus, for any individual with observed characteristics  $x$ , the expected net return is positive at the optimum level and the unobserved individual component is bounded by the expected ratios of marginal costs to marginal returns of attending  $E_{i^*-1}$  rather than  $E_{i^*}$ , for the lower bound, and from attending  $E_{i^*}$  rather than  $E_{i^*+1}$ , for the upper bound, given characteristics  $x$ .

Consequently, the probability for an individual to choose  $E_i$  is given by:

$$\text{Prob}(E_{i^*}=E_i / x) = \text{Prob} \left[ \frac{c(E_i) - c(E_{i-1})}{r(E_i) - r(E_{i-1})} \cdot \frac{1}{\mathbf{j}(x)} \leq \mathbf{e} \leq \frac{c(E_{i+1}) - c(E_i)}{r(E_{i+1}) - r(E_i)} \cdot \frac{1}{\mathbf{j}(x)} \right]$$

(7)

This means that the enrolment threshold for an individual with characteristics  $x$  for attending  $E_{i+1}$  rather than  $E_i$ , with  $i \in \{0 \dots k-1\}$  is given by the expected ratio of marginal cost to marginal return given  $x$ :

$$\text{Enrolment threshold } (E_{i+1} / x) = \frac{c(E_{i+1}) - c(E_i)}{r(E_{i+1}) - r(E_i)} \cdot \frac{1}{\mathbf{j}(x)}$$

(8)

Thus, any change in the observed characteristics  $x$  may change educational attendance decisions in the extent to which it affects the expected ratio of marginal costs to marginal returns. Note that for the present analysis, it is not necessary to assess the actual returns and the actual costs of each educational track, but rather to determine how the observed characteristics influence the expected ratio of marginal costs to returns.

Taking the logarithm of the expression and assuming that  $\ln \mathbf{e}$  is normally distributed with mean 0 and variance  $\mathbf{s}^2$  and that  $\mathbf{j}(x) = \exp[\mathbf{b}x]$ , we obtain:

$$\text{Prob}(E_{i^*}=E_i/x) = \text{Prob} \left[ \frac{\mathbf{m}_i - \mathbf{b}x}{\mathbf{s}} \leq \ln \mathbf{e} \leq \frac{\mathbf{m}_{i+1} - \mathbf{b}x}{\mathbf{s}} \right]$$

or

$$\text{Prob}(E_{i^*}=E_i/x) = \Phi \left( \frac{\mathbf{m}_{i+1} - \mathbf{b}x}{\mathbf{s}} \right) - \Phi \left( \frac{\mathbf{m}_i - \mathbf{b}x}{\mathbf{s}} \right),$$

(9)

where  $\mathbf{m}_{t+1} = \ln \left[ \frac{c(E_{i+1}) - c(E_i)}{r(E_{i+1}) - r(E_i)} \right]$  and  $\Phi$  is the standard normal cumulative distribution function.

This expression takes the familiar form of an ordered probit model, where  $\mathbf{m}_i$  are the cut values. The ordered probit model written above can only be identified up to some factor of proportionality. Since the ratio of the parameters to  $\mathbf{S}$  matters, it is convenient to normalise  $\mathbf{S}$  to 1 (Maddala 1997, p. 23). The log-likelihood function for the individual's educational attendance decision is given by

$$L(E_i / x) = \sum_i I_{E_i} \log \left[ \Phi(\mathbf{m}_{t+1} - \mathbf{b}x) - \Phi(\mathbf{m}_i - \mathbf{b}x) \right], \quad (10)$$

where  $I_{E_i}$  is an indicator variable equal to 1 if the individual chooses education level  $E_i$  and 0 otherwise, and the parameters  $\mathbf{b}$  and the cut values  $\mathbf{m}_i$  can be estimated by maximising the log-likelihood function.

#### 4. Data and definition of the variables

For the purpose of the analysis, data from the German Socio-Economic Panel (GSOEP, waves 1984 to 1997) has been merged with regional data. The GSOEP is a longitudinal household survey conducted on an annual basis since 1984. It contains information on various socio-economic factors like education, employment and income. In addition to information collected annually, the data set also retrieves some retrospective information about social background or employment history. The regional data was collected from various annual editions of publications from the Federal Office for Statistics (Statistische Jahrbücher, Fachserien 11 and 14, Bildung im Zahlenspiegel) as well as from the Federal Ministry of Research and Education (Grund- und Strukturdaten).

##### Dependent variable

Young persons are assumed to face two opportunities: attending university ( $E_1$ ), or not being enrolled in higher education ( $E_0$ ). The educational decision has been restricted to only two categories here, because some of the explanatory variables did not allow for a further differentiation (in particular the variables related to public financial support).

Therefore, the general model described in Section 3 may be simplified in the following way. Equation (7) becomes:

$$\text{Prob}(E_{i^*} = E_1 / x) = \text{Prob} \left[ 0 < \frac{c(E_1) - c(E_0)}{r(E_1) - r(E_0)} \cdot \frac{1}{\mathbf{j}(x)} \leq \mathbf{e} \right] = \text{Prob} \left[ -\infty < \frac{\mathbf{m}_1 - \mathbf{b}x}{\mathbf{S}} \leq \ln \mathbf{e} \right]$$

and equation (9) becomes, with  $\mathbf{S}$  normalised to 1:

$$\text{Prob}(E_{i^*}=E_{1/x}) = 1 - \Phi(\mathbf{m}_1 - \mathbf{b} x) \quad (11)$$

Thus, the model can be estimated with the help of a binary probit where  $\mathbf{m}_1$  is equal to minus the constant term.

The sample entails West German residents aged 21 to 26 because it corresponds to the typical age span in which those individuals willing to pursue tertiary level studies do so<sup>5</sup> (see Figure A1 in annex). Those persons having already finished tertiary level studies have been excluded from the sample, since they would have been misclassified in the lowest category „not enrolled in education“ although they did chose to invest in higher education. People engaged in military or civil service are excluded from the sample.

### **Explanatory variables**

The attendance decision is determined by a series of observed characteristics  $x$  influencing the cost and/or the return of choosing  $E_{1/}$ . Remember that we cannot identify whether the variables affects the cost or the return (or both), but that the model estimates the net effect of the variables on the expected ratio of marginal cost to marginal return, which determines the probability of enrolment. Some descriptive statistics are given in annex (Table A1) for the estimation sample.

- Family background

A first series of variables which might affect the probability of enrolment in higher education concerns the social background of the individuals. Indeed, the ratio of costs to returns, or the way people perceive it, is likely to be influenced by the social environment they grew up in and so are consequently individuals' educational decisions.

Unfortunately, the GSOEP contains no direct information on parental income. However, the possible impact of short-term financial constraints should be captured to some extent by a variable containing net other<sup>6</sup> household income in the previous year. Moreover, the GSOEP contains information on the economic situation of the father at the time when the person was 15 years old. This may be used as an indicator of the probable permanent income during childhood as well as of social status, which might affect the expectations regarding costs and returns to education. Hence, a set of dummy variables has been constructed to describe the occupational status of the father: whether the father was a blue collar worker (reference category<sup>7</sup>), a white collar worker, a civil servant or self-employed.

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<sup>5</sup> Different delimitations of the age span were tested and this proved not to change the results significantly.

<sup>6</sup> That is, total net household income minus own net income in previous year.

<sup>7</sup> Unknown or missing occupation of the father was considered as also belonging to the reference category.

Furthermore, the education level of the parents is likely to also play a role, regardless of the occupational situation. That is why two variables for the level of education of the mother and of the father, measured in terms of years of schooling, were included in the analysis.

- Labour market return expectations

According to human capital theory, individuals are supposed to expect from their educational investments that they improve their labour earnings, or generally speaking, their labour market position. Therefore, the impact on educational decisions of variables reflecting the labour market return to be expected from education should be tested empirically. Indeed, differences – across individuals or across time - in the labour market outcome of education are assumed to have an impact on educational choices since they influence the expected benefit which might be obtained from the acquisition of further education.

Here, we focus on the effects of expected outcomes in terms of gross hourly wages, unemployment risk and labour force participation (part-time employment and non-employment). We also examine the impact of the local structure of employment, in particular the extent of self-employment and of the public sector, on educational decisions. The estimation of these labour market expectations are based on the assumption that people observe the current labour market situation of „comparable“ persons of the previous generation - meaning persons with the same observed characteristics - and expect their own situation to become similar. This assumption seems rather realistic considering that current labour market situation represents the best information potential students dispose of on the labour market situation that can be expected in the future. Moreover, some recent studies (Dominitz and Manski (1996) for the USA and Wolter (2000) for Switzerland) provide evidence that student expectations do not deviate significantly from the currently observable wage structure. Finally, for the purpose of the analysis, it is not essential whether those „expectations“ really correspond to what people expect to be their labour market outcome given a certain level of education, but rather whether these „expectations“ influence the perceived ratio of costs to returns and therefore educational attendance decisions.

The computation of these variables is done with the help of out-of-sample prediction which are then applied to the sample we are interested in<sup>8</sup>, namely the individuals aged between 21 and 26. One particular issue of interest is whether the absolute levels (e.g. the level of unemployment or the level of wages) or rather the relative returns (e.g. the decrease of the unemployment risk or the wage premium associated with the completion of tertiary level studies) matter. In order to examine whether youths rather respond to expectations for their total life-cycle or to expectations concerning the first stage of

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<sup>8</sup> Alternatively, one could simply take the average wages, rates of unemployment, part-time employment and non-employment in the region or differentiated by gender. The procedure applied here is not really different, but has the advantage of making it possible to differentiate the averages according to a greater number of variables and thus to compute personal expectations depending on a certain number of characteristics. A similar approach was adopted by Wilson et al. (2000).

their life-cycle, the labour market return expectations were also estimated for the first stage of vocational career only, i.e. up to age 40.

As far as gross hourly wage<sup>9</sup> expectations are concerned, the procedure is the following. In a first step, a wage equation is estimated on a secondary sample of „older“ people in function of age, age squared, gender, nationality, family background, region and year<sup>10</sup>. Interactions between age/age squared and gender have been included to account for differing age-wage profiles between men and women. The estimated coefficients are then used to predict the expected income of the primary sample<sup>11</sup>, given their personal characteristics, for each age between 19 and 55. The net present value<sup>12</sup> of these expected income streams was computed and used as an estimator of expected life-cycle income given some personal characteristics.

Furthermore, the same procedure was repeated separately for tertiary level graduates and for individuals having a lower qualification. We thus obtain differentiated expected wage trajectories in case the individual completes university education and in case he does not. The ratio of the expected life-cycle income of the higher educated to that of the lower educated provides an indicator of the return to tertiary level graduation in terms of wages. Note that for the sample of higher education graduates, the expected income flows are estimated from age 26 and not 19 as for the less qualified. This makes it possible to account for the different lengths of studies and for the opportunity cost associated with longer studies.

The expected income trajectories are depicted in Figure A2 and Figure A3 in annex for different groups of workers. The predicted wage profiles show a concave shape. Completing tertiary level studies brings a wage premium, which widens with age (Figure A2a). Predicted hourly wages are higher for men than for women at all ages, but the differential increases with age (Figure A2b and A3a). They are also higher for the subgroup of young people who are enrolled in higher education than for those who are not enrolled, whether they graduate or not (Figure A2c and Figure A3b). In other words, individuals who are not enrolled in higher education would earn less than people who are enrolled even if they graduated. Conversely, individuals who are observed to be enrolled in higher education would earn more than those who are not enrolled even if they did not

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<sup>9</sup> Deflated with the consumer price index, like all other variables expressed in DM amounts.

<sup>10</sup> The choice of the explanatory variables is restricted by the necessity of using variables which are also available for the sample of young individuals. All other variables (like marital status, labour market experience) are captured by the error term, which implies that individuals are assumed to adopt an average behaviour regarding these variables.

<sup>11</sup> Due to the loglinear functional form of the wage equation and assuming that the residuals are normally distributed, the prediction is given by  $\exp(\hat{\mathbf{b}}\mathbf{X} + \frac{1}{2}\mathbf{S}^2)$ , where  $\hat{\mathbf{b}}$  is the vector of estimated coefficients,  $\mathbf{X}$  the vector of explanatory variables and  $\sigma$  the standard error of the prediction (cf. Greene (1993), p.60).

<sup>12</sup> A real discount rate of 3 percent was used. Further tests with alternative discount rates did not appear to change the results significantly.

graduate. This suggests a kind of sorting of the individuals with characteristics<sup>13</sup> providing them for the best earning prospects into higher education.

A similar procedure is applied in order to compute measures for the expected labour market outcome in terms of employment prospects. First, the probability of experiencing unemployment expresses the extent to which the investment in education is risky in the sense that the wage premium associated with university graduation cannot be drawn in case the person is unemployed. The probability of being unemployed was estimated with the help of a simple probit model in function of gender, nationality, family background, region and year on a subgroup of the secondary sample, namely those persons being either employed or unemployed<sup>14</sup>. The prediction applied on the primary sample gives a measure of the average unemployment risk to be expected by an individual given his personal characteristics in his working career.

Moreover, the reduction of the unemployment risk due to higher education can be seen as a return to education in itself. Here again, the estimations were also conducted separately for poorly and highly educated workers, and the ratio of the predicted unemployment risk in case of non-graduation to the unemployment risk in case of graduation provides an estimate of the return to tertiary level studies in terms of reduction of the unemployment risk. Figure A4a in annex shows that higher education reduces significantly the unemployment risk. Women have a higher probability of being unemployed (Figure A4a), and this is true both in cases with and without a higher education degree (Figure A4b). Young people attending a tertiary level institution appear to face a lower unemployment risk (Figure A4a), whether they graduate or not (Figure A4c), than those who are not enrolled. This confirms the presence of a streaming into higher education of the persons with characteristics promising them to the best employment prospects.

The extent of labour force participation may also affects educational decisions, since not participating in the labour market, whatever the reason, means abstaining from reaping the benefits of education in terms of wages. Thus, differences in educational decisions across individuals, e.g. between men and women, might be due to the fact that differences in labour force attachment are anticipated at the time educational decisions are made, which modifies the perception of the return to education. Therefore, some measures of part-time work and non-employment propensities were added. The probability of working part-time was estimated by a probit model - using as explanatory variables gender, nationality, family background, region and year - on the sample of employed people in the secondary sample and the prediction applied to the primary sample. Identically, the probability of being out of work was estimated on the sample of those persons being either employed, unemployed or not-employed and a personal propensity to be out of work estimated for the primary sample. The relative propensities of weak labour force attachment depending on education were computed by estimating the propensities

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<sup>13</sup> For instance family background.

<sup>14</sup> This sample definition ensures that the estimated probability is close to the usual definition of the unemployment rate.

separately for poorly and highly educated and building the ratio of the former to the latter.

The variables depicting the local structure of employment were built from the prediction of a probit model for the probability of being self-employed and of being employed in the public sector<sup>15</sup> depending on gender, nationality, family background, region and year. Indeed, the employment structure may modify the perception of the utility of a tertiary level degree on the labour market<sup>16</sup>.

- Educational policy

A further set of variables attempts to capture to some extent the effects of public policy related variables, particularly those related to educational policy, as far as these are likely to affect the cost to return ratio. First of all, the regression includes a variable for public expenditure for higher education by student. The decision to relate educational expenditure to the number of students is imposed by the necessity of avoiding endogeneity problems, since total expenditure depends directly on the number of students. This variable, obtained from the official regional statistics, gives information on public financial involvement in the provision of education in the region, which might influence the perception of the quality of education provided and the expectations regarding the future return to education accordingly. Also the regional average number of students by teacher ratio in the previous year is meant to capture to some extent the quality of educational provision, i.e. it is assumed to be an indicator of the internal efficiency of educational provision, since the larger the number of students per teacher is, the lower the quality of education is expected to be.

Furthermore, the impact on student enrolments since the mid-eighties of measures of public financial support to students is worth being examined, because raising enrolment rates is the primary aim of such measures. Public financial support of education in Germany essentially takes place within the framework of the BAföG (Bundesausbildungsförderungsgesetz), introduced in 1971. Three variables were included in the model. First, the expected chance of being entitled to a BAföG grant/loan was approximated on the basis of the GSOEP data by estimating the probability for students to receive BAföG as a function of family background (in particular net household income in the previous year, parental education and occupational position), nationality, year and region. Secondly, the expected BAföG amount among the beneficiaries was estimated with the GSOEP data as a function of the same variables. Finally, the share of

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<sup>15</sup> Also the impact of sectoral distribution of employment (defined as employment in agriculture, industry and services) was explored, but since these variables proved systematically insignificant, they were eventually dropped from the regressions.

<sup>16</sup> A look at the correlation matrix of these labour market variables (available upon request) do not point to serious collinearity problems except between the probability of non-employment and the probability of part-time employment. However, even in case of collinearity, the coefficient estimates are consistent. Only the standard errors are overestimated and the t-values underestimated. Since for these two variables, the t-values proved to be already above the critical 1% level of significance (see Table 1), they were both included in the regression. Omitting one of them would result in inconsistent estimates of the coefficient of the remaining variable (see Greene 1993, chapter 9.2.).



BAföG which takes the form of a repayable loan<sup>17</sup> is also included. Indeed, at the time BaföG was introduced, it was a mere subsidy, i.e. not repayable. However, from 1974 onwards an increasingly important part of the grant had to be reimbursed and in 1983, all of the BaföG had to be reimbursed. However, the system was reformed again and since 1990, half of the BaföG amount is a grant, half of it is a repayable loan.

Also the regional environment may matter. For instance, demographic factors might put pressure on public finance, e.g. if the proportion of children in age of being enrolled in education is high compared to the total population. The effect of the wealth of the region, defined by the gross domestic product per head, might also highlight the extent to which the region is subject to financial constraints.

- Further control variables

Finally, some further control variables were included in the in order to reduce unobserved individual heterogeneity and control for sample composition effects. Age and age squared are expected to account for the observed concave profile of participation in tertiary education. Dummy variables for gender and nationality were also added, as well as a linear time trend and its square.

## 5. Estimation results

Specification tests show that the social background variables explain the major part of the variation in enrolments in tertiary education (see the results of tests reported in annex in Table A2). Indeed, the inclusion of the family background variables causes the Pseudo R<sup>2</sup> to rise strongly compared to a regression including the control variables only, and the likelihood ratio test performed between those two models shows that the family background variables proves extremely significant.

However, the addition of further variables for labour market return expectations and/or educational policy does improve the fit. The Pseudo R<sup>2</sup> value increases, though only slightly, with the inclusion of the labour market variables in addition to the family background and control variables, and the likelihood ratio test shows that these variables are jointly significant. Similarly, the further addition of public policy variables improves the fit and these variables proved jointly significant.

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<sup>17</sup> Repayable from the 5<sup>th</sup> year on after graduation and not submitted to interest payments unless the regular duration of studies is exceeded.

**Table 1: Binary probit estimates with robust standard errors**

Dependent variable: 1 = enrolled in higher education, 0 = not enrolled in higher education

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<b>Explanatory variables</b>	<b>Coefficient</b>	<b>t-statistic*</b>
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<b>Social background</b>		
Schooling mother	0.205	9.79
Schooling father	0.131	5.47
Father white collar	0.909	7.82
Father civil servant	0.720	4.65
Father self-employed	1.366	5.08
Net other household income last year/1000	0.144	6.20
<b>Labour market expectations</b>		
Expected hourly wage (net present value)	0.018	0.64
Expected hourly wage return (net present value)	2.155	2.77
Expected unemployment probability	3.448	2.61
Expected relative unemployment probability	0.224	3.79
Expected part-time employment probability	-2.509	-4.71
Expected relative part-time employment probability	-0.040	-0.40
Expected non-employment probability	-3.516	-3.17
Expected relative non-employment probability	0.002	0.28
Expected self-employment probability	-5.868	-3.03
Expected public employment probability	3.279	4.10
<b>Educational policy</b>		
Expenditure for higher education by student	0.001	0.03
Students-teacher ratio last year	0.025	2.29
Expected chance of receiving BAföG	3.994	8.53
Expected monthly BAföG amount	0.002	4.12
BAföG loan share	-0.010	-4.55
GDP per head/1000	-0.016	-3.55
Ratio of pupils/students to total population	0.345	0.27
<b>Control variables</b>		
Age	2.907	8.72
Age squared	-0.060	-8.25
Male	-1.325	-2.86
Foreign	0.894	4.19
Trend	0.046	1.19
Trend squared	0.001	0.14
Constant ( $-\mu_1$ )	-43.82	11.15
Log likelihood	-3448.6	
Pseudo R <sup>2</sup>	0.238	
Sample size	12,091	

\* If  $|t| > 1.96$  (resp. 2.58, 1.65), then the hypothesis that the coefficient is equal to zero is rejected at a significance level of 5 percent (resp. 1 percent, 10 percent).

Table 1 reports the estimation results. The coefficients reported should be interpreted in a qualitative way, since they do not express the effect of the variables on the enrolment probability itself, but rather on the latent utility index. The quantitative effect of selected explanatory variables on the enrolment probability itself will be computed and reported in section 6.

- Effect of social background

All family background variables have a significant coefficient at a one percent significance level. As expected, the educational attainment (measured in years of schooling) of the parents – both the mother and the father<sup>18</sup> - seems to be significantly correlated with the enrolment probability of their children. Thus, children of more highly educated parents are more likely to attain tertiary level education. This might be due to the fact that their parents value more education and are consequently more likely to encourage them to pursue further studies. Thus, the perception of the return might be higher. Another reason could be that highly educated parents are in a better position to help their children in their schooling duties or are more likely to have children with a higher learning ability. A higher ability is expected to drive down the expected cost to return ratio, since it reduces the cost of acquiring education and might also help to better take advantage of the qualification acquired.

The occupational position of the father is also clearly related to the enrolment probability of the young persons. The coefficients reported should be interpreted in relation to the reference category, which consists of blue collar fathers (or fathers for whom no information on occupational status is available, not known or missing). Hence, having a white collar worker or a civil servant as a father instead of a blue collar worker increases significantly the chances of being enrolled in higher education. The same holds for sons and daughters of self-employed. This may be the consequence of long-term financial constraints, under the hypothesis of imperfect capital markets, incite children to start working at the first possible opportunity instead of continuing further studies. If such an effect is observable, public financial support policies may prove useful in raising the enrolment rates among poorer families.

Furthermore, net household income in the previous year has a positive effect on enrolment probability, even though parental education and occupation have been controlled for. In other words, children of poorer families have lower chances of reaching a high level of educational achievement. This points to the presence of short-term liquidity constraints binding participation in higher education and legitimates a priori policies of financial support to potential students of poorer family background<sup>19</sup>. A test regression only including the family background variables in addition to the control variables<sup>20</sup> shows that adding variables for labour market return expectations and/or public policy seems somewhat to lower the impact of parental education on educational decisions, which means that omitting to do so results in overestimating the

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<sup>18</sup> The father's schooling level seems somewhat less determining than that of the mother, but this might be due to the fact that part of the schooling effect is of an indirect nature and goes via the occupational attainment, for which no information is available for mothers while it is separately captured for men.

<sup>19</sup> However, this argument has to be interpreted with caution since the presence of financial constraints does not necessarily imply per se that a policy of financial support to poorer families will prove efficient in inducing a stronger enrolment probability.

<sup>20</sup> Available upon request.

impact of parental education. This result confirms the one found by Goux and Maurin (1999) for France.

- Effect of labour market expectations

Labour market expectations appear to have a significant impact on enrolment decisions. Concerning wages and unemployment expectations, youths seem to respond more to the outcome of the next older generation, since the expectations of wages and unemployment up to the age of 40 proved to affect more strongly and more significantly educational decisions than expectations of the whole working career. For these reasons, the variables depicting wage and unemployment related expectations up to age 40 were included. As far as labour force attachment (part-time work and non-employment propensity) and the extent of public and self-employment are concerned, the results do not differ significantly, whether expectations for the first stage or for the whole working career are considered. Therefore, the variables for the whole life-cycle were included.

The absolute wage an individual can expect to earn might affect the probability of attending a tertiary level institution in different ways. First, the prospects of earning a higher hourly wage might increase the incentive to pursue further studies in order to benefit in the future from this high wage. On the other hand, a higher wage, especially among young people, implies higher opportunity costs for studying, which should decrease the incentive to pursue further studies. Therefore, the cost effect and the return effect go in opposite directions and the net effect of this variable on the expected cost to return ratio is unclear. The estimation results show that the absolute level of wage expected does not influence the probability of attending a tertiary level institution in a significant way. However, the expected wage return to education, i.e. the wage premium associated with the completion of higher education, which was expected to decrease the expected ratio of cost to return via the return side proves to have a significant and strong positive impact on higher education attendance. Thus, the results provide empirical support for the human capital theory.

As far as unemployment is concerned, the reverse pattern is observable: whereas the absolute level of unemployment risk has a very strong impact on the probability to be engaged in higher education, the unemployment return of education, i.e. the reduction of the unemployment risk due to a higher education degree, has a much lower impact on attendance decisions. However, even though the effect is rather limited, the impact on enrolments of the unemployment return to tertiary education is highly significant. Beyond the obvious utility of further education with a view to diminishing one's unemployment risk in the future, one further reason for the strong effect of the unemployment risk variable might be that in times of high unemployment, especially high youth unemployment, remaining in the education system might be seen as a sensible alternative in the short run (high unemployment risk means lower opportunity costs for studying). Thus, the cost effect and the return effect go in the same direction and both contribute to lowering the enrolment threshold, i.e. the expected marginal cost-marginal return ratio, and thus to favouring enrolment decision.

As expected, since it affects the extent to which individuals are likely to take advantage of their education, the extent of labour force participation matters. Individuals with a higher risk of being employed only on a part-time basis, i.e. who face lower return expectations, are significantly less likely to be enrolled in higher education. Similarly, the prospects of being non-employed appear to have a strong negative influence on higher education enrolments. One further assumption we wanted to test empirically was the following: The more education contributes to reducing the probability of working part-time or to be out of work (i.e. affects positively the expected return), the greater the participation in higher education should be. If so, a significantly positive coefficient would have been expected for the variables depicting expected relative part-time and non-employment propensities. However, this assumption was not confirmed by the regression results, since the coefficients of these variables were not significantly different from zero.

The local structure of employment also affects enrolments. High prospects of becoming self-employed reduce educational participation in a very strong and significant way. A possible explanation for this may be that educational credentials could act as a signal of productivity in the eyes of employers and lose relevance if one is due to become self-employed. In other words, the return to education is lower for self-employed. Finally, the higher the probability is of being employed in the public sector, e.g. because public sector is widespread in the place of residence, the higher the participation is in higher education. This may be due to the fact that wages are indexed on qualification in the public sector, and thus having a higher education level necessarily results in higher wages, and the wage return to be expected from education is highly reliable.

- Effect of educational policy

The estimates found for the public policy variables give an idea of the possible effectiveness of public policy in influencing enrolments in tertiary education, whilst controlling for the influence of other variables such as family background and return expectations. Rather surprisingly, the extent of public investment in tertiary education, measured as educational expenditure by student, proved insignificant. One explanation could be that this is a too broad measure of the intensity of educational efforts, since the total costs of education per student arise from many sources (e.g. subjects offered, real estate prices etc.). Against the expectations, the impact of the students-teachers ratio in the previous year proved significantly positive. This is not consistent with the interpretation of a high students-teacher ratio as an indicator of poor quality of education. An alternative interpretation could be that a high students-teacher ratio signals a high popularity of universities in the region concerned, which in turn, might be seen by potential students as an indicator for the good quality of education offered there.

Public financial support to students aims at reducing the cost of education in order to increase enrolments. The results show that the prospect of being entitled to BAföG seems to have a very strong positive influence on the probability of pursuing education. Also the amount granted by BAföG plays a role in higher education attendance decisions, though to a lesser extent. Thus, the higher the amount of BAföG is that individuals can expect to get, the higher the probability is that they are enrolled in education.

Conversely, the BAföG loan share has a negative impact on enrolments: the larger the part of the BAföG to be reimbursed, the lower the probability to be enrolled in higher education. This negative coefficient is explainable by the fact that if BAföG has to be reimbursed after the end of the studies, this is expected to diminish the return to education in the future.

The regional GDP per head variable has a negative coefficient, implying that, all else being equal, living in a poorer region is associated with higher chances of participating in higher education. There is no evidence of effects of demographic pressure in the sense that the coefficient of the ratio of the population in age of being enrolled to total population proved insignificant.

- Effect of control variables

The coefficients of the age and age squared variables, highly significant, account for the concave pattern of life-cycle wage profiles. Being a male, all else being equal, is associated with lower chances of being enrolled in tertiary education. Interestingly, further tests showed that adding labour market return expectations variables causes the sign of the gender variable to reverse: while it was positive in the absence of labour market expectations variables, it turns negative as soon as these are controlled for. This means that though women have, generally speaking, a lower probability of being enrolled in tertiary education, they tend to invest more than men in their education given their labour market prospects.

The same holds for foreigners: while a simple regression with the control variables only produces a negative coefficient for foreigners, suggesting that these have lower overall educational prospects, adding the variables for family background causes the coefficient to turn insignificant and the addition of variables for labour market prospects and public policy causes it to turn positive and significant. The trend terms proved insignificant.

## 6. Simulation of changes in expected returns and educational policy

The coefficient estimates indicate the direction of the effects and their significance, but provide little information on the quantitative impact on the enrolment outcome of changes in the variables. However, the estimation results can be used to simulate the effect of changes in selected variables and assess their quantitative impact on the enrolment threshold and on the enrolment probability of a person with given observed characteristics. Indeed, changes in some variables will affect the expected ratio of marginal cost to marginal return of attending university. If the changes turn out to increase the expected ratio of costs to return, this will reduce the probability of enrolment in higher education accordingly. If the changes lower the ratio of costs to returns, this will raise the probability of participation in higher education.

More formally, following equation (8), the enrolment threshold for attending education level  $E_1$  rather than  $E_0$  is given by the ratio of expected marginal cost to marginal return of attending university given characteristics  $x$ , which can be recovered from the  $\hat{m}$  and  $\hat{b}$  coefficients drawn from the probit estimation:

$$\text{Enrolment threshold } (E_1 / x) = \frac{c(E_1) - c(E_0)}{r(E_1) - r(E_0)} \cdot \frac{1}{j(x)} = \frac{\exp[\hat{m}_1]}{\exp[\hat{b}x]} = \exp[\hat{m}_1 - \hat{b}x]$$

and the attendance probabilities are given by equation (11).

In Table 2, the effects of a 10 percent change in the labour market return expectations and in educational policy on the expected ratio of marginal cost to marginal return of enrolment and thus on the enrolment probability itself are simulated for an individual with average characteristics.

As can be seen, for an individual with average characteristics, the expected ratio of marginal cost to marginal return of enrolment in higher education amounts in the reference model to some 4.14 and the enrolment probability predicted by the model to about 7.8 percent.

- Effect of changes in labour market return expectations

If the expected hourly wage return, i.e. the ratio of expected life-cycle wage for holders of a tertiary level degree to expected wages in the absence of such a degree, increases by 10 percent, this lowers the expected ratio of marginal cost to marginal return of enrolment in higher education by 0.7 points for an average individual and the enrolment probability accordingly increases by more than 3 percentage points. Also a 10 percent increase in personal unemployment risk drives the higher education enrolment threshold down and causes the enrolment probability of an average person to raise accordingly.

Conversely, a raise of 10 percent in the propensity of an average person to work part-time induces a raise in the expected marginal cost-marginal return ratio and thus a lower



probability to be enrolled in tertiary education. However, the effect on the enrolment probability of the propensity of being completely out of work is stronger, which is consistent with intuition.

**Table 2: Effect of a 10 percent increase in selected explanatory variables on the participation in higher education**

	<b>Enrolment threshold</b>	<b>Enrolment probability</b>
<b>Reference situation</b>	4.14	7.78
<b>Changes in labour market returns</b>		
Expected hourly wage return	3.42	10.96
Expected unemployment probability	4.11	7.89
Expected part-time employment probability	4.33	7.16
Expected non-employment probability	4.42	6.85
<b>Changes in educational policy</b>		
Net other household income last year	3.97	8.38
Expected chance of receiving BAföG	3.60	9.99
Expected monthly BAföG amount	3.78	9.17
BAföG loan share	4.25	7.40

- Effect of changes in educational policy

Let us imagine, for instance, that parents or any other household member were given an educational allowance to compensate for the foregone earnings of the potential student, which amounts to 10 percent of net other household income of the previous year. If everything else remained unchanged, this would lower the higher education enrolment threshold, but to a limited extent. As a result, the enrolment probability would only increase slightly.

If the coverage of BAföG grants/loans was extended so that the expected chance of an average individual of being entitled to BAföG increased by 10 percent, this would significantly lower the expected marginal cost-marginal return ratio and induce an increase in the enrolment probability by about 2.2 percentage points. An increase of 10 percent in the BAföG monthly amount the average beneficiary may expect to receive also lowers the enrolment threshold and increase the enrolment probability, but to a somewhat lower extent than the extension of BAföG coverage. Therefore, at the same financial costs, extending BAföG coverage proves more efficient in increasing enrolments than increasing the average the BAföG amount granted. Finally, raising by 10 percent the proportion of BAföG which has to be reimbursed induces a small increase in the expected ratio of marginal cost to marginal return, but the quantitative effect is rather small.

## 7. Conclusion

If the empirical evidence available so far has been rather unanimous in stating a positive correlation between social origin and educational achievement, very few studies analyse the role of economic incentives, in particular the influence of expectations regarding the labour market return of education and of educational policy on educational decisions, especially for Germany. This paper tried to provide a more comprehensive analysis of the determinants of participation in higher education in West Germany, by also modelling the impact of economic considerations.

The estimations are based on a model of utility maximisation, where the decision to attend one of several educational tracks of different levels is determined by the expected ratio of marginal cost to marginal return for different enrolment alternatives, given some personal characteristics. The model is estimated empirically on the basis of data from the German Socio-Economic Panel as well as of regional data. The analysis concentrates on the impact on the enrolment probability of social origin, of expectations regarding the labour market outcome of higher education and of public educational policy. The results were quantified in a simulation exercise of the impact of changes in selected variables on the enrolment threshold and on the enrolment probability itself.

The results show that the probability of enrolment in higher education is strongly influenced by social origin. Parental education and occupational position, in particular, are essential. Thus, sons and daughters of blue collars have the lowest prospects of pursuing higher education. Moreover, there seems to be evidence of financial constraints binding participation in higher education, which a priori legitimate policies of financial support for education.

Even though family background seems to be the main determinant of participation in higher education, the enrolment probability also depends on labour market return expectations. Thus, this seems to accord with the human capital theory. The results are based on measures for expectations of the education-specific labour market outcome constructed by running out-of-sample predictions of life-cycle wages, unemployment risk and labour market participation, given some personal characteristics. The absolute level of the unemployment risk given observed characteristics appears to be a strong incentive to participate in higher education, more than the reduction of the unemployment risk due to a higher educational degree. As far as wages are concerned, the expected return to education in terms of life-cycle wages affects significantly educational decisions, whereas the level of expected wages proves insignificant. A 10 percent change in the expected wage return to higher education was simulated and appears to reduce significantly the expected ratio of cost to return of an average person, i.e. his enrolment threshold, and raise significantly the enrolment probability. A higher risk of being employed part-time and even more of being out of work proved to reduce the utility of higher education and thus reduce the probability of being enrolled in higher education.

The results concerning the impact of public policy variables give an idea of the possible effectiveness of public policy in influencing enrolments in tertiary education. Whereas

the overall level of public expenditure for each student engaged in tertiary education did not prove to have a significant impact, there seems to be evidence that policy measures more specifically directed to potential students do have an impact. In particular, the simulation using the estimation results shows that, at the same financial costs, extending the coverage of public financial support in the form of the BAföG is expected to be more efficient in increasing enrolments than increasing the amount of BAföG granted. The extent of the repayable part of the financial aid, conversely, has a dampening, though limited, influence on enrolments.

On the whole, the analysis suggests that even though social origin is a strong determinant of educational decisions, individuals do consider economic motives, in particular the labour market outcome they may expect of education, and that they respond to some extent to financial incentives such as policies of financial support for education in the form of BAföG. These results provide empirical support for the human capital theory.

## References

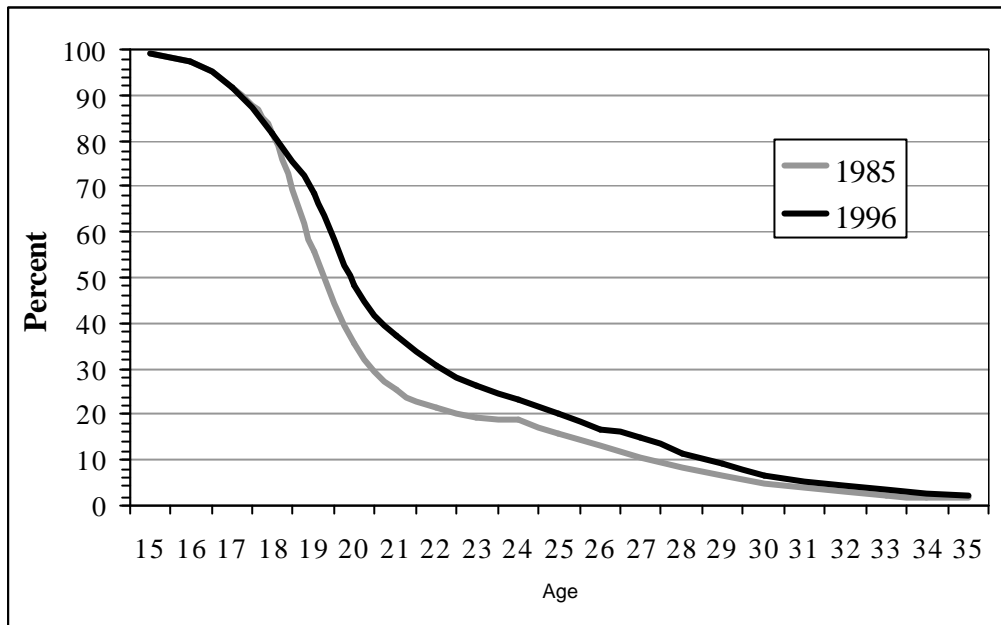
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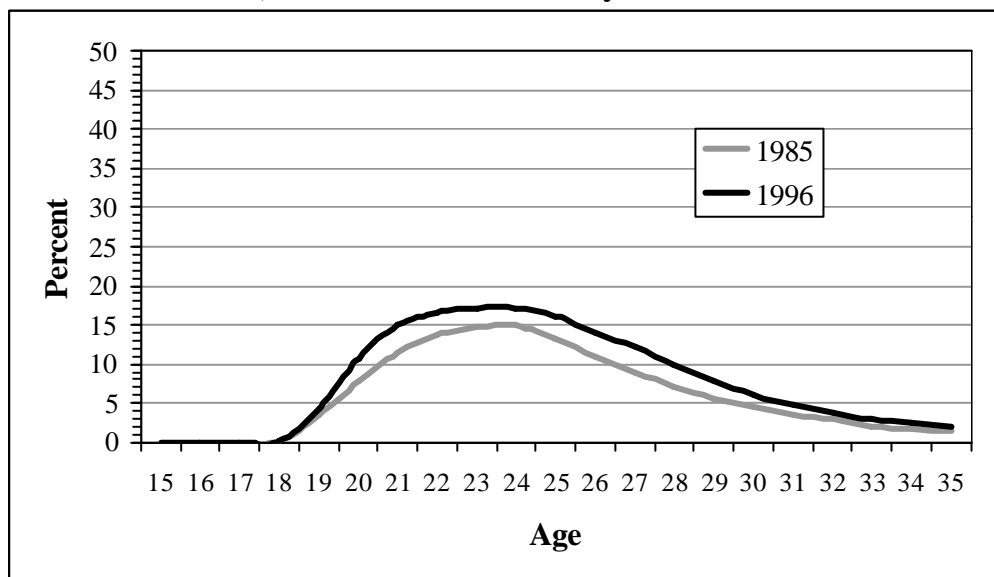
## Annex

**Figure A1: Participation in education by age (% of individuals of same age)**

### a) total enrolments in education



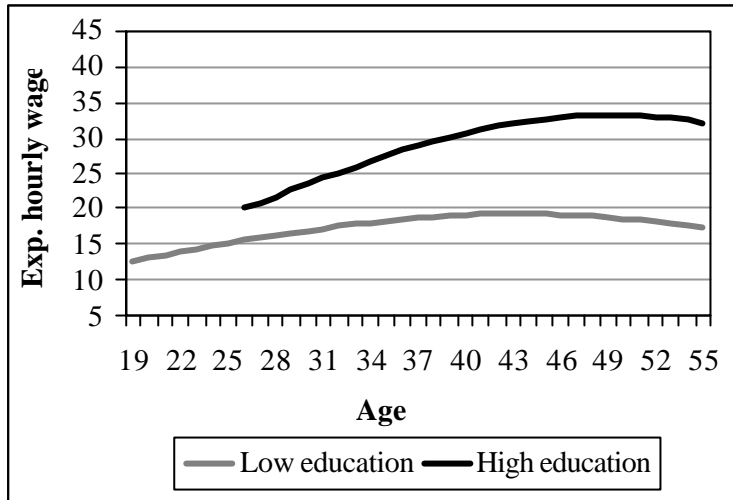
### b) enrolments in tertiary education



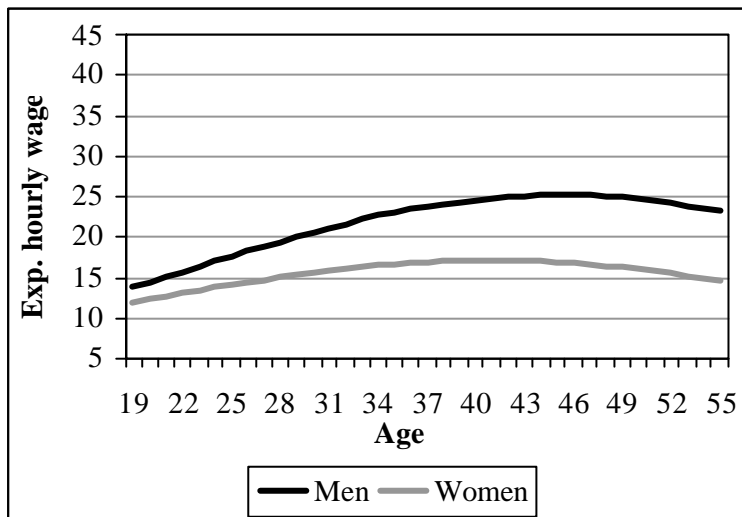
Source: Bildungsgesamtrechnung des IAB, BeitrAB 226 (2000)

**Figure A2: Expected wage profiles (estimation sample)**

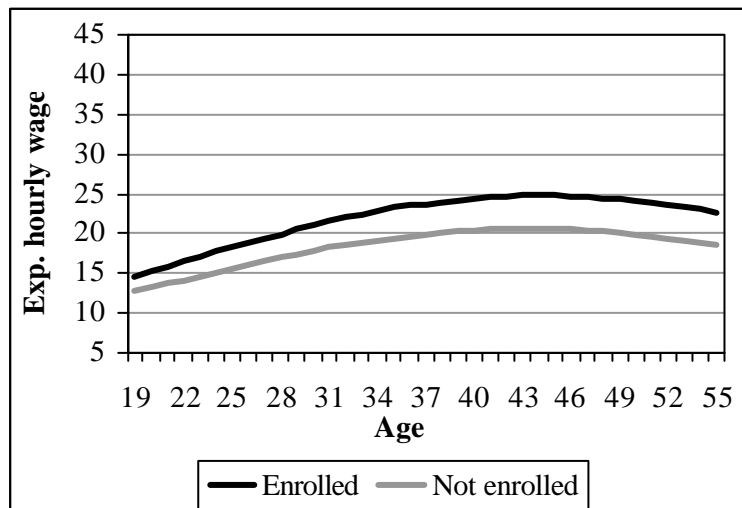
**a) by education**



**b) by gender**



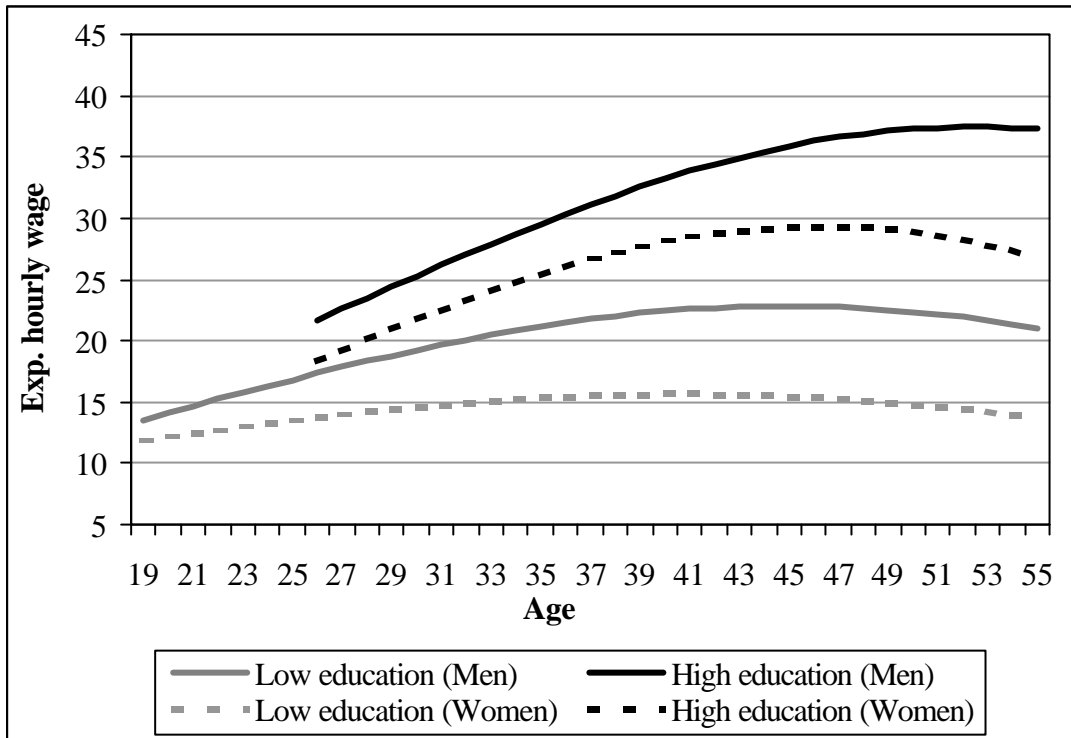
**c) by enrolment decision**



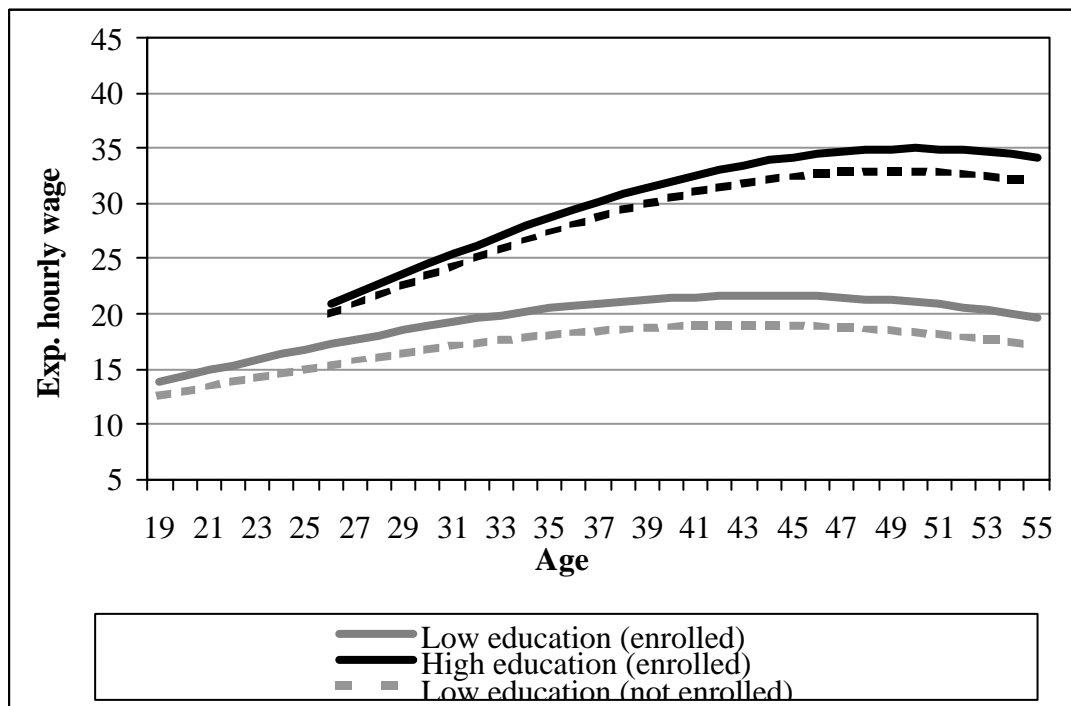
Source: GSOEP, own calculations.

**Figure A3: Expected wage profiles by education (estimation sample)**

**a) by education and gender**



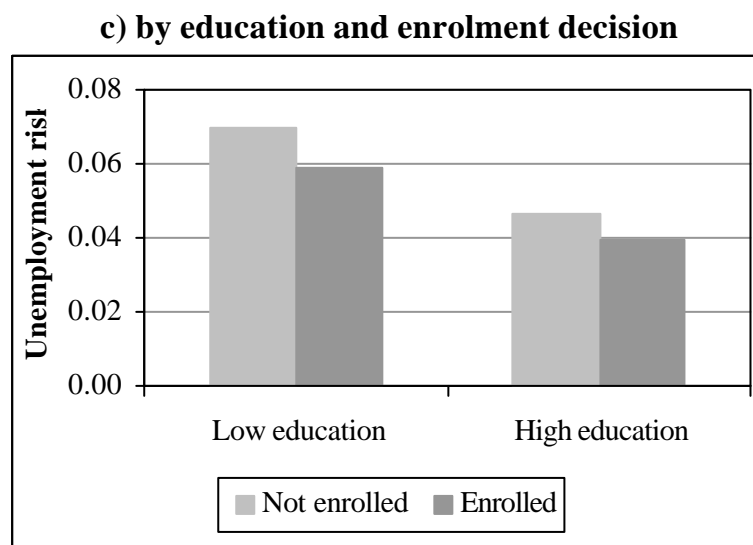
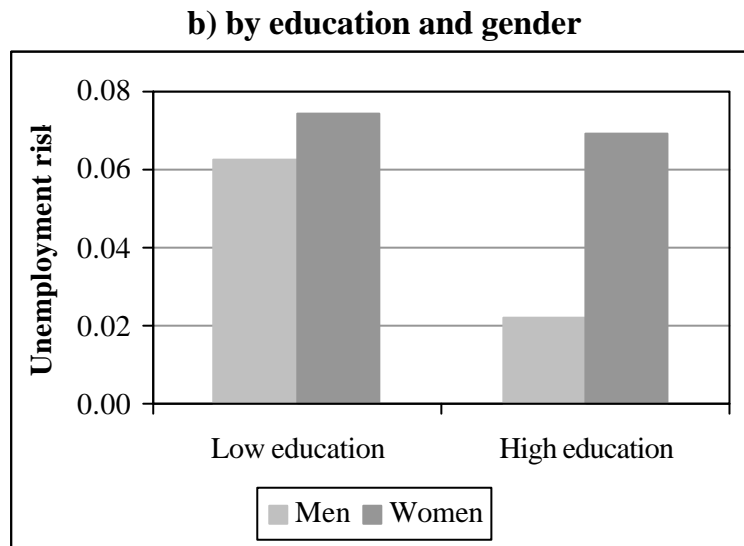
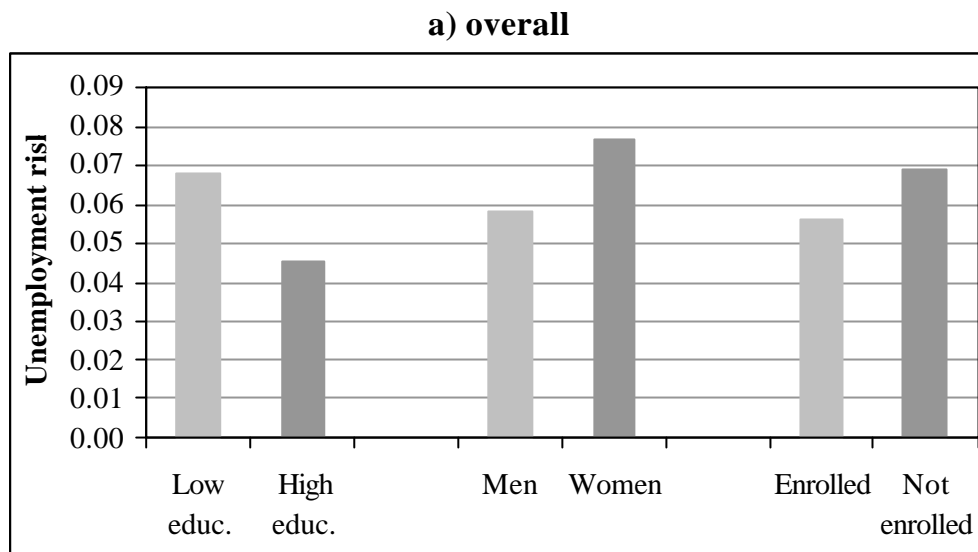
**b) by education and enrolment decision**



Source: GSOEP, own calculations.



**Figure A4: Expected unemployment risk (estimation sample)**



Source: GSOEP, own calculations.

**Table A1: Summary statistics**

<b>Variable</b>	<b>Mean (s.d.*)</b>	<b>Minimum</b>	<b>Maximum</b>
Enrolled in higher education	0.133	0	1
Age	22.7 (1.7)	20	25
Age squared	516.2 (77.4)	400	625
Male	0.51	0	1
Foreign	0.11	0	1
Trend	7.3 (3.6)	2	14
Trend squared	66.5 (56.1)	4	196
Schooling mother	10.2 (1.7)	7	18
Schooling father	11.1 (2.3)	7	18
Father white collar	0.22	0	1
Father civil servant	0.10	0	1
Father self-employed	0.14	0	1
Net other hh. income last year/1000	2.8 (2.3)	0	57.9
Expected hourly wage (net present value)	20.9 (4.8)	11.3	39.9
Expected hourly wage return (idem)	1.16 (0.11)	0.80	1.48
Expected unemployment probability	0.067 (0.03)	0.011	0.245
Exp. relative unemployment probability	2.3 (1.8)	0.9	14.4
Exp. part-time employment probability	0.192 (1.8)	0.001	0.558
Exp. relative part-time empl. probability	0.84 (0.50)	0.01	2.67
Expected non-employment probability	0.183 (0.15)	0.017	0.449
Exp. relative non-empl. probability	3.75 (4.97)	0.63	69.58
Expected self-employment probability	0.086 (0.05)	0.020	0.417
Exp. public employment probability	0.266 (0.09)	0.054	0.606
Expenditure higher education by student	17.57 (4.34)	11.71	39.75
Students-teacher ratio last year	14.39 (3.06)	5.97	22.00
Expected chance of receiving BAföG	0.34 (0.16)	0.00	0.78
Expected monthly BAföG amount	498.2 (79.3)	220.7	798.9
BAföG loan share	74.5 (23.7)	49.4	99
GDP per head/1000	34.3 (5.62)	24.0	62.2
Ratio of pupils/students to total population	0.17 (0.02)	0.06	0.21

\* standard deviation.

**Tabel A2: Likelihood ratio tests: restricted against full model<sup>a)</sup>**

		Variables included in full model <sup>b)</sup>			
		Control Fam. background Labour market Public policy	Control Fam. background Labour market	Control Fam. background	Control
Variables included in restricted model	Control Fam. background Labour market	188.38 (0.00)			
	Control Fam. background	227.93 (0.00)	39.55 (0.00)		
	Control	1554.12 (0.00)	1365.74 (0.00)	1326.19 (0.00)	
Pseudo R <sup>2</sup>		0.2376	0.2168	0.2124	0.0659

a) All the regressions are run on the same sample. The null hypothesis is that the variables omitted in the restricted model are jointly insignificant. In the table, the  $\chi^2$  values are reported and in parentheses the significance level at which the null hypothesis is rejected.

b) Control variables: age, age squared, gender, nationality, trend, trend squared.

Family background variables: schooling mother, schooling father, father white collar, father

civil servant, father self-employed, net other household income last year.

Labour market expectations variables: expected gross hourly wage, expected wage return,

expected unemployment risk, expected unemployment return, expected part-time employment propensity, expected relative part-time employment propensity, expected

non-employment propensity, expected relative non-employment propensity, expected

self-employment propensity, expected public employment propensity.

Public policy variables: expenditure for higher education by student, students-teacher ratio

last year, expected chance of receiving BAföG, expected monthly BAföG amount, BAföG loan share, GDP per head, ratio pupils/students to total population.