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New Evidence from Germany

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Financial Student Aid and Enrollment into Higher Education: New Evidence from Germany

Viktor Steiner *
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Abstract:
We estimate the elasticity of enrollment into higher education with respect to the amount of means tested student aid (BAfoeG) provided by the federal government using the German Socioeconomic Panel (SOEP). Potential student aid is derived on the basis of a detailed tax-benefit microsimulation model. Since potential student aid is a highly non-linear and discontinuous function of parental income, the effect of BAfoeG on students' enrollment decisions can be identified separately from parental income and other family background variables. We find a small but significant positive elasticity similar in size to those reported in previous studies for the United States and other countries.

JEL Classification: H52, H24, I28

Keywords: Higher Education, Financial Incentives, Competing Risk Model

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1 Introduction

Public financial aid for students is provided in most OECD countries with the aim of increasing equity in access to as well as the overall enrollment into tertiary education (for an overview see OECD, 2007). Whether financial student aid achieves this aim is an important question both in public economics and in the public policy debate. Identification of the causal effect of financial student aid is difficult because potential endogeneity and selectivity of enrollment decisions regarding observed and unobserved individual characteristics also affecting the availability of financial student aid. Whilst there are numerous empirical studies on this question for the US, there is only scant empirical evidence for other OECD countries, and for European countries in particular. This study contributes to the growing literature on the causal effects of financial student aid on enrollment rates into tertiary education and provides empirical evidence on this topic for Germany.

Several recent studies for the US have attempted to estimate the effects of financial student aid on enrollment into higher education by making use of exogenous changes in the price of college faced by specific groups of students. These studies show that financial incentives such as tuition, grants and loans affect educational choices of high-school alumni. For the US, it was estimated that a 1,000$ change in direct cost of college changes the college entry rates by 3 to 4 percentage points (see Dynarski 2003 or Kane 2003 for an overview of this literature). This effect has been found in studies that analyzed an increase in the costs of college (e.g. Kane 1994) as well as a decrease of the costs by an extension of financial aid for students (e.g. Dynarski 2000 or Abraham and Clark 2006). For a selective sample of high-school alumni who applied for a specific grant program, a more recent study (Kane 2003) reports lower elasticities. Seftor and Turner (2002) have found sizeable effects of the introduction of a means tested federal grant program on the enrollment rates of already somewhat older alumni. Finally, a recent case study by Linsenmeier et al. (2006) found that changes in the financial aid package introduced by a single college increased enrollment rates of low-income minority students significantly but had no significant overall effect.

For European countries, we are aware of only a few empirical studies analyzing the impact of student aid on enrollment into tertiary education. In a comparative study for several European countries, Winter-Ebmer and Wirz (2002) analyze the overall effect of public funding on enrollment into higher education. They find that public expenditures for the education system as a whole affect enrollment into university by an elasticity of 1, although no significant effect of an additional increase of expenditures for higher education alone was found. Exploiting variations in the generosity of the Swedish financial aid for student system

over time, Frederiksson (1997) finds a positive effect of the amount of monthly student aid on the enrollment rate to university in Sweden on the basis of a time-series analysis. Nielsen et al. (2008) analyze the effects of a Danish student aid reform on enrollment rates into tertiary education and find weaker effects than those obtained in some of the mentioned studies for the US.

For Germany, Lauer (2002) finds on the basis of a microeconometric choice model estimated on data from the German Socio Economic Panel (SOEP) that extending the entitlement to BAfoeG seems to be more effective in raising enrollment rates into higher education than increasing the BAfoeG amount received by the individual student entitled to this subsidy. Treating the BAfoeG reform of 1990 as a "natural experiment", by which student aid was changed from a full loan system to a partial loan-grant system, Baumgartner and Steiner (2005) find on the basis of a simple "differenence-in-difference" approach using SOEP data that this change had no significant influence on enrollment rates into higher education. Applying the same empirical methododogy, Baumgartner and Steiner (2006) also could not find a significant effect on enrollment rates of the 2001 BAfoeG reform, which increased the amount received by eligible students by an average of 10%. One reason for the insignificance of the BAfoeG effects in these latter studies might be that the "difference-in-difference" estimator only uses eligibility status for the identification of the BAfoeG effect and may therefore be rather inefficient, especially in relatively small samples.

In our study, we follow a different identification strategy that uses BAfoeG information more efficiently and, at the same time, also takes into account the endogeneity of students' enrollment decisions into higher education and the amount of financial aid. The observed amount of student aid is obviously highly endogeneous because it is zero for those potential students not enrolling into higher education. Furthermore, there might be other unobserved factors affecting both an individual's enrollment decision and the amount of BAfoeG received. We circumvent these endogeneity problems by simulating for each alumni the potential (counterfactual) BAfoeG amount he or she could receive in case she enrolled in tertiary education using a detailed tax-benefit microsimulation model. As described in the next section, the potential individual BAfoeG amount is a highly nonlinear function of parental income due to the means test, important differences in the definition of income relevant for the calculation of BAfoeG, the non-indexation of the BAfoeG amounts to inflation, and the dependence of BAfoeG on family background variables other than income. We can thus identify the effect of BAfoeG on enrollment decisions separately from the effect of parents' income without relying on specific functional form assumptions. To estimate these

effects we specify a simple model of educational choice with a student's potential BAfoeG amount and parental income as explanatory variables (Section 3). To account for both the timing of transitions into higher education and right-censored observations, we estimate a discrete-time hazard rate model with the two competing risks „vocational training" and „enrollment into university" using an unbalanced panel of alumni observed in the period 1999-2005.

Our estimation results summarized in Section 4 show that the BAfoeG amount has a positive significant effect on enrollment rates into higher education, which is comparable to those found in previous studies for the U.S.: An increase of BAfoeG by 1,000 Euro *per year* would increase the enrollment rate of high-school alumni by 2 percentage points, from currently 76 % to 78 %. This estimate is of similar size as those obtained for other countries in the studies mentioned above. We also find that the estimated enrollment effect with respect to the BAfoeG amount is substantially larger than the one regarding parental income. These results seem robust to a number of sensitivity checks. We conclude that marginal increases in financial student aid, as introduced by two recent reforms, have only small effects on average enrollment rates into higher education in Germany.

2 Institutional Background

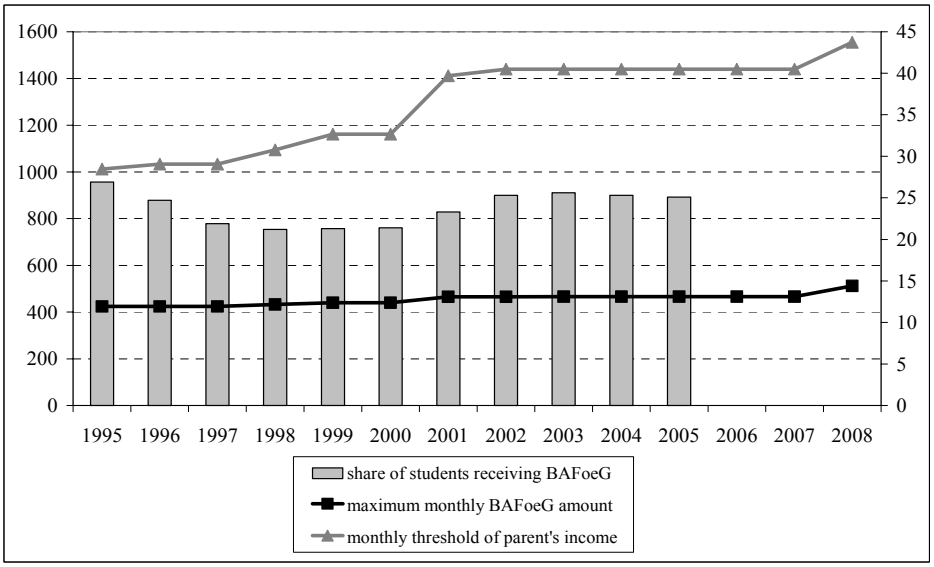
Financial aid for students in Germany in its current form was introduced by the Federal students' financial assistance scheme (*Berufsausbildungsfoerderungsgesetz*, BAfoeG) in 1971. In 2005, about 1.5 billion Euro were spent on BAfoeG for students. The general purpose of the introduction of this scheme was to enhance equal opportunities in education. Thus, the transfer scheme is means-tested and depends on parental income, income of an eventual married spouse, as well as income and asset of the applicant. Moreover, it depends on the presence, age and income of siblings and other household members. When it was introduced in 1971, BAfoeG was granted as a non-refundable subsidy. In the first year after its introduction, almost 45% of all students were granted the transfer. At the beginning of the 1980s, BAfoeG was changed into an interest-free loan that had to be repaid after completion of university education. Since 1991, 50% of "BAfoeG" is paid as a grant and 50% as a loan that has to be repaid after completion of tertiary education The loan part of BAfoeG has to be repaid beginning 5 years after the last BAfoeG amount has been received. Individuals with a monthly net income below 960 Euro (this threshold is increased if children are present in the household) are exempt from repayment obligations. For alumni with outstanding grades, there are reductions of repayment obligations.

As an approximation, the aid scheme can be described as follows. The monthly BAfoeG amount B is granted in full amount to students whose parents' income Y does not exceed a certain threshold C. The part of parents' income exceeding C is withdrawn at a rate of 50%. Formally, the scheme can thus be described as:

$$(1) \qquad B = B - \frac{\max(0, Y - C)}{2}$$

The components of parents' income Y includes gross income from all sources less taxes and social security contributions. Old age pensions and unemployment benefits, that are not fully part of taxable income in Germany, are also part of Y. Other social transfers such as social assistance, however, are not counted as parental income in this definition. In the case of a married student, Y also includes income of the married spouse. The threshold C depends on the number of household members. If a student has siblings who are also receiving BAfoeG, the total expression of the fraction is equally divided among all siblings eligible for BAfoeG. The parameters of this function are changed every few years. Before 2001, the monthly maximum BAfoeG claim B amounted to 550 Euro. After 2001, this was increased to 585. The income threshold C for parents living in the same household without other children amounted to 1,161 Euro before 2001 and was then increased to 1,440 Euro per month.

Figure 1: Development of monthly BAfoeG amount, income thresholds (left scale) and share of recipients (in %, right scale)



Note: Share of students receiving BAfoeG is only available up to the year 2005.

Source: Deutscher Bundestag (2007).

Figure 1 shows the development of the maximum monthly BAfoeG amount as well as the thresholds for parental income. Moreover, the graph shows the share of students actually

taking-up BAfoeG. Obviously, the share of about 45 % recipients among all students right after introduction of the scheme in the early 1970s has dramatically declined and remains between 20 and 25 percent. After the share declined in the late 1990s to almost 20 percent, the BAfoeG reform of 2001 increased the share up to 25% again. Very recently, a new „BAfoeG reform“ has been decided by German parliament. Under this reform, both the income thresholds as well as the amount of BAfoeG claims is increased by 10 percent. As can be seen from Figure 1, this is the first reform since the last increase in these parameters in the year 2001.

3 Empirical Methodology

3.1 Data and Identification Strategy

Most previous studies on the effect of financial aid for students on the enrollment decision rely on data that only include information on financial student aid for those high school alumni who actually enrolled into tertiary education. Thus, the *observed* amount of student aid is a highly endogenous variable, for various reasons. The most obvious reason is that the observed amount of student aid for those not enrolling into higher education is zero, of course. Furthermore, there is the usual suspicion of unobserved factors affecting both an individual's enrollment decision and the amount of BAfoeG received (see, among others, Dynarski 2003 or Van der Klaauw 2002). In the present context, this may be related to a potential students (unobserved) employment behavior in case student aid is means tested regarding student's own income. The usual approach is to circumvent these endogeneity problems is to make use of some sort of exogenous variation in the financial aid amount introduced by a reform (see, e.g., Dynarski, 2003, Baumgartner and Steiner, 2005, 2006). Since this identification strategy relies on the information whether or not someone was affected by the reform treatment effects can usually not be estimated very precisely in small or medium-sized samples. Furthermore, estimated treatment effects are only interpretable relative to the specific policy change used for the identification and cannot be used to calculate the marginal effects of changing financial student aid or to predict the likely effects of different student aid reforms.

Since we have to rely on a relatively small sample size and want to estimate the effect of enrollment into tertiary education with respect to changes in the amount of BAfoeG, we circumvent the problem of endogeneity of the observed BAfoeG amount, by calculating for each individual the *potential* BAfoeG amount using a tax-benefit microsimulation model

based on the German Socio-Economic Panel Study (SOEP).[1] For this analysis, we have integrated the simulation of the detailed BAfoeG regulations into this tax-benefit model. As has been explained in the previous section, BAfoeG is a highly non-linear function of parent's income (or perhaps the income of the student's married spouse), age, number and income of siblings or other household members. Moreover, the amount of BAfoeG depends on the student's income. However, since this is endogenous, we calculate for each observation the potential amount of BAfoeG on the case that the individual does not have own earnings. Still, we have to assume that the potential BAfoeG amount is not correlated with unobserved factors affecting their childrens' enrollment decision.

Following this argument, we have to include all other factors that might influence the educational decision of high-school alumni and are correlated with the potential BAfoeG amount, in particular parental background variables such as the parents' education and their income. As has been explained above, financial aid and parents' income are correlated, since BAfoeG is mainly a function of parents' income and household size. The question then remains, how the effects of these two variables, BAfoeG and net parents' income can be identified. We argue that identification of the two effects comes from several sources. First of all, BAfoeG is a non-linear function of a gross measure of the parents' income with an important discontinuity induced by the means tests. Furthermore, parents' net income is also a highly non-linear function of gross income, due to the progressivity of the German personal income tax and various means tested income transfers. Figure A1 in the Appendix illustrates this variation. Second, there was a reform of the BAfoeG scheme in 2001 (which lies in our observation period 1999-2005), when all parameters of the BAfoeG function explained in section 2 above where increased. This reform induced an exogenous increase in the potential BAfoeG amount for the years after 2001. Finally, we deflate both income and the BAfoeG amount to prices of 2000. Since the BAfoeG amounts and the basic allowances are not indexed to inflation and their nominal amounts where changed only once (under the 2001 reform) in the observation period, there is additional variation in the amount of BAfoeG and parents' net income induced by bracket creeping, as shown by Figure A2 in the Appendix.

As already mentioned above, we use data from the German Socio-Economic Panel Study (SOEP). Our sample consists of all persons that state to have a completed the entrance-level degree for university education (i.e, *Abitur*) in the years 1999 to 2005. This gives us a

[1] The microsimulation model STSM we us is described in Steiner et al. (2008). The SOEP is a very rich longitudinal data set that contains information on all sorts of income, activities and many other socio-economic variables for about 20,000 individuals living in roughly 12,000 households each year; see Wagner et al. (2007) for more information on the SOEP.

total number of 634 individuals. We drop all observations for whom we cannot track the parents and thus lack the information of parental income and other background variables, and cannot calculate the potential claim for student's aid. This leaves us a sample of 599 individuals.

The panel structure of the SOEP allows us to track parental income of all high-school alumni, even if they do not live in the same household as their parents, which is required to simulate the exact amount of potential BAfoeG claim for all high-school alumni. Panel information is also needed to identify transitions into higher education. In the SOEP, each individual is asked whether he or she has passed an educational degree since the previous interview. The academic year in Germany usually starts in September (for schools) or October (for universities) and ends by June/July (differs by federal state). Thus, educational degrees such as high-school degree („Abitur") or other university admission degrees are usually obtained in May or June. Enrollment into university can only start at the beginning of each term, i.e. usually in October (sometimes also for the spring term, which begins in April or March). In the SOEP, more than 75 percent of all individuals are interviewed within the first quarter of each year. At the time of their interview, all persons are asked whether they have gained an educational degree (i.e. „Abitur") since the past interview. This timing implies that at time period *t*, when we learn about a university admission degree (in time period *t-1*), we might already observe a transition to university or a vocational training. On the other hand, many students do not enroll to university in the first year after high-school but several years after. Thus, we track observations for a maximum of 5 years after completion of their high-school degree. Observations for individuals who obtained their entrance level (high-school degree) later than in 2000 and have not enrolled into higher education before the observation period ends are treated as right-censored in the estimation.

Table 1: Sample size and observed transitions

Transition observed after period ...	Vocational training	University	Right censored cases	Total
1	77	163	73	313
2	51	146	23	220
3	5	28	6	39
4	0	19	2	21
5	1	5	0	6
Total	134	361	104	599

Source: SOEP, waves 2000-2006.

Of all 599 high-school alumni in our sample, 361 (60%) choose to enroll in university in the maximum of 5 years after they have completed high-school and 134 (22%) choose vocational training. The remaining 104 observations (17%) are right-censored, i.e. we do not observe a transition into vocational training or university education during the observation period. In total, we observe 929 spells.

Table 2 lists descriptive statistics of the main explanatory variables. As already explained above, one main advantage of the SOEP data is that we can track the parents of most of the high-school alumni even if they do not live in the same household as their parents any more due to the panel structure of the data. Thus, we have information on the parents' income as well as educational background. The panel structure of the data also allows us to track all siblings of the high-school alumni in our sample. We include the number of siblings in the form of two dummy variables, one indicating that a person has one sibling and one dummy indicating that a person has two ore more siblings.

Table 2: Descriptive statistics

	Mean	Std. Dev.
Family background variables		
Father holds university degree	0.28	–
Mother holds university degree	0.20	–
Dummy indicating 1 sibling	0.49	–
Dummy indicating more than 1 sibling	0.11	–
Dummy indicating sex = male	0.53	–
BAfoeG related Variables		
Share of observations eligible for BAfoeG	0.56	–
BAfoeG amount per month among those eligible (in €)*	286	131
Monthly BAfoeG amount (in €)*	149	165
Income related Variables		
Parents' equivalence income: net monthly income of parents' household, divided by square root of household members (in €)*	1,887	1,038
Number of observations	929	

* Parents' income and amount of BAfoeG is measured in real values (prices of 2000).

Source: SOEP, waves 2000-2006.

Obviously, the most important variable in our estimation is the potential amount of BAfoeG claim. This is simulated for all high-school alumni using the tax-benefit simulation model

STSM.[2] The STSM has been augmented by a modul that simulates BAfoeG claims for this purpose. 56% of all high-school alumni in our sample were eligible to BAfoeG if they would decide to enroll into university. The average positive claim amounts to 286 Euro per month, the unconditional mean amounts to 149 Euro per month. As a measure of parental income we include the net monthly income of the household of the parents, which we divide by the square root of household members in order to account for economies of scale through sharing the household. We argue that this reflects the resources of the family better than net household income. If parents are not living together, we add the sum of the equivalence incomes of the household in which the mother lives and the household of the father.

3.2 Model Specification

To estimate the elasticity of the enrollment rate into higher education to the amount of BAfoeG we specify a simple model of educational choice with the potential BAfoeG amount a student expects to receive if he or she were to enroll into higher education as an explanatory variable. To account for both the timing of transitions into higher education and right-censored observations, we specify a discrete-time hazard rate model. Since a considerable share of all high-school alumni opts for a vocational training after high-school, we allow for two competing risks, namely „vocational training“ (A) and „enrollment into university“ (B). We assume that enrollment into university or vocational training are independent absorbing states and can occur only once a year. The destination specific hazard rate, $h_{ij}(t_i \mid x_{it})$, i.e. a potential student's conditional probability of making a transition into state j (j = A, B) in period t, given no transition has occurred until the beginning of that period, is specified by a multinomial logit:

$$(2) \qquad h_{ij}(t_i \mid x_{it}) = \frac{\exp\left(\beta'_j x_{it}\right)}{1 + \sum_{j=1}^{2} \exp\left(\beta'_j x_{it}\right)}$$

The vector x_{it} contains the potential BAfoeG amount and a number of other explanatory variables, such as parents' net income, parents' educational status and number of siblings which may vary over time. Moreover, we include time and state-specific dummy variables that control for differences in educational policies by time and states and other economic factors (business cycle etc.) that could affect the individual enrollment decision.

[2] For more details on the tax-benefit model STSM, see Steiner et al. (2008).

The "survivor rate", $S(t)$, which gives the (unconditional) probability of not having enrolled into higher education up to period t, can be written (ignoring person and time indices) as

$$(3) \quad S(t \mid x) = \prod_{k=1}^{t-1} \left[1 - h\left(t \mid x\right)\right], \text{ with } h\left(t\right) = \sum_{j=1}^{2} h_j\left(t \mid x\right),$$

by virtue of the assumption that competing risks are independent. In terms of the hazard rate and the survivor function, the probability of a transition into state j in period t is given by

$$(4) \quad P_j\left(t \mid x\right) = h_j\left(t \mid x\right) \prod_{\tau=1}^{t-1} \left[1 - h\left(t \mid x\right)\right].$$

Assuming that, conditional on x, all observations are independent, the sample likelihood function is given by

$$(5) \quad L = \prod_{i=1}^{n} \left[h_{ij}\left(t_{ij} \mid x_{it}\right)\right]^{\delta_{ij}} \prod_{\tau=1}^{t_i-1} \left[1 - h\left(t_i \mid x_{it}\right)\right]$$

$$\text{with } \delta_{ij} = \begin{cases} 1, & \text{if individual } i \text{ makes a transition into state } j \\ 0, & \text{otherwise.} \end{cases}$$

Hence, for a person with an observed transition in the observation period the contribution to the likelihood function is given by the respective transition probability in equation (4), for a censored spell it is given by the survivor function in equation (3), both written in terms of the hazard rate. Note that the survivor function not only provides information on individuals right-censored at the end of the observation period, but also for those who left the panel due to sample attrition.

4 Estimation Results

The model described in the previous section is estimated on the basis of pooled SOEP data from waves 2000-2006.[3] We model the duration time in a flexible way with two baseline hazard rates, *d2* and *d3*. *d2* takes on the value 1 in time period 2 (and 0 else) and *d3* takes on the value 1 in time period 3, 4 and 5. Time period 1 serves as reference category. These time dummies are interacted with the dummy indicating „male", since men might make a transition to either vocational training or university later than women because many male youth undergo their civilian or military service immediately after school. In addition to the baseline hazards we also include year dummies in order to control for potential general trends. Table A1 in the

[3] Unfortunately, we cannot use older waves since the microsimulation model STSM is not available for prior waves.

Appendix shows estimated coefficients. marginal effects and standard errors for both the transition rate into vocational training and into university education.

Since we are primarily interested in this latter transition here, in Table 3 we focus on the marginal effects of the most important explanatory variables on the enrollment rate into university, where the marginal effects are evaluated at sample means. Since the mean elapsed spell duration is 1.6 years in the sample, the marginal effects can be interpreted as change in the transition rate into university between period 1 and 2.

The time dummy indicating period 2 is strongly significant and positive, indicating that considerably more high-school alumni enroll in university one year after their high-school degree rather than right after school. This especially holds for men, although this interaction is only significant at the 10 percent level. The dummy for period 3 or more (d3) is not significant, neither is the interaction with the male dummy. Evaluated at the sample mean, men have a lower probability to enroll into university than women.

Table 3: Marginal effects on the transition rate to university

	Marginal Effects	Std. Error
d2	0.2784	0.0634
d3	0.1045	0.0998
d2×male	0.1503	0.0900
d3×male	0.2201	0.1716
male	-0.2568	0.0475
Monthly BAfoeG amount (in 100 Euro)*	0.0327	0.0169
Monthly net equivalence income of parents (in 100 Euro)*	0.0060	0.0030
Father holds university degree	-0.0143	0.0413
Mother holds university degree	0.0938	0.0436
One sibling	0.0315	0.0386
More than one sibling	-0.0217	0.0616
Year dummies and regional dummies skipped (see Table A1 in the Appendix)		

* The marginal effects for the monthly BAfoeG amount and parents' income are the combined effects of the linear and the quadratic term of BAfoeG and parents' income, respectively.

Source: Estimation results in Table A1 in the Appendix.

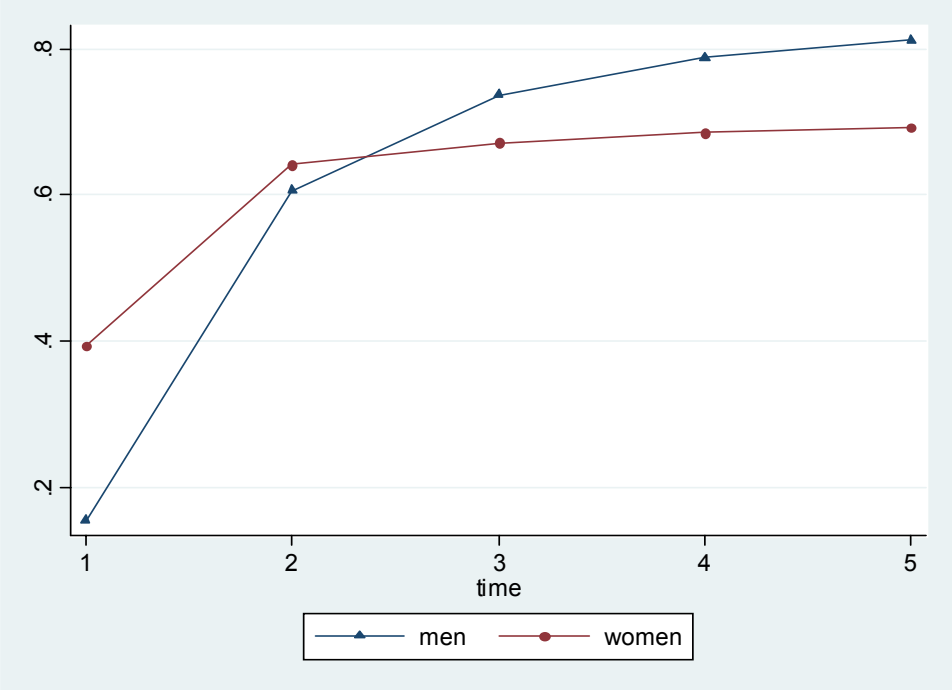
The most important result in Table 3 is that the monthly BAfoeG amount has a positive and significant effect (at the 10 percent level) on the transition rate to university. Note that the marginal effect shown in Table 3 is the joint effect of the linear and quadratic term of the BAfoeG variable. This joint effect indicates that an increase of the monthly BAfoeG amount by 100 Euro increases the transition rate university by 3.3 percentage points. Another interesting result is that parental income has a positive and significant effect on the transition rate into university education, which is considerably smaller than the BAfoeG effect. Our results suggest that a 100 Euro increase of monthly net equivalence income of the parents' household would increase the transition rate to university by 0.6 percentage points. This effect is significant at the 5 percent level.

Interestingly, none of the other socio-economic background variables are statistically significant except for mother's education: If the mother holds a university degree, the transition rate to university increases by 9 percentage points. All other family background variables (education of the father and number of siblings) do not have significant effects. This result, in particular the insignificance of the parental education variables, might seem surprising at first sight. However, we know from previous empirical studies that in Germany, also the choice of secondary education, and in particular upper secondary education is heavily influenced by the parents' educational background (Lauer 2003). Thus, our interpretation of this result is that, once individuals have made it up to the high-school degree, parental education does not play a role for the choice of tertiary education any more, in particular since we also control for parental income.

Our estimation predicts that after 5 periods, on average, 76 percent of all high-school alumni have chosen to start tertiary education. These results are in line with official statistics reporting that 75% of all high-school alumni enroll in university 5 periods after completion of the high-school degree (Statistisches Bundesamt 2007). Figure 2 shows the cumulated probability of transition to university separately for men and women.[4]

[4] The predictions are based on a model that has been estimated under the restriction that the BAfoeG claim does not have a significant effect on the transition to vocational training. This restriction does not change the marginal effects of the variables with respect to the transition into university. Estimation results of the full and the restricted model are presented in Table A1 in the Appendix.

Figure 2: Cumulated probability of transition to university for men and women



Source: Estimation results in Table A1 in the Appendix.

We use this cumulated probability in order to predict how an increase of monthly BAfoeG amount and parents' income affects the cumulated probability of transition to university. In order to get comparable measures how BAfoeG or parental income affect the cumulated probability of transition to university to those that can be found in the literature, we increased both variables by 1,000 Euro per year and simulated the effect of this change on the cumulated probability of transition to university after 5 years. We find that an increase in BAfoeG for all high-school alumni by this amount increases the cumulated probability of transition to university, i.e. the enrollment rate after 5 years by 2 percentage points from 76.2 % to 78.4 %. An increase of annual parental income by 1,000 Euro would increase the enrollment rate by about 0.5 percentage points (see Table 4).

The effects we find for both the BAfoeG is somewhat smaller than estimates reported in the literature for the United States. Dynarski (2003) finds an increase in the enrollment rate of 3.6 percentage points for every additional 1,000 US$ in her study on the effects of the Georgia HOPE scholarship program. Analyzing a grant program in the District of Columbia, Abraham and Clark (2006) find an increase in the enrollment rate of high-school graduation age residents of exactly the same amount, 3.6 percentage points, for every additional 1,000 US $ of aid. Our results are, however, very much in line for those found for other European

countries. Nielsen et al. (2008), for example, find that a 1,000 US$ increase of financial aid for students in Denmark increases enrollment to university by 1-3 percentage points.

Table 4: Cumulated share (in%) of high-school alumni enrolling into university after an increase in BAfoeG or parents' income

Time period	Model prediction	BAfoeG is increased by 1,000 Euro per year	Parents' income is increased by 1,000 Euro per year
1	28.5	33.3	29.1
2	64.2	68.8	64.9
3	71.7	75.2	72.3
4	74.8	77.5	75.4
5	76.2	78.4	76.8

Source: Estimation results in Table A1 in the Appendix.

5 Sensitivity Analysis

To check whether estimated BAfoeG effects on the transition rate to university are sensitive to model specification, we have performed several sensitivity checks. First, as an alternative to the flexible baseline hazard as specified in the model presented above, we have estimated a model with a linear specification of the baseline hazard. The estimation results of this model are reported in Table A2 in the Appendix. The coefficients and marginal effects of the variables do not change much. In particular, the marginal effects of the BAfoeG and parents' income variables are of similar magnitude as in the specification reported above. The only change concerns the pattern of the cumulated probabilities to transit to university. As can be seen from Figure A1 in the Appendix, the spike from period 1 to 2, in particular for males, disappears when the model is estimated with a linear specification of the baseline hazard. However, the cumulated probability of having enrolled into higher education after 5 years is very similar (0.77) to the one predicted based on the model with the flexible baseline hazard.

Second, we have tested also a different functional form of the BAfoeG claim. Instead of the flexible specification as presented above, we estimated a model with a linear specification of the BAfoeG claim. The results of this estimation are presented in Table A3 in the Appendix. They show that in this model, the linear coefficient as well as the corresponding marginal effects of monthly BAfoeG and parental income are of very similar magnitude as in the model described in the previous section. For this linear specification of the BAfoeG claim, we have also interacted this variable with the baseline hazard dummy variables in order

to check whether the influence of the potential BAfoeG claim varies for different periods. However, we found that these interaction terms are not significant.

Another sensitivity test regards the problem of sample attrition. A relatively high share of high-school alumni are leaving the SOEP a few years after graduation.[5] If this happens before we observe the first transition to vocational training or university education, this attrition is relevant for our sample and may affect our estimation results, in particular if attrition is not random. As has been shown in Table 1 above, about one sixth of the observations in our sample do not transit to vocational training or to university within the observation period. This is not a problem for our estimation as long as this is "true right-censoring" in the sense that these individuals are in the sample for the whole observation period without transition. However, we loose some of them before the end of the observation period. For these individuals, we do not know whether they have a transition in the years that would still cover our observation period, but are not observed due to sample attrition. Table A4 in the Appendix shows the observation periods of individuals without transition into university or vocational training. Without sample attrition, individuals who graduated from high-school in 199-2001 should be observed 5 periods, those who graduated in 2002 should be observed 4 periods, etc. However, as Table A4 in the Appendix shows, only 30 of the 104 individuals without transition are observed over the whole observation period, the rest drops out before time. Most of these observations are lost in the first or second period after their high-school graduation. In order to check whether sample attrition is correlated with any of our explanatory variables, we have estimated a model with sample attrition as an additional competing risk.

Estimation results are reported in Table A5 in the Appendix. None of the coefficients of the socio-economic variables has a significant influence on leaving the sample. In particular, leaving the sample is obviously not correlated with parental income of the BAfoeG claim. The only variables that are significant are time and year dummies. Moreover, the coefficients of this model for the transition to vocational training or university are not much different from our basic model. We thus conclude that sample attrition, although a problem that decreases the number of observations of our sample, seems not to bias our estimates of the effect of BAfoeG on the transition to university.

Finally, we check whether our estimation results are sensitive to the relative restrictive assumption on the error term structure underlying the multinomial logit specification. In fact,

[5] Often, but not necessarily, this occurs on leaving the parental household.

a generalized Hausman test rejects the hypothesis that the alternatives vocational training and university education are independent. Thus, we have estimated a mixed logit model (random coefficient logit model), which does not rely on the IIA assumption, where the constant term in each of the two alternative categories university and vocational training is specified as a normally distributed random variable. Estimation results for this model yielded a very small error variance, no significant change of the log-likelihood and almost the same coefficient estimates as for the model without the heterogeneity components (see Table A 6).

6 Conclusion

The aim of this study was to contribute to the growing literature on the causal effects of financial student aid on enrollment rates into tertiary education. We have estimated the average effect of means tested financial student aid provided by the federal government (BAfoeG) on the enrollment rate into higher education in Germany. To circumvent the problem that BAfoeG is only observable for students and may be endogenous with respect to enrolment into university education for other reasons as well, we have calculated for each individual the potential BAfoeG amount using a tax-benefit microsimulation model based on the German Socio-Economic Panel Study (SOEP). The simulated potential individual BAfoeG amount is a highly nonlinear function of parental income due to the means test, important differences in the definition of income relevant for the calculation of BAfoeG, its non-indexation to inflation, and its dependence on family background variables other than income. This allowed us to identify the effect of BAfoeG on enrollment decisions separately from the effect of parents' income without relying on specific functional form assumptions.

Our estimation results show that increasing BAfoeG would have a small but significant positive effect on the average enrollment rate into university comparable in size to estimates for the US. The estimated enrollment effect with respect to parental income is also positive and statistically significant. A further interesting result is that a higher BAfoeG amount would induce potential students to enrol earlier at university. These effects are based on a discrete-time hazard rate model which account for both the timing of transitions into higher education and right-censored observations. Estimation results seem robust to alternative specifications of our microeconometric model, as shown by various model specification checks.

From a policy perspective, our estimate of a relatively small enrollment elasticity with respect to the amount of financial student aid implies that financial incentives alone will not achieve the policy goal of substantially increasing the share of students in university education within age cohorts at feasible fiscal costs. However, it is important to keep in mind

that the enrollment elasticity estimated here and in most other studies is conditional on having obtained a high school diploma, which currently is a prerequisite for entering university education in Germany. Implementing policies aimed at increasing the share of potential students within age cohorts could thus be more effective in achieving the mentioned policy goal than increasing the amount of financial student aid.

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Appendix

Table A1: Coefficients and Marginal Effects of the Multinonmial logit model

	Transition to vocational training		Transition to university	
Variables	Coefficient	Std. Error	Coefficient	Std. Error
d2	1.3025	0.3808	1.4886	0.3350
d3	-1.3624	0.7930	0.2697	0.4137
d2×male	0.9150	0.5398	0.8481	0.4168
d3×male	2.3237	1.0062	1.8479	0.5202
d1999	-0.4135	0.4197	0.0881	0.3040
d2000	-0.5114	0.3497	-0.6187	0.2892
d2001	-0.5679	0.3528	-0.4901	0.2565
d2002	-0.7047	0.3341	-0.4160	0.2431
d2003	-0.4618	0.3383	0.0053	0.2444
male	-2.1859	0.3349	-1.6016	0.2182
Monthly BAfoeG amount	0.0529	0.2577	0.2631	0.1927
Monthly BAfoeG amount squared	0.0205	0.0576	-0.0262	0.0437
Parents' net income	0.0328	0.0211	0.0268	0.0144
Parents' net income squared	-0.0002	0.0002	-0.0001	0.0001
Father holds university degree	-0.8278	0.2643	-0.2100	0.1858
Mother holds university degree	-0.2853	0.2789	0.3411	0.1915
One sibling	-0.4596	0.2323	-0.0197	0.1745
More than one sibling	-0.5034	0.4132	-0.2762	0.2804
City states	0.0354	0.4263	-0.0188	0.3440
North-West	-0.7086	0.3852	-0.6181	0.2913
Mid-West	-0.0083	0.2900	0.2473	0.2233
South	-0.8423	0.3658	0.3382	0.2407
Constant	-0.3861	0.6571	-0.9730	0.4914
	Marg. Effect	Std. Error	Marg. Effect	Std. Error
d2	0.0561	0.0352	0.2784	0.0634
d3	-0.1030	0.0328	0.1045	0.0998
d2×male	0.0547	0.0606	0.1503	0.0900
d3×male	0.1660	0.1875	0.2201	0.1716
d1999	-0.0413	0.0313	0.0435	0.0707
d2000	-0.0244	0.0292	-0.1189	0.0578
d2001	-0.0340	0.0286	-0.0872	0.0540
d2002	-0.0484	0.0252	-0.0647	0.0524
d2003	-0.0430	0.0258	0.0243	0.0549
male	-0.1518	0.0345	-0.2568	0.0475
Monthly BAfoeG amount *	0.0041	0.0121	0.0327	0.0169
Parents' net income *	0.0023	0.0022	0.0060	0.0030
Father holds university degree	-0.0768	0.0244	-0.0143	0.0413
Mother holds university degree	-0.0444	0.0240	0.0938	0.0436
One sibling	-0.0449	0.0222	0.0315	0.0386
More than one sibling	-0.0313	0.0330	-0.0217	0.0616
City states	0.0017	0.0410	-0.0192	0.0764
North-West	-0.0433	0.0287	-0.1190	0.0589
Mid-West	-0.0143	0.0270	0.0532	0.0504
South	-0.0880	0.0240	0.1136	0.0560
Number of observations:	929			
Log-likelihood:	-791.3			

* The marginal effects for the monthly BAfoeG amount and parents' income are the combined effects of the linear and the quadratic term of BAfoeG and parents' income, respectively.

Source: Estimations based on SOEP, waves 2000-2006.

Table A2: Coefficients and Marginal Effects of the Multinonmial logit model, linear baseline hazard

	Transition to vocational training		Transition to university	
Variables	Coefficient	Std. Error	Coefficient	Std. Error
time	0.0053	0.2190	0.4091	0.1634
time×male	0.7517	0.2974	0.6577	0.2148
d1999	-0.6571	0.4091	-0.1192	0.2957
d2000	-0.2441	0.3388	-0.3527	0.2742
d2001	-0.5832	0.3428	-0.4403	0.2486
d2002	-0.6901	0.3257	-0.3399	0.2360
d2003	-0.3826	0.3275	0.0702	0.2373
male	-2.6272	0.5049	-1.9718	0.3597
Monthly BafoeG amount	0.0996	0.2576	0.2737	0.1940
Monthly BAfoeG amount squared	0.0139	0.0565	-0.0261	0.0437
Parents' net income	0.0830	0.0424	0.0604	0.0268
Parents' net income squared	-0.0010	0.0007	-0.0004	0.0004
Father holds university degree	-0.8019	0.2581	-0.1858	0.1796
Mother holds university degree	-0.2641	0.2723	0.3531	0.1836
One sibling	-0.3555	0.2247	0.0903	0.1683
More than one sibling	-0.3922	0.4003	-0.1674	0.2697
City states	0.1120	0.4089	0.0134	0.3347
North-West	-0.6412	0.3752	-0.6116	0.2894
Mid-West	-0.0037	0.2821	0.2212	0.2171
South	-0.7578	0.3587	0.3982	0.2330
Constant	-0.6806	0.7566	-1.5500	0.5483
	Marg. Effect	Std. Error	Marg. Effect	Std. Error.
Time	-0.0197	0.0211	0.0978	0.0352
Time×male	0.0493	0.0288	0.1204	0.0463
d1999	-0.0550	0.0288	-0.0020	0.0675
d2000	-0.0101	0.0325	-0.0713	0.0582
d2001	-0.0391	0.0284	-0.0784	0.0530
d2002	-0.0520	0.0254	-0.0517	0.0516
d2003	-0.0409	0.0267	0.0343	0.0538
male	-0.1833	0.0541	-0.3017	0.0713
Monthly BAfoeG amount *	0.0050	0.0122	0.0332	0.0171
Parents' net income *	0.0027	0.0068	0.0068	0.0030
Father holds university degree	-0.0762	0.0248	-0.0058	0.0403
Mother holds university degree	-0.0441	0.0246	0.0983	0.0422
One sibling	-0.0432	0.0226	0.0392	0.0376
More than one sibling	-0.0316	0.0340	-0.0227	0.0602
City states	0.0119	0.0439	-0.0026	0.0744
North-West	-0.0385	0.0305	-0.1141	0.0589
Mid-West	-0.0114	0.0276	0.0536	0.0491
South	-0.0856	0.0249	0.1300	0.0543
Number of observations:	929			
Log-likelihood:	-826.9			

* The marginal effects for the monthly BAfoeG amount and parents' income are the combined effects of the linear and the quadratic term of BAfoeG and parents' income, respectively.

Source: Estimations based on SOEP, waves 2000-2006.

Table A3: Coefficients and Marginal Effects of the Multinonmial logit model, linear specification of BAfoeG

	Transition to vocational training		Transition to university	
Variables	Coefficient	Std. Error	Coefficient	Std. Error
d2	1.3043	0.3803	1.4710	0.3345
d3	-1.3545	0.7885	0.2049	0.4127
d2×male	0.9009	0.5400	0.8530	0.4170
d3×male	2.2729	1.0021	1.8803	0.5192
d1999	-0.4008	0.4196	0.1180	0.3044
d2000	-0.4930	0.3504	-0.6123	0.2896
d2001	-0.5560	0.3532	-0.4683	0.2571
d2002	-0.6930	0.3337	-0.3827	0.2430
d2003	-0.4478	0.3377	0.0285	0.2445
male	-2.1840	0.3350	-1.6118	0.2187
Monthly BAfoeG amount	0.1596	0.0914	0.1594	0.0685
Parents' net income	0.0767	0.0427	0.0499	0.0271
Parents' net income squared	-0.0009	0.0007	-0.0003	0.0004
Father holds university degree	-0.8414	0.2623	-0.2430	0.1848
Mother holds university degree	-0.3019	0.2786	0.3344	0.1915
One sibling	-0.4066	0.2304	0.0539	0.1742
More than one sibling	-0.4058	0.4076	-0.1430	0.2760
City states	-0.0065	0.4199	-0.1273	0.3474
North-West	-0.7160	0.3827	-0.6648	0.2903
Mid-West	-0.0244	0.2879	0.1934	0.2231
South	-0.8541	0.3650	0.3018	0.2402
Constant	-0.6815	0.6802	-0.9664	0.4875
	Marg. Effect	Std. Error	Marg. Effect	Std. Error
d2	0.0577	0.0353	0.2748	0.0633
d3	-0.1011	0.0333	0.0945	0.0993
d2×male	0.0532	0.0602	0.1533	0.0900
d3×male	0.1538	0.1817	0.2350	0.1679
d1999	-0.0418	0.0312	0.0457	0.0708
d2000	-0.0244	0.0292	-0.1198	0.0577
d2001	-0.0346	0.0285	-0.0865	0.0541
d2002	-0.0492	0.0251	-0.0625	0.0524
d2003	-0.0434	0.0257	0.0261	0.0549
male	-0.1514	0.0345	-0.2579	0.0475
Monthly BAfoeG amount *	0.0092	0.0088	0.0306	0.0169
Parents' net income *	0.0025	0.0022	0.0055	0.0029
Father holds university degree	-0.0751	0.0241	-0.0191	0.0409
Mother holds university degree	-0.0453	0.0239	0.0950	0.0436
One sibling	-0.0454	0.0222	0.0323	0.0386
More than one sibling	-0.0327	0.0326	-0.0171	0.0615
City states	0.0053	0.0413	-0.0299	0.0749
North-West	-0.0418	0.0288	-0.1243	0.0582
Mid-West	-0.0118	0.0268	0.0478	0.0500
South	-0.0865	0.0240	0.1084	0.0557
Number of observations:	929			
Log-likelihood:	-791.8			

* The marginal effects for the monthly BAfoeG amount and parents' income are the combined effects of the linear and the quadratic term of BAfoeG and parents' income, respectively.

Source: Estimations based on SOEP, waves 2000-2006.

Table A4: Observation periods of individuals without transition into university or vocational training

Year of high-school graduation	Number of periods observed 1	2	3	4	5	Total
Year						
1999	2	1	1	0	0	4
2000	6	2	2	1	0	11
2001	7	4	1	1	0	13
2002	6	2	0	0	0	8
2003	10	8	2	0	0	20
2004	20	6	0	0	0	26
2005	22	0	0	0	0	22
Total	73	23	6	22	0	104

Source: SOEP, waves 2000-2006

Table A5: Multinomial logit model, specification with sample attrition as separate state

Variables	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Transition to …	Vocational Training		University		Sample Attrition	
d2	1.5490	0.4184	1.7350	0.3770	1.4689	0.7019
d3	-1.3848	0.7975	0.2341	0.4238	-0.1956	1.1247
d2×male	0.6299	0.5689	0.5624	0.4541	-1.8672	0.9183
d3×male	2.2310	1.0107	1.7683	0.5306	-0.8910	1.5488
d1999	-0.5656	0.4224	-0.0680	0.3087	-2.5290	1.0626
d2000	-0.6158	0.3558	-0.7354	0.2971	-1.0270	0.5992
d2001	-0.6917	0.3575	-0.6148	0.2632	-1.4411	0.5921
d2002	-0.7756	0.3395	-0.4822	0.2508	-0.6403	0.4757
d2003	-0.5837	0.3430	-0.1188	0.2515	-1.2782	0.5919
male	-2.1581	0.3369	-1.5782	0.2217	0.3686	0.4434
Monthly BAfoeG amount	0.1391	0.2672	0.3313	0.2012	0.2577	0.4535
Monthly BAfoeG amount squared	0.0078	0.0589	-0.0370	0.0451	-0.0154	0.1005
Parents' net income	0.0813	0.0432	0.0594	0.0280	0.0871	0.0734
Parents' net income squared	-0.0009	0.0007	-0.0004	0.0004	-0.0010	0.0011
Father holds univ. degree	-0.7912	0.2677	-0.1680	0.1899	0.6279	0.4128
Mother holds univ. degree	-0.2963	0.2819	0.3307	0.1960	0.0400	0.4043
One sibling	-0.3582	0.2329	0.0965	0.1775	0.5963	0.4030
More than one sibling	-0.3652	0.4127	-0.1294	0.2828	0.5452	0.6138
City states	-0.0404	0.4292	-0.1065	0.3560	-0.3234	0.8701
North-West	-0.6467	0.3896	-0.5573	0.2978	0.8209	0.5783
Mid-West	0.0267	0.2943	0.2816	0.2288	0.6276	0.5104
South	-0.8760	0.3693	0.3129	0.2450	-0.2384	0.6508
Constant	-0.6466	0.7144	-1.0995	0.5190	-4.3080	1.2922
Number of observations	929					
Log likelihood	-901.9					

Source: Estimation based on SOEP. waves 2000-2006.

Table A6: Random-effects multinomial logit specification

Variables	Transition to vocational training		Transition to university	
	Coeff.	Std. Error	Coeff.	Std. Error
D2	1.3025	0.3808	1.4886	0.3350
D3	-1.3624	0.7930	0.2697	0.4137
D2×male	0.9150	0.5398	0.8481	0.4168
D3×male	2.3237	1.0062	1.8479	0.5202
d1999	-0.4135	0.4197	0.0881	0.3040
d2000	-0.5114	0.3497	-0.6187	0.2892
d2001	-0.5679	0.3528	-0.4901	0.2565
d2002	-0.7047	0.3341	-0.4160	0.2431
d2003	-0.4618	0.3383	0.0053	0.2444
male	-2.1859	0.3349	-1.6016	0.2182
BAfoeG level 1	0.0529	0.2577	0.2631	0.1927
BAfoeG level 2	0.0205	0.0576	-0.0262	0.0437
BAfoeG level 3	0.0328	0.0211	0.0268	0.0144
Parents' net income	-0.0002	0.0002	-0.0001	0.0001
Parents' net income squared	-0.8278	0.2643	-0.2100	0.1858
Parents live together	-0.2853	0.2789	0.3411	0.1915
Father holds university degree	-0.4596	0.2323	-0.0197	0.1745
Mother holds university degree	-0.5034	0.4132	-0.2762	0.2804
One sibling	0.0354	0.4263	-0.0188	0.3440
More than one sibling	-0.7086	0.3852	-0.6181	0.2913
City states	-0.0083	0.2900	0.2473	0.2233
North-West	-0.8423	0.3658	0.3382	0.2407
Mid-West	-0.3861	0.6571	-0.9730	0.4914
South	1.3025	0.3808	1.4886	0.3350
Constant	-1.3624	0.7930	0.2697	0.4137
Variance of Random Effect	1.615 e-16	6.879 e-09		
Number of obs:	929			
Log likelihood:	-791.3			

Source: Estimation based on SOEP. waves 2000-2006.

Figure A1: Scatter plot of the potential amount of BAfoeG and parents' net income (equivalence income) in Euro per month

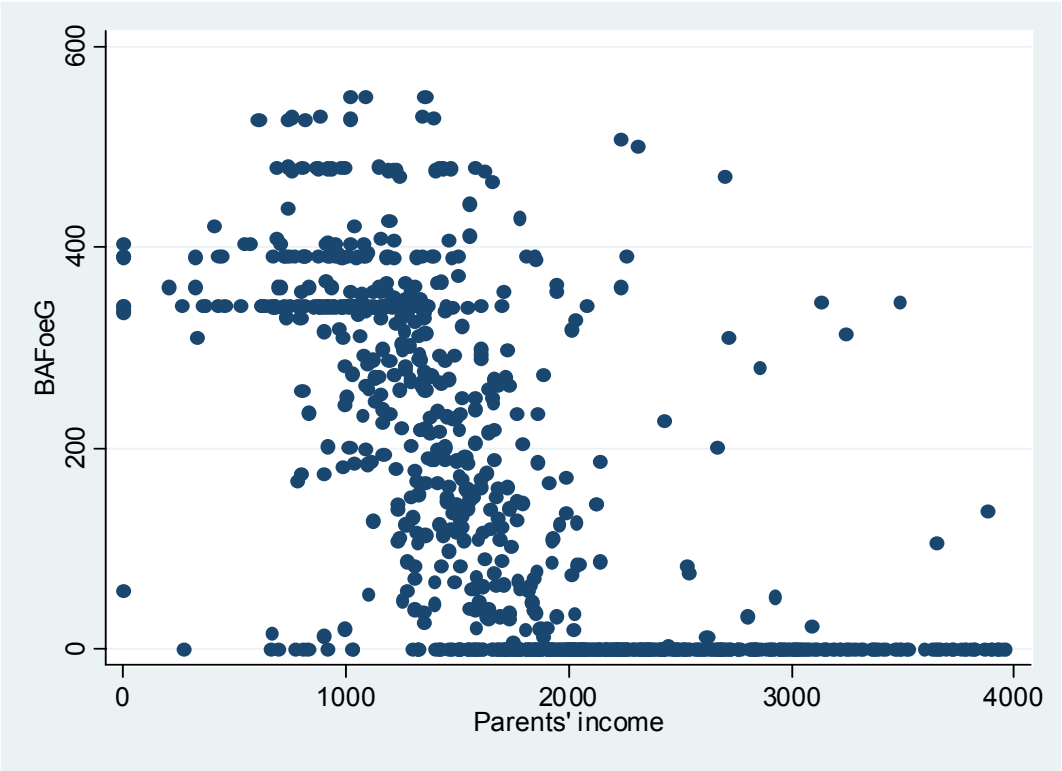
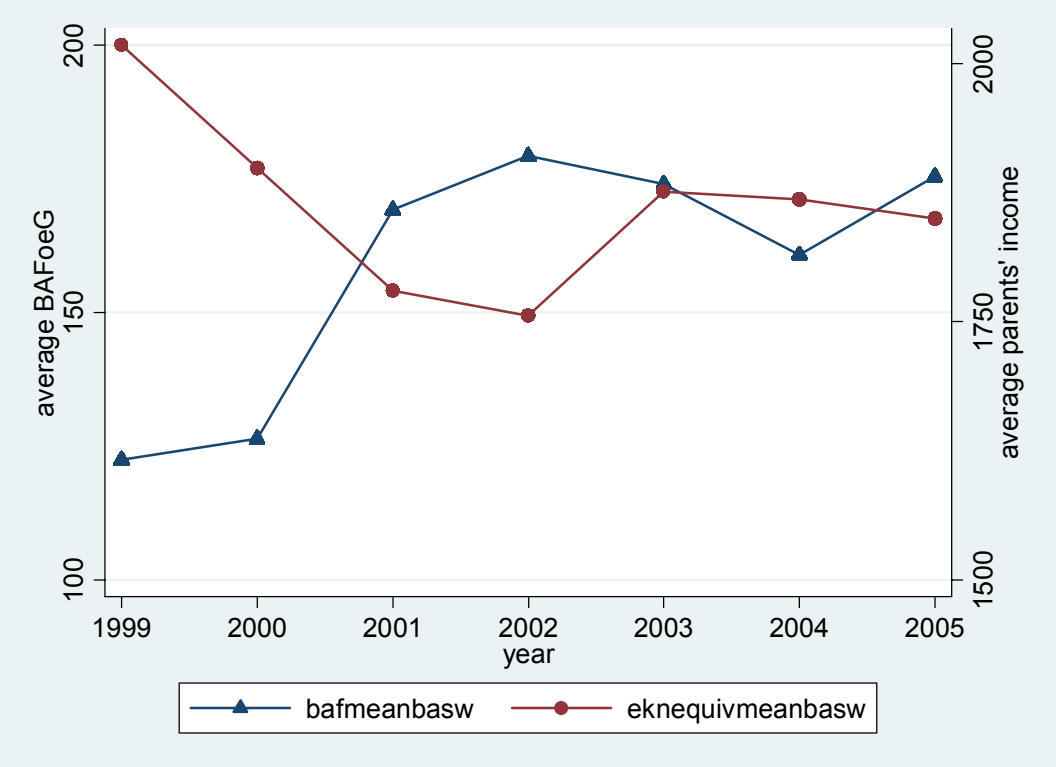


Figure A2: Mean of potential BAfoeG amount and parents' net income (equivalence income) by year, 1999-2005 (all amounts in Euro per month)



Note: Weighted using SOEP cross-sectional weighing factors.

Figure A3: Cumulated probability of transition to university for men and women, based on a model with linear baseline hazard