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Daniela Glocker

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DIW Berlin
German Institute for Economic Research
Mohrenstr. 58
10117 Berlin
Tel. +49 (30) 897 89-0
Fax +49 (30) 897 89-200
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The Effect of Student Aid on the Duration of Study*

Daniela Glocker†

DIW Berlin

Abstract

In this paper I evaluate the effect of student aid on the success of academic studies. I focus on two dimensions, the duration of study and the probability of actually graduating with a degree. While there is an extensive literature on the impact of student aid on its intended outcome, the uptake of tertiary education, the impact on the outcome and on study incentives has been mainly ignored. But introducing student aid changes the students' budget constraint. The increase in the budget-set might lead to shorter time-to-degree if paid work is substituted by study time. I analyze the effect of financial student aid granted by the German Federal Education and Training Assistance Act (BAfoeG). To determine its impact, I estimate a discrete-time duration model allowing for competing risks to account for different exit states (graduation and dropout) using individual level panel data from the German Socio-Economic Panel (SOEP) for the years 1984-2007. My findings suggest that the duration of study is responsive to the type of financial support a student receives. There are three main results. First, student aid recipients finish faster than comparable students who are supported by the same amount of parental/private transfers only. Second, although higher financial aid does on average not affect the duration of study, this effect is (third) dominated by the increased probability of actually finishing university successfully.

Keywords: academic outcomes, student aid, duration of study, BAfoeG, German Socio-Economic Panel

JEL: I20, I22.

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†Deutsches Institut für Wirtschaftsforschung (DIW Berlin), 10117 Berlin, Germany, email: dglocker@diw.de.

1 Introduction

Enrollment in tertiary education is an important and widely discussed topic in the academic literature[1]. But focusing only on the intake of new students disregards the actual success of university studies. A successful course of study can be measured in terms of actual graduation, the final mark of the degree or in some cases, the time until the degree is obtained. In this study I evaluate the effect of student aid on the success of tertiary education in terms of time-to-degree and actual graduation rates. While the change in enrollment has been widely studied[2], the question of the impact of student aid on the success of academic studies remains an open one.

Therefore I will focus in this paper on the effect of student aid on the outcome of university studies. I jointly analyze the impact of student aid, first on the probability to graduate, and second on the duration of study. A student has the choice to spend his time either on working to raise money for his education, on studying more intensively to reduce the time until graduation and therefore improving the return to his education or thirdly on leisure. When deciding how to allocate his time, a student first has to consider how to cover his subsistence level expenditures (i.e. cost of living, tuition fees, insurance, etc.). Wealthy students can cover these costs by drawing money from their own or their parents wealth. Students from poor families do not have this opportunity. In a situation where borrowing constraints and no efficient student aid system exist, these students can only cover their costs by working, which results in less time available for studying. This will prolong their time in tertiary education or may even force these students to drop out of university, see e.g. Ehrenberg and Sherman (1987) or Stinebrickner and Stinebrickner (2009). On the other hand, a too generous student aid program may set wrong incentives. Students may remain in education longer than they would without the funding. This would create unnecessary public costs not only for the compensation of student aid, but also in terms of resources allocated to these students. Garibaldi et al.

[1]see e.g.Cameron and Taber (2004), Shea (2000), Carneiro and Heckman (2002) or Keane and Wolpin (2001)

[2]see e.g. Dynarski (2003) or Kane (2003) for a literature overview for the US and Baumgartner and Steiner (2006), Lauer (2000) or Steiner and Wrohlich (2008) for Germany

(2007) report evidence on the effect of financial constraints on study behavior. They find that Italian university graduates study more efficiently if tuition costs are raised at the end of their course of study. This causes the late completion rates to decrease and leaves final grades unchanged. Using German data from the University Konstanz, Heineck et al. (2006) analyze the effect of tuition on long term studies. They find that for a few subjects, e.g. Biology or Psychology, the time until graduation decreases with the introduction of tuition fees, but at the same time the probability to drop out increases for all majors.

Previous research on the effect of student aid on the time-to-degree, has primarily focused on Ph.D.-students. Using data on all graduate students who entered the Ph.D. program at Cornell University, Ehrenberg and Mavros (1995) find that completion rates and mean durations of the time doctoral students spend until completing their degree are sensitive to the type of financial support the students receive. Students with fellowships and research assistantships have higher completion rates and a shorter time-to-degree than the students with teaching assistantships, tuition waivers, or students who support themselves. These findings are supported by Siegfried and Stock (2001, 2006) who use data on Ph.D. graduates in economics in the US. They also find that students who receive fellowships that require no work graduate faster. In contrast, Booth and Satchell (1995) find no significant effects of student aid on the graduation time using British data. The focus on Ph.D.-students can be explained by the small variation of time-to-degree for undergraduate students in many countries. These small variations are mainly due to the university programs which expect the student to finish in a certain time frame. If a student does not finish within this time frame, he mostly drops out of the program. Ph.D.-students, in contrast, can arrange their time-to-degree more flexibly according to their own preferences.

A study which focuses on undergraduate students is conducted by Häkkinen and Uusitalo (2003) who evaluate a student aid reform in Finland. They find that a more generous supply of student grants results in a shorter duration of study. Since the effect was concentrated in fields with long average time until graduation, the authors suggest that this effect seems to be due to limits in the aid duration.

In the following I will evaluate the effect of student aid on the outcome of study for Germany. Germany is a particularly suitable example because, first, the German Socio-Economic Panel (SOEP) provides a rich database of individual level data since 1984. It is possible to track students from the beginning of their tertiary education through the following years. Second, only recently the more time constrained Bachelor and Master programs have been introduced to German universities. The usual degree before this, i.e. in the "pre-Bologna"[3] period, was a diploma, which was awarded upon reaching a certain amount of credit points. Students were able to decide on their own, how many credit points they wanted to acquire during each term[4]. This has the advantage that the time-to-degree for undergraduate students was very heterogeneous. These circumstances allow me to model the effect of time-to-degree for undergraduate students, rather than on the smaller and more selective sample of Ph.D.-students.

The main source of student aid in Germany are transfers based on the Federal Education and Training Assistance Act (BAfoeG). This act was introduced in 1971 to allow children from low income families to pursue higher education according to their abilities. A need based amount of student aid should ensure the coverage of their living-expenses during their time of study.

To determine the effect of student aid on the outcome of study I use the SOEP from the pre-Bologna period and apply a discrete duration model framework allowing for competing risks and unobserved heterogeneity. Explicitly allowing for competing risks has the advantage that the direct effect of student aid on the duration of study can be disentangled from the indirect sample selection effect through drop-outs.

The results of this study show that an increase in student aid has no significant effect on the time-to-degree. But increasing student aid affects the hazard to drop out. With

[3]The Bologna process changed the degrees obtainable in Germany to the international Bachelor/Master system. Prior the main degrees (Diplom/Magister) were not bound to be achieved in a certain time frame (3-4 years Bachelor, 1-2 years master)

[4]The term "credit points" oversimplifies the situation, but in general only a certain amount of courses was needed to complete a degree and the time frame in which these courses could be taken was fairly lenient.

more financial aid, students tend to drop out less often. This has two main effects. First, students stay longer in tertiary education, and second, more students eventually graduate. However, the results also show that the type of funding matters. Ceteris Paribus, about 86 percent of BAfoeG eligible students who are receiving the maximum amount of funding finish university by the time they reach the 16th semester, compared to only 45 percent of students who are receiving the same amount as private transfers.

The paper is structured as follows. After a short theoretical motivation and a brief overview of the student aid system in Germany in section 2, the empirical analysis is presented in section 3, where the empirical methodology of the competing risk model is presented in subsection 3.1. The description of the data set, data selection and variable definitions are given in subsection 3.2. In section 4 the results are presented. Section 5 concludes.

2 Theoretical and Institutional Background

In a simple model of a student's time allocation one might think of a student having three options to spend time on: he could work to raise money, study to reduce the time until graduation and thereby increase the return to his education[5] and thirdly he could spend time on leisure. The budget constraint in such a model would be given by labor income, transfer payments from the family and financial aid. In the absence of an efficient student aid system, credit constraints may appear due to capital market imperfections. Enrolled students face the problem to cover their living expenses when no chance to borrow money or to be supported by the family exists. Receiving financial aid results in an upward shift of the budget constraint for students who are eligible for these transfers. In a simple static labor supply model the predicted effect (for an interior solution) would be an increase in study time and leisure. If the prediction from this myopic model holds in all time periods (i.e. students optimize each semester and intertemporal supply concerns are neglected),

[5]Studies for Germany find a positive correlation between the success (grades) and time-to-degree, see e.g. Schaeper and Minks (1997). An earlier graduation also leads to a longer period of returns given a fixed retirement age.

a shorter time-to-degree is expected.

If a student needs to exert a certain fixed amount of effort to satisfactorily finish a year, he might not be inclined to study more, even if the budget constraint is relaxed. This case can be considered a corner solution in the aforementioned model. The result of allocating student aid to such a student would not be that the student finishes more quickly, but rather that only leisure is increased and therefore the time-to-degree is not affected. However, BAfoeG could also reduce the time-to-degree. Without the opportunity to smooth consumption the student might be inclined to invest more in studying to quickly gain access to the higher post-graduation wages. If the necessity to work is alleviated by giving financial aid to the student, it reduces the incentive to start working as soon as possible. Therefore the time-to-degree might even be prolonged by the receipt of student aid.

The main source of financial student aid in Germany are transfers based on the Federal Education and Training Assistance Act ("BundesAusbildungsfoerderungsGesetz", BAfoeG for short). Introduced in 1971, the basic principle of BAfoeG is to create equal educational opportunities for students from low income families by providing governmental subsidies. The act was amended several times with respect to repayment and entitlement conditions. But the aim to support students who do not have the means to finance tertiary education themselves remained (Blanke, 2000).

In general any student with a university entrance qualification under the age of 30 at the beginning of his studies may apply for student aid. But the award of BAfoeG is means tested. For each applicant the means test involves three steps to check whether a student qualifies for student aid or not. First, all income sources of the student are taken into account, i.e. his own wealth and labor income. Second, the financial capacity of the student's parents is evaluated, wealth, labor income but also the need for possible expenditures are considered[6]. In both steps, the act defines a minimum, the fundamental allowance ("Freibetrag"), for the amount of wealth and income[7] which are excluded in the

[6]e.g. if the parents have to take care of other children, or other household members

[7]The Gross income is exempted from a lump sum for social security payments and potentially alimony payments

calculations. In the final step, a pre-defined amount of basic financial need[8] ("Bedarfssatz") is compared to the financial capacity which is simply the sum of the amounts from the first two steps. If the amount of basic financial need exceeds the financial capacity a student has, he is considered to be eligible for transfers according to BAfoeG. The amount of the transfers are then simply the difference between the basic financial need and the financial capacity.

Being eligible for BAfoeG enables the student to be supported for the standard period of study which may vary by subject and the type of university (university of applied science or university), but usually lies between 7 and 9 semesters. The eligibility for transfers according to BAfoeG, however, are subject to a yearly re-evaluation of the financial need of the student.

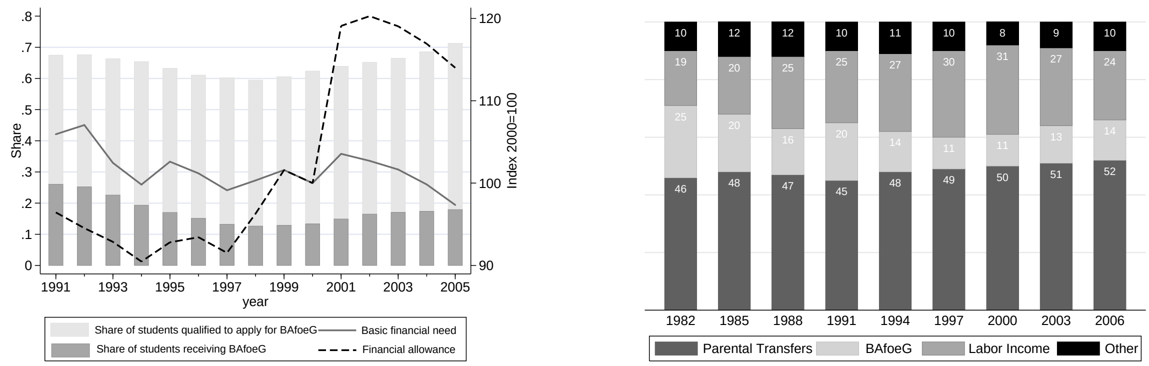
The pre-defined amount for the basic need and the fundamental allowance is revised every second year. Based on the development of real income, productivity and changes in living-expenses, these amounts should be adjusted to ensure that the living expenses of a student remain covered. Up to 1997 a steady decrease in the share of students receiving BAfoeG can be observed (figure 1(a)). This is mainly due to the insufficient adjustment of the amount of basic financial need and fundamental allowance. In the following years, the adjustments of the amount of basic financial need were still small, but the cut-off value of income exemption was increased in 2001 by about 20 percent. This led to an increase of eligible students and therefore of students receiving BAfoeG. Nevertheless, the amount of financial aid decreased in real terms, which left students with the problem how to cover their living expenses.

Figure 1(b) shows the different income sources for students between the years 1982 and 2006. It can be seen, that the share of parental transfers remain fairly stable over time. The share of income from student aid however declined over the years from 25 percent of the students income to only 11 percent in 2000. Contrary to this development, the share of labor income increased drastically from 19 percent to 30 percent during the same

[8]The basic financial need varies with possible expenditures of the student, i.e. if he lives with his parents, has health insurance coverage through his parents and which type of school he attends (university or university of applied science)

period. As a result of the BAfoeG reform in 2001, the share of income due to BAfoeG increased slightly in the following years. At the same time a decrease in the share of labor income is observable.

Figure 1: Development of BAfoeG related Variables



(a) Development of amount of basic financial need, fundamental allowance, share of students qualified to apply for BAfoeG and share of BAfoeG recipients

(b) Sources of monthly income of students between 1982-2006 (in percent)

Source: Bundesministerium für Bildung und Forschung (2007)

These developments are in line with the findings of Keane and Wolpin (2001). Reducing the amount of student aid, or tightening the eligibility criteria leads to students working more in order to keep their standard of living.

3 Empirical Methodology

3.1 Model Specification

To determine the effect of student aid on the time-to-degree, I will focus on models using the information on timing in the data. For each period the probability to leave university in that given period is modeled. The measurement of the time variable plays an important role in order to apply the right model. While graduating from university is possible at every point in time, the usual way "time spent at university" is measured, is in half year terms (semesters). Therefore, I apply a duration model in discrete time and define a period to be a semester. Furthermore I estimate a competing risk model, because students leave university either by dropping out or by graduating with a degree.

T_i denotes the length of the completed spell, i.e. time-to-degree or dropout, of individual i, a discrete non-negative random variable. The variable takes on the value t if the spell ends in interval $(I_{t-1}, I_t]$ by one of the two exit states. The hazard rate, $h_{ij}(t)$, is the conditional probability of transition from studying to the exit state j in interval t, given the individual has been studying until the beginning of that interval:

$$h_{ij}(t|\alpha_j(t), x_i(t), \epsilon_i^m) \quad = \quad Pr_j(T_i = t|T_i \geq t, \alpha_j(t), x_i(t), \epsilon_i^m) \tag{1}$$

where $j = 1$ denotes graduating from university, $j = 2$ dropping out and $\alpha_j(t)$ is the alternative specific baseline hazard which is common to all individuals. The vector of covariates for individual i in interval t is denoted by $x_i(t)$. In addition to a set of individual characteristics, $x_i(t)$ contains income variables like private transfers, scholarships and the amount of student aid received. Following Heckman and Singer (1984), I assume a time-invariant unobserved individual effect, ϵ_i^m, which is drawn from an arbitrary discrete probability distribution with a small number of mass-points, $m = 1, 2, ...M$:

$$E(\epsilon_i^m) = \sum_{m=1}^{M} P(\epsilon_i^m)\epsilon_i^m = 0; \quad \sum_{m=1}^{M} P(\epsilon_i^m) = 1; \quad E(\epsilon_i^m x_i(t)) = 0, \quad \forall m = 1, 2, \ldots, M \tag{2}$$

The mass-points and their probabilities can be interpreted as the respective proportion of students in the sample belonging to a particular group. The mass-points as well as their probabilities are estimated simultaneously with the other parameters in the model.

Conditional on the individual-specific unobserved heterogeneity and the vector of observed explanatory variables x_i, the latent durations for the two exit states are assumed to be independent. They can therefore be modeled as competing risks[9].

The hazard rate for an exit at time t to any destination j is simply the sum of the

[9] For an extensive formal discussion of the competing risk model see e.g Prentice et al. (1978), Han and Hausman (1990) or Abbring and van den Berg (2003)

individual destination specific hazard rates:

$$h_i(t|\alpha_j(t), x_i(t), \epsilon_i^m) \quad = \quad \sum_{j=1}^{2} h_{ij}(t|\alpha_j(t), x_i(t), \epsilon_i^m) \tag{3}$$

The unconditional probability to study at the end of interval t, the so called survival function, can be expressed as the product of probabilities of remaining in a spell in all previous periods up to period t:

$$S_i(t|\alpha_j(t), x_i(t), \epsilon_i^m) = Pr(T_i > t|\alpha_j(t), x_i(t), \epsilon_i^m) = \prod_{k=1}^{t} [1 - h_i(k|\alpha_j(k), x_i(k), \epsilon_i^m)] \tag{4}$$

Hence, the unconditional probability of transition in period t for individual i into exit state j is given by

$$\begin{aligned} Pr_j(T_i = t|\alpha_j(t), x_i(t), \epsilon_i^m) \quad &= \quad h_{ij}(t|\alpha_j(t), x_i(t), \epsilon_i^m) \prod_{k=1}^{t-1} (1 - h_i(k|\alpha_j(k), x_i(k), \epsilon_i^m)) \\ &\quad \text{for } j \in \{1, 2\} \end{aligned} \tag{5}$$

In an intrinsically discrete time model, the hazard rate can be formulated as a multinomial logit, where in my case the alternatives are "still studying/censored", "graduation" and "dropout". Since the probabilities sum up to one, a convenient normalization is to use one alternative as reference category. In the following this reference category will be the alternative "still studying/censored".

$$h_{ij}(t|\alpha_j(t), x_i(t), \epsilon_i^m) \quad = \quad \frac{\exp(\alpha_j(t) + \beta_j' x_i(t) + \epsilon_i^m)}{1 + \sum_{l=1}^{2} \exp(\alpha_l(t) + \beta_l' x_i(t) + \epsilon_i^m)} \tag{6}$$

In the following empirical analysis the baseline hazard is specified by a set of dummy-variables. The baseline hazards may vary with the alternatives, e.g time to graduation takes at least six semester whereas it is more likely to drop out in the first few semesters. To account for this difference between the alternatives and in order to avoid duration categories with too few observations I combine semesters for the baseline hazard into reasonable clusters.

Given a random sample of individuals, the sample likelihood function is:

$$L = \prod_{i=1}^{n} \sum_{m=1}^{M} P(\epsilon_i^m) \prod_{j=1}^{2} \left[h_{ij}(t|\alpha_j(t), x_i(t)\epsilon_i^m)\right]^{\delta^{ij}} \prod_{k=1}^{t-1} \left[1 - h_i(k|\alpha_j(k), x_i(k), \epsilon_i^m)\right] \quad (7)$$

$$\text{where } \delta_{ij} = \begin{cases} 1 & \text{individual i makes transition to destination j} \\ 0 & \text{otherwise} \end{cases}$$

with n being the number of individuals in the sample. Equation (7) is maximized with respect to the coefficients of the baseline hazard α_j, the coefficients of the explanatory variables β_j, and the mass-points together with the corresponding probabilities $P(\epsilon^m)$, subject to the restrictions on the individual effect given in equation (2), using a standard numerical optimization procedure[10].

3.2 Data and Variables

The empirical analysis is based on data from the German Socio-Economic Panel (SOEP) for the years 1984 to 2007. The SOEP is a yearly household panel which surveys a wide range of social and economic characteristics (Wagner et al. (2007)). The feature that is of main interest for this paper, is the retrospective monthly calendar, which allows to identify whether a person studied during a certain semester[11]. If a person is observed as having studied in the months between October and March, he counts as a student in the winter term (“Wintersemester”). Being a student in the summer term (“Sommersemester”) implies having studied between April and September. An exception occurs if a student is observed as starting tertiary education in September, this student will count as having started in the winter term since many universities offer introductory/preparation classes before the actual semester starts.

The key variable for the analysis is the amount of student aid received. Like other income variables in the SOEP, the student aid received is recorded as monthly amount. Since these variables are surveyed retrospectively the analysis covers the period from the winter term of 1983/1984 to the summer term of 2006 (which ended in September 2006).

[10] For the estimation I use Stata-routine gllamm version 2.3.13 written by Rabe-Hesketh et al. (2004)

[11] There are two semesters each year and each last 6 months. About half of that time is filled with lectures.

To ensure the comparability of students who received and who did not receive financial aid, I restrict the sample to students who are qualified to apply for student aid. Hence the sample contains only students who were not older than 30 years at the time of enrollment. Although non-German nationalities may be supported by student aid, they have to meet additional requirements which are not modeled in the following. Therefore I restrict the sample to German students who have studied at least one semester[12].

After adjusting the sample, there are 787 individuals left, of whom 240 can be completely observed from the beginning of their study to the successful completion, 408 are right censored, i.e. haven't finished their studies by the time they are no longer observed, and 139 are identifiable as university dropouts. Since I can observe the students at the semester level, I have a total of 6,063 observations.

A complication in the data is that the amount of financial aid received cannot be separated into student aid transfers according to BAfoeG and into other financial aid, i.e. scholarships. Therefore I simulate student aid eligibility for each student, which allows me to distinguish between BAfoeG recipients and students who receive scholarships. The simulation is based on the respective BAfoeG regulation for each year, where the calculation of BAfoeG eligibility is based strictly on the wording of the law. If an individual is eligible for BAfoeG and also received financial aid, this observation is treated as "received BAfoeG". According to this simulation, 220 individuals were granted at least once in their student career financial aid in the form of BAfoeG.

Table 1 reports summary statistics for the main explanatory variables. In the first column the mean and standard deviation for the whole sample are given. The next two columns distinguish between students who were never and students who were at least once in their university career supported by BAfoeG. The last two columns distinguish within the group of student aid recipients between the periods where a student did not and the periods where the student did receive financial aid.

[12]Until 1991 the sample contains only observations from West-Germany, afterward East-Germans are considered as well given an individual started studying after 1991

Table 1: Descriptive statistics of main explanatory variables

	All students	BAfoeG non-recipients	BAfoeG recipients	BAfoeG recipients in periods of non-receipt	BAfoeG recipients in periods of receipt
Income per semester in 1,000 Euros[1]					
BAfoeG	0.25	0.00	0.90	0.00	1.30
	(0.56)	(0.00)	(0.73)	(0.00)	(0.74)
Scholarship	0.13	0.11	0.17	0.47	0.01
	(0.34)	(0.33)	(0.35)	(0.67)	(0.06)
Private Transfers	0.36	0.39	0.26	0.33	0.23
	(0.73)	(0.8)	(0.53)	(0.63)	(0.53)
Labor Income	0.13	0.16	0.06	0.12	0.04
	(0.35)	(0.41)	(0.12)	(0.23)	(0.10)
Sum of all Income	3.26	3.80	2.31	2.91	2.01
	(3.94)	(4.71)	(1.46)	(2.64)	(1.21)
Month of semester					
receiving BAfoeG	0.89	0.00	3.20	0.00	4.92
	(1.78)	(0.00)	(1.98)	(0.00)	(1.54)
Share of students working	0.59	0.60	0.57	0.55	0.40
Daily Hours during week spend on					
Work (conditional on students working)	5.86	5.94	5.66	5.31	5.64
	(3.01)	(3.11)	(2.74)	(2.63)	(3.2)
Work (unconditional)	1.97	2.15	1.49	1.76	1.43
	(2.76)	(2.98)	(2.02)	(2.30)	(2.52)
Education	6.73	6.53	7.25	7.53	7.20
	(2.43)	(2.46)	(2.29)	(4.95)	(2.56)
Individual characteristics					
Age at beginning of study	21.56	21.51	21.69		
	(2.1)	(2.05)	(2.2)		
Married	0.02	0.02	0.01		
	(0.15)	(0.16)	(0.12)		
Male	0.54	0.54	0.53		
	(0.5)	(0.5)	(0.5)		
First enrolled at a university	0.68	0.68	0.68		
(not a univ. of appl. science)	(0.47)	(0.47)	(0.47)		
Parental characteristics					
Income in 1,000 Euros[1]	12.10	14.32	6.39	7.44	6.00
	(9.17)	(9.44)	(5.1)	(5.74)	(5.01)
Parents are German born	0.79	0.82	0.71		
	(0.41)	(0.38)	(0.45)		
Parents have at least	0.47	0.53	0.31		
a highschool degree	(0.5)	(0.5)	(0.46)		
Outcome					
Right Censored	0.51	0.53	0.50		
	(0.50)	(0.50)	(0.50)		
Successfully completed studies	0.31	0.30	0.31		
	(0.46)	(0.46)	(0.46)		
Dropped out	0.18	0.17	0.20		
	(0.38)	(0.37)	(0.40)		
Time in semesters					
until graduation	11.39	11.51	11.07		
	(3.56)	(3.76)	(2.96)		
until drop out	8.05	7.76	8.80		
	(4.9)	(4.84)	(4.99)		
until beeing right censored	6.55	6.09	7.83		
	(4.43)	(4.07)	(5.09)		
# of students	787	567	220	143	220

Note: data source SOEP 1984-2007, own calculations; Mean values with standard deviation in parentheses.
First column gives the overall mean, second and third the means for BAfoeG recipients and non-recipients, fourth and fifth column split the recipient's mean into mean value during time of BAfoeG receipt and non-receipt (77 students received BAfoeG during all their studies).
Time is measured in semesters where a semester consists of 6 months (April-Sept or Oct - March).
[1]in prices of 2000.

About 28 percent of the students in the sample received student aid at least once during their university career. On average, they received about 1,300 EUR per semester during the time they were supported. This are 265 EUR per month given that on average 4.9 month per semester student aid was granted. The comparable number reported in official sources yields an average of monthly spending per supported student of about 260 EUR in the year 2006[13]. BAfoeG eligibility depends on financial resources of a student. Students who are eligible for transfers according to BAfoeG, receive with 260 EUR only a third of the private transfers of non recipients. Also variables describing the parental background show the expected pattern. Since BAfoeG eligibility is dependent on parental income it is not surprising that parental income is the lowest for student aid recipients. While parents of students not eligible for BAfoeG earn about 14,300 EUR per semester, parents of BAfoeG recipients earn only half of that.

Since the income of the parents during the periods of BAfoeG receipt is only slightly lower than during the time where the student were not found to be eligible for student aid, the main reason for loosing the entitlement for BAfoeG seems to be own labor income. The average labor income increases almost to the level of non BAfoeG recipients. This suggests either that BAfoeG eligible students have to work more when they are not financially supported, or that students drop out of BAfoeG-eligibility because they earn too much and therefore exceed the personal fundamental allowance for labor income.

This is also found when looking at the hours worked during the week. While students who do not receive student aid work about 1.8 hours, students supported by BAfoeG just work 1.4 hours. This difference is mainly due to more students working while not receiving student aid (55 percent compared to 40 percent), rather than a difference in hours worked.

Even with student aid, recipients have a lower total amount of financial resources (2,310 EUR) than students who are not eligible for BAfoeG (3,800 EUR). This is a monthly difference in income of about 250 EUR.

[13]Federal Statistical Office, Fachserie 11 Reihe 7, calculation of ratio of governmental financial spending per month and subsidized students. Comparing the time between 1991-2006 yields a mean difference of 30 Euros.
Income variables are in 2000 prices.

Almost two third of the students who are not right censored, have successfully finished their studies. This is independent of their source of funding. The same holds for the share of students that drop out before finishing. About one third of the students who can be observed from the beginning to the end of their study fail to complete their degree.

With regard to the other outcome of interest, the time-to-degree, I find only a small difference between BAfoeG recipients and non-recipients. For both groups the average lies at 11 semester which is above the normal time of study allotted for a course of study. These numbers are in line with comparable data compiled by the OECD (2007). There are however differences between student aid recipients and non recipients for the average time until they drop out. While non-recipients drop out on average after 7 semesters, students who received at least once student aid transfers according to BAfoeG drop out after 8 semesters.

4 Estimation Results

To estimate the parameters I use a mixed multinomial logit model which allows me to control for unobserved heterogeneity (see section 3.1). Based on the Bayesian Information Criterion (BIC)[14], I find that a specification with four mass-points (three are estimated jointly with the parameters, the fourth can be backed out from the results) is best suited for this specification[15]. All three estimated mass-points, and their probabilities are significant, showing that there is unobserved heterogeneity in the data.

Since the model is an extended multinomial logit, the coefficients are hard to interpret directly. Unlike in the linear model, the marginal effects depend on the values of all covariates. I therefore report in table B1 in the appendix the sample average of the marginal effects for each individual. The standard errors for the marginal effects are calculated using the delta method, based on robust standard errors from the mixed multinomial logit model. A negative (positive) sign for the marginal effect indicates a decrease (in-

[14] $BIC = -(2 \ln L - k \ln(n))$

[15] The values of BIC for the specification with different mass-points can be found in table C3 in the appendix.

crease) in the hazard rate which results in a higher (lower) average time-to-degree (or time-to-dropout).

The baseline hazard for graduating increases with the time spend studying. The probability to graduate, conditional on survival up to the respective period, increases by 12 percent in semester seven and eight up to 46.6 percent in semester 15 and later relative to the base category[16]. The baseline hazard to drop out is similar to the baseline hazard to graduate as the hazard is fairly low in the first 10 semesters (less than 20 percent higher compared to the base category) and increases sharply thereafter. The pattern exhibited by the baseline hazard shows, that it is the more likely to make the transition to any of the exit states the longer a student is studying, whereby the transition to graduate is more likely in each of the seventh and the following semester.

The control variables affect the transition probabilities beyond the simple baseline hazards. I find that most of the significant coefficients translate into significant marginal effects as well. There are however only a few variables with a significant impact on the duration of study.

Turning to the main outcome of interest, I find that BAfoeG eligible students have a significantly lower hazard to graduate than non eligible students. That means in each period their probability to graduate is lower than for students who are not eligible for student aid. At the same time, BAfoeG eligible students have a higher hazard to drop out in a given period.

The average marginal effect of the amount of student aid granted is negative for both, graduation as well as dropout, but significant only for the hazard to drop out. In a given period an increase in BAfoeG by one unit (1,000 EUR) would therefore lead to a decrease in the conditional probability to drop out by 2.6 percentage points. The BAfoeG increase attenuates the increasing baseline hazard. Given that the baseline hazard to drop out in the first semesters is roughly 6 percentage points, this increase nearly halves the increase in the risk to drop out in the first six semesters. At the same time, an increase in the

[16] Values calculated from table B1 in the appendix, i.e. the baseline hazard to graduate in semester 7 is calculated as $0.159 - 0.039 = 0.12$

amount of BAfoeG has no direct effect on the hazard to graduate. While the marginal effect is not significant, the negative sign implies that the hazard to graduate decreases in the amount of BAfoeG received. Student aid therefore lowers the probability of dropping out but at the same time prolongs the time-to-degree.

I also find negative marginal effects for both the hazard to graduate and to drop out for the other income measures: private transfers and scholarships. But the type of transfer received seems to matter. In contrast to the impact of BAfoeG, private transfers and scholarships significantly decrease the conditional probability to graduate, i.e. students with these types of funding tend to study longer. On the other hand the effect on the hazard to drop out is weaker than for BAfoeG (and even insignificant for funding by scholarships). Qualitatively an increase in funding for BAfoeG receiving students would therefore lead to a stronger decrease in the drop-out rate with less of an extension to the average time-to-degree, than increases in other types of funding.

Looking at the other covariates, I find that none of the parental background variables exhibits a significant impact, equally so for the individual background characteristics, i.e. gender, age at the beginning of studies or wether the parents are German born. The dummy which captures if the student first enrolled at a regular university or an university of applied science has a negative effect on the hazard to graduate as well as on the hazard to drop out. This captures the usual case that a degree obtained in the same discipline usually takes longer to complete (even under perfect conditions) at a regular university. The higher drop out hazard might be explained by stricter requirement about the time in which a certain amount of courses have to finished or the number of times exams can be retaken at universities of applied sciences.

My results indicate that the time spent working has no effect on the average hazard to graduate or to drop out. The time spent on education however has a positive significant effect on the hazard to graduate. An additional hour each day spend studying increases the hazard to graduate in a given period by 0.3 percentage points. At the same time, one more hour spent studying decreases the conditional probability to drop out by 0.2

percentage points. This finding suggests that doing some type of paid work while studying is not detrimental to successfully completing the course of study, as long as the time for work is not taken away from time spent on education.

To further analyze the channels through which BAfoeG affects the graduation and dropout rate, I calculate in the following the unconditional probability for both exit states. In table 2, I report the cumulative transition rates for the sample average as well as for several funding scenarios based on an average student. The cumulative transition rate is the probability of a student making a transition from studying to graduation or dropping out in a given interval (i.e. up to the 4th, 8th, 12th or 16th semester).

Table 2: Cumulative transition rates for different funding scenarios

	Graduation				**Dropout**			
	t=4	t=8	t=12	t=16	t=4	t=8	t=12	t=16
Mean:								
Base	-	0.20	0.50	0.58	0.07	0.14	0.18	0.18
	-	(0.01)	(0.02)	(0.04)	(0.00)	(0.00)	(0.01)	(0.01)
Increase by 600 EUR	-	0.20	0.53	0.62	0.05	0.10	0.14	0.14
	-	(0.01)	(0.02)	(0.04)	(0.00)	(0.00)	(0.01)	(0.01)
Increase by 1,200 EUR	-	0.19	0.55	0.66	0.03	0.07	0.10	0.11
	-	(0.01)	(0.02)	(0.04)	(0.00)	(0.00)	(0.00)	(0.01)
Scenario 1: Intermediate level parents/no BAfoeG								
Base	-	0.04	0.47	0.71	0.02	0.08	0.18	0.23
Increase by 600 EUR	-	0.03	0.48	0.74	0.01	0.04	0.14	0.20
Increase by 1,200 EUR	-	0.02	0.47	0.76	0.00	0.01	0.11	0.17
Scenario 2: Poor parents/Increased BAfoeG/eligibility								
Base	-	0.06	0.65	0.83	0.01	0.06	0.14	0.16
Increase by 600 EUR	-	0.04	0.66	0.86	0.01	0.03	0.11	0.13
Increase by 1,200 EUR	-	0.02	0.66	0.88	0.00	0.01	0.09	0.11
Scenario 3: Poor parents/no BAfoeG/work/eligibility								
Base	-	0.07	0.29	0.36	0.15	0.42	0.56	0.61
Increase by 600 EUR	-	0.05	0.32	0.42	0.08	0.29	0.49	0.56
Increase by 1,200 EUR	-	0.02	0.37	0.53	0.01	0.07	0.33	0.44
Scenario 4: Rich parents/no BAfoeG								
Base	-	0.00	0.17	0.45	0.00	0.01	0.11	0.26
Increase by 600 EUR	-	0.00	0.16	0.45	0.00	0.01	0.10	0.25
Increase by 1,200 EUR	-	0.00	0.16	0.45	0.00	0.00	0.09	0.25
Scenario 5: No parental support/maximum BAfoeG								
Base	-	0.03	0.70	0.86	0.00	0.02	0.11	0.13
Increase by 600 EUR	-	0.02	0.69	0.87	0.00	0.01	0.10	0.13
Increase by 1,200 EUR	-	0.01	0.69	0.87	0.00	0.00	0.10	0.12

Standard Errors in parentheses
Source: Own calculations, based on estimation results in table B1 in the appendix

For the different funding scenarios I set all variables, except the income variables, to their mean in order to produce probabilities for an average student. I consider five scenarios to evaluate the impact of a change in student aid conditional on the different financial endowments a student might have. In each scenario there is a base case for which the probability is reported in table 2 calculated at the values reported in table A2 in the appendix. Starting from the base values, the amount of BAfoeG is successively increased, first by 600 EUR and then by 1,200 EUR per semester (100 Euros per month and 200 Euros per month). I fix all covariates except for the income variables, which vary by scenario. One exception occurs in scenario 3. Here I also vary the hours spent working and studying. The hours worked are first set to 5, since labor income is the only financial source these students have. This also reduces the time spent on education (I set this to 2 hours less than the average per day). With a BAfoeG increase of 600 EUR I reduce the hours worked by half and increase the hours spent on education by one. For a BAfoeG increase of 1,200 EUR, the time spent working is set to zero, and the hours spent on education is set to its mean.

For the average student in the sample (first six rows of table 2) the probability to have graduated by the 16th semester is 58 percent which is a bit smaller than the average graduation rate from 2000-2006 with 67 percent[17]. The same holds for the probability to have dropped out by the 16th semester which differs only slightly from the actual dropout rate of 21 percent (Heublein et al., 2008). Increasing BAfoeG results in a sizable increase in the probability to graduate of 4 and 8 percentage points for 600 and 1,200 EUR higher BAfoeG. At the same time the probability to drop out decreases by 4 and 7 percentage points.

To get an intuition for the graduation and dropout probabilities of students with different sources of funding, the second to sixth block of table 2 shows the same increase in BAfoeG as described before, but for five different income situations.

In all of the scenarios, increasing BAfoeG results in an increase in the probability to graduate, except for scenario 4 where the probability to graduate does not change. In the other scenarios however, the probability to graduate increase by one to 17 percentage

[17]own calculation; ratio of graduates to newly enrolled university students with German nationality for the years 2000 to 2006, see Federal Statistical Office, Fachserie 11 Reihe 4.3.

points (an increase of more than 50 percent). At the same time a marked decrease in the probability to drop out is found for all scenarios.

Differences arise when comparing an average student with different main sources of funding, i.e. having high parental transfers (scenario 4) versus being funded with the corresponding amount of BAfoeG (scenario 5). The probability to have graduated by the 16th semester is for an average student who is funded by high parental transfers only about half the probability when being funded by BAfoeG (45% and 86%, respectively).

The differences in the graduation rate might be a result of BAfoeG regulations. The time of being funded by BAfoeG is limited, and additionally half of the BAfoeG amount received must be repaid. Private transfers on the other hand can be seen as a non repayable grant which is not restricted to be paid only for a fixed period since it is unlikely that parents will set a limited time of support in advance.

With intermediate levels of funding, that is in scenario 1 and 2, the initial graduation rate for a student with an income situation that might arise in low income families, who receives student aid support (scenario 2) is higher than if such a student is supported wholly by the parents albeit at an intermediate level (83% and 71%, respectively). For both groups the main effect of BAfoeG is again a decrease in the probability to drop out up to the 16th semester.

An average student who works and receives only little parental transfers (scenario 3) benefits the most. In this scenario an increase of BAfoeG by 1,200 EUR per semester increases the probability to graduate by 17 percentage points. The probability to drop out is the highest among all of the scenarios. The introduction of BAfoeG receipt results in a huge drop in the probability to drop out as it decreases from 61 percent in the base scenario to 44 percent. However even with this strong decline this group faces the highest dropout risk.

For the interpretation of my results in light of possible credit constraints, the last case is of most interest. With an increase in student aid by 1,200 EUR per semester, there are two main effects: First the probability to graduate increases and second the hazard to drop out decreases. The strong effect on the probability to drop out can be interpreted as a result of credit constraints. A decrease in student aid seems to have only a minor effect on prolonging the time till graduation caused by the students need to take up work in order to compensate the financial loss. It seems to be from greater importance that these students are confronted with the need to work full time to cover their living expenses and therefore drop out of university when their financial funding is reduced. This implies that with more student aid less students drop out, which on the other hand leads to more students eventually finishing university. This effect is also found in Ehrenberg and Mavros (1995) who claim, that the impact on the mean completion rate is much higher than the effect on the duration.

To check the robustness of my result, I ran regressions with higher polynomials in income and additionally allowed for time fixed effects. The results of these estimations can be found in table C2 in the appendix. The time effects are insignificant in the model with linear income variables, as well as in the model with non-linear income variables. The Akaike Information Criterion (AIC) suggests that the specification with nonlinear income variables is preferred over the simple linear model, but since the Bayesian information criteria suggest the linear specification, I choose the simpler model.

I estimate my preferred specification with different mass-points in order to control for unobserved heterogeneity and to find the right number of mass-points. I find that the estimation with 4 mass-points is the best according to both information criteria. The results can be found in table C3 in the appendix. I also ran a model allowing the individual effect to vary across exit states implying that the unconditional latent durations may be correlated. This specification, however, did not converge regardless of the choice of starting values, indicating that there is no correlation in the unconditional latent durations.

To ensure that my results are robust to right-censoring, I ran my preferred model again without the right censored observations. The resulting parameter estimates (see table C1 in the appendix) do not differ significantly from the specification including right censored observations (see table B1 in the appendix).

Lastly, I considered different specifications of the functional form of the baseline hazard. The results are reported in table C4 in the appendix. Although the information criteria suggest a different specification of the baseline hazard, the loss of degrees of freedom is negligible. I therefore prefer the most flexible functional form using dummy variables.

5 Conclusion

In this paper I have analyzed the question how student aid affects the outcome of tertiary education. I have focused on two dimensions, the duration of study and the probability of actually graduating with a degree. I estimate a duration model which allows me to analyze jointly the effect of student aid on both the probability to graduate and the time-to-degree. I focus on student aid provided by the German student aid system (BAfoeG) which is a need based financial support to students from low income families.

Theoretically, the effect of a change in the generosity of student aid on the duration of study is ambiguous. To answer the direction of the impact empirically I draw on 24 waves from the German Socio-Economic Panel and apply a discrete-time duration model with two different exit states (graduation and dropout), accounting for unobserved heterogeneity.

My main findings are that BAfoeG eligible students have per se a lower hazard to graduate and a higher conditional probability to drop out. The amount of BAfoeG received however reduces the drop out hazard on average by 2.6 percentage points per 1,000 EUR BAfoeG per semester. When I investigate this average effect further by comparing different funding scenarios for students, I find that an increase in BAfoeG by up to 200 EUR per month would further reduce the risk to drop out by up to one third. With one exception I find only small effects on the hazard to graduate, which suggest that the main effect is due to a longer duration of studies. The exception is students from low income families with no student aid support. An average student with poor financial endowments faces the highest dropout risk. With an increase in the amount of BAfoeG there is a major increase in the probability to graduate. So even if more student aid leads to a longer duration of study, this result might actually be favorable in policy terms. I also also find that the type of financial aid matters. Comparing BAfoeG eligible students who are funded with the maximum amount of student aid to students who receive the same amount in private transfers, more student aid recipients graduate by the 16th semester (86 percent compared to 45 percent).

But the results should be taken with a grain of salt. A potential concern is that BAfoeG is a very cheap student loan where often only a share of the total funds granted has to be repaid. I simplify the role of BAfoeG due to the unobservability of the actual debt. The share of the received BAfoeG amount that needs to be repaid differs depending on the student's circumstances. For example a student who is in the top 30 percent of all students graduating that year, must only repay 25 percent of the BAfoeG if he finished within the funding time limit. This might be an incentive for a funded student to concentrate on his studies and finish as soon as possible. My results comparing BAfoeG recipients with students funded only by private transfers, suggests that this might be an incentive for graduating faster. However controlling for unobserved heterogeneity should alleviate this problem.

My findings are comparable to the results found in studies focusing on Ph.D. students[18], but apply to a much wider range of students. Using data from the German Socio-Economic Panel allows me to consider funding for undergraduate students, the majority of enrollees in higher education. While I base my study on data from the Pre-Bologna era, it helps to shed light on the effect of the introduction of Bachelor degrees on enrollment. Recent statistics show that the dropout rate is much higher in Bachelor programs than in the traditional Diploma course of study[19]. My results suggest that this can be attributed (at least in part) to the tighter schedule of the Bachelor degrees. Less time than in the Diploma system can be spend on working in the market and financial

[18]see e.g. Ehrenberg and Mavros (1995) or Siegfried and Stock (2001, 2006)

[19]see e.g. Heublein et al. (2008)

constraints become more important accordingly. The role of student aid is therefore even more important for Bachelor degrees than it was before and should become a focus of future research as well as policy considerations.

References

ABBRING, J. H. AND G. J. VAN DEN BERG (2003): "The identifiability of the mixed proportional hazards competing risks model." *Journal of the Royal Statistical Society Series B-Statistical Methodology*, 65(Part 3), 701–710. ISSN 1369-7412.

BAUMGARTNER, H. AND V. STEINER (2006): "Does More Generous Student Aid Increase Enrolment Rates into Higher Education? Evaluating the German student aid reform of 2001." Discussion Paper 563, DIW Berlin.

BLANKE, E. A. (2000): *BAföG - Eine Idee und ihre Gestaltung*. Kohlhammer, Stuttgart.

BOOTH, A. L. AND S. E. SATCHELL (1995): "The Hazards of Doing a PhD: An Analysis of Completion and Withdrawal Rates of British PhD Students in the 1980s." *Journal of the Royal Statistical Society. Series A (Statistics in Society)*, 158(2), 297–318.

BUNDESMINISTERIUM FÜR BILDUNG UND FORSCHUNG (2007): "Die wirtschaftliche und soziale Lage der Studierenden in der Bundesrepublik Deutschland 2006 – 18. Sozialerhebung des Deutschen Studentenwerks durchgeführt durch HIS Hochschul-Informations-System." BMBF.

CAMERON, S. V. AND C. TABER (2004): "Estimation of Educational Borrowing Constraints Using Returns to Schooling." *Journal of Political Economy*, 112(1), 132–182.

CARNEIRO, P. AND J. J. HECKMAN (2002): "The Evidence on Credit Constraints in Post-Secondary Schooling." *The Economic Journal*, 112(482), 705–734.

DYNARSKI, S. M. (2003): "Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion." *American Economic Review*, 93(1), 279–288.

EHRENBERG, R. G. AND P. G. MAVROS (1995): "Do doctoral students' financial support patterns affect their times-to-degree and completion probabilities." *The Journal of Human Resources*, 30(3), 581–609.

Ehrenberg, R. G. and D. R. Sherman (1987): "Employment While in College, Academic Achievement, and Postcollege Outcomes: A Summary of Results." *The Journal of Human Resources*, 22(1), 1–23.

Garibaldi, P., F. Giavazzi, A. Ichino, and E. Rettore (2007): "College Cost and Time to Complete a Degree: Evidence from Tuition Discontinuities." Discussion Paper W12863, NBER Working Paper.

Häkkinen, I. and R. Uusitalo (2003): "The effect of a student aid reform on graduation: a duration analysis." Discussion paper, Uppsala University.

Han, A. and J. A. Hausman (1990): "Flexible Parametric Estimation of Duration and Competing Risk Models." *Journal of Applied Econometrics*, 5(1), 1–28.

Heckman, J. and B. Singer (1984): "A Method for Minimizing the Impact of Distributional Assumptions in Econometric Models for Duration Data." *Econometrica*, 52(2), 271–320.

Heineck, M., M. Kifmann, and N. Lorenz (2006): "A duration analysis of the effects of tuition fees for long term students in Germany." Working Papers of the Research Group Heterogenous Labor 06-05, Research Group Heterogeneous Labor, University of Konstanz/ZEW Mannheim.

Heublein, U., R. Schmelzer, and D. Sommer (2008): "Die Entwicklung der Studienabbruchquote an den deutschen Hochschulen - Ergebnisse einer Berechnung des Studienabbruchs auf der Basis des Absolventenjahrgangs 2006." HIS: Projektbericht.

Kane, T. J. (2003): "A Quasi-Experimental Estimate of the Impact of Financial Aid on College-Going." Working Paper Series 9703, NBER Working Paper.

Keane, M. P. and K. I. Wolpin (2001): "The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment." *International Economic Review*, 42(4), 1051–1103.

Lauer, C. (2000): "Gender Wage Gap in West Germany: How Far Do Gender Differences in Human Capital Matter?" Discussion paper, Centre for European Economic Research (ZEW).

OECD (2007): *Education at a glance 2007.* OECD, Paris.

Prentice, R., J. Kalbfleisch, A. J. Peterson, N. Flournoy, V. Farewell, and N. Breslow (1978): "The Analysis of Failure Times in the Presence of Competing Risks." *Biometrics*, 34(4), 541–554.

Rabe-Hesketh, S., A. Skrondal, and A. Pickles (2004): "GLLAMM Manual." Discussion Paper 160, U.C. Berkeley Division of Biostatistics Working Paper Series.

Schaeper, H. and K. H. Minks (1997): "Studiendauer - eine empirische Analyse ihrer Determinanten und Auswirkungen auf den Berufseintritt." HIS Kurzinformation,A1/97.

Shea, J. (2000): "Does parents' money matter?" *Journal of Public Economics*, 77(2), 155–184.

Siegfried, J. and W. A. Stock (2001): "So You Want to Earn a Ph.D. in Economics: How Long Do You Think it Will Take?" *Journal of Human Resources*, 36(2), 364–378.

Siegfried, J. J. and W. A. Stock (2006): "Time-to-Degree for the Economics Ph.D. Class of 2001-2002." *American Economic Review*, 96(2), 467–474.

Statistisches Bundesamt Wiesbaden (2007): "Fachserie 11 Reihe 7: Ausbildungsförderung nach dem Bundesausbildungsförderungsgesetz (BAföG)."

Statistisches Bundesamt Wiesbaden (2008): "Fachserie 11 Reihe 4.3: Nichtmonetäre hochschulstatistische Kennzahlen 1980-2006."

Steiner, V. and K. Wrohlich (2008): "Would Increased Financial Aid for Students Raise Enrolment into Higher Education? - New Evidence for Germany." Discussion Paper 805, DIW Berlin.

Stinebrickner, R. and T. Stinebrickner (2009): "The Effect of Credit Constraints on the College Drop-Out Decision: A Direct Approach Using a New Panel Study." *American Economic Review*, 98(5), 2163–2184. Online Publication date: 1-Jan-2009.

Wagner, G. G., J. R. Frick, and J. Schupp (2007): "The German Socio-Economic Panel Study (SOEP) - Scope, Evolution and Enhancements." *Schmollers Jahrbuch*, 127(1), 139–169.

A Definitions

Table A1: Definition of Variables

Variable	Definition
Income Variables[1]	
BAfoeG:	Amount of BAfoeG an individual received in one semester
Scholarship:	Amount of Scholarship an individual received in one semester
Private transfers received:	Amount of private transfers an individual received in one semester
Labor Income:	Amount of labor income an individual earned in one semester
Parental Income:	Amount of labour income of the students parents earned in one semester
Daily hours during week spent	
working:	hours an individual has spent working in a job
on education:	hours an individual has spent studying
Individual characteristics	
Age at beginning of study:	Age when student enrolled in tertiary education
Married:	Dummy variable indicating if student is married (=1)
First enrolled at a university:	Dummy variable that indicates whether an individual started studying at a university (=1) or at a university of applied science (=0)
Male:	Dummy variable indicating if student is male (=1)
Subject in which degree is obtained	Dummy variables indicating in which subject (e.g. Medicine, Science) degree was obtained (only available for graduated students)
Parental characteristics	
Parents have high-school degree:	Dummy variable indicating whether at least one parent has “Fachhochschulreife” or “Abitur”
Parents are German born:	Dummy variable indicating that both parents are of German nationality
Other	
Semester	half year term, a semester consists of 6 month (April-September or October-March)

[1]in 1,000 EURO and 2000 prices using consumer price index as deflator

Table A2: Base Scenarios

Variable Names	Scenario 1: Intermediate level parents no BAfoeG no eligiblitiy	Scenario 2: Poor parents increase BAfoeG eligibility	Scenario 3: Poor parents no BAfoeG no eligibility	Scenario 4: Rich parents no BAfoeG no eligiblitiy	Scenario 5: No parental support maximum BAfoeG eligiblity
BafoeG	0	1.8	0	0	3.6
Private Transfers	1.8	0.6	0 .6	3.6	0
Scholarship	0	0	0	0	0
Eligible for BafoeG	0	1	0	0	1

Income variables are in 1,000 EUR

B Estimation Results

Table B1: Estimation Results Multinomial Logit

Variable	Coefficient Estimates Graduation	Dropout	Marginal Effect, sample average Graduation	Dropout
Eligible for BAfoeG	-0.714†	0.290	-0.024†	0.016*
	(0.407)	(0.391)	(0.012)	(0.008)
BAfoeG	-0.668	-1.165**	-0.009	-0.026*
	(0.531)	(0.248)	(0.016)	(0.013)
Private transfers received	-1.641**	-1.177**	-0.038**	-0.017†
	(0.243)	(0.221)	(0.012)	(0.010)
Scholarship	-1.875**	-1.127**	-0.045*	-0.013
	(0.699)	(0.350)	(0.023)	(0.014)
Daily hours during week spend on				
Education	0.102**	-0.045	0.003*	-0.002*
	(0.035)	(0.040)	(0.001)	(0.001)
Work	0.061	0.069†	0.001	0.001
	(0.047)	(0.042)	(0.001)	(0.001)
Work x BAfoeG eligible	0.181†	0.080	0.005	0.000
	(0.096)	(0.066)	(0.003)	(0.001)
Individual characteristics				
Age when started studying	-0.018	0.084	-0.001	0.003†
	(0.072)	(0.075)	(0.002)	(0.001)
Male	0.205	-0.185	0.008	-0.007
	(0.270)	(0.339)	(0.008)	(0.006)
First enrolled at a university	-3.126**	-2.338**	-0.081**	-0.042*
(not a univ. of appl. science)	(0.436)	(0.396)	(0.022)	(0.021)
Parental characteristics				
Mother has highschool-degree	0.364	0.014	0.011	-0.003
	(0.419)	(0.392)	(0.013)	(0.006)
Father has highschool-degree	-0.510	-0.367	-0.012	-0.005
	(0.339)	(0.351)	(0.010)	(0.005)
Parents are German born	-0.316	-0.797*	-0.001	-0.021
	(0.323)	(0.345)	(0.010)	(0.013)
Subject in which degree is intended				
(Base: Law, Economics)				
n.a.	-3.429**	0.000	-0.108**	0.042**
	(0.417)	(.)	(0.024)	(0.015)
Medicine	0.381	0.000	0.012	-0.004*
	(0.402)	(.)	(0.013)	(0.002)
Social Science,Humanities	1.576**	0.000	0.053**	-0.015**
	(0.421)	(.)	(0.019)	(0.005)
Engineering, Math, Informatics	1.020*	0.000	0.033†	-0.010**
	(0.483)	(.)	(0.018)	(0.003)
Art, Design	4.216**	0.000	0.168**	-0.033**
	(0.787)	(.)	(0.041)	(0.011)
Science	0.273	0.000	0.008	-0.003
	(0.590)	(.)	(0.019)	(0.002)
Language, Cultural Studies	1.696**	0.000	0.058*	-0.016**
	(0.523)	(.)	(0.023)	(0.006)
Baseline Hazard Graduation				
(Base: Graduation in semester 1-6)				
Graduation in semester 7-8	4.440**	0.000	0.159**	-0.034**
	(0.451)	(.)	(0.032)	(0.012)
Graduation in semester 9-10	6.962**	0.000	0.286**	-0.048**
	(0.670)	(.)	(0.047)	(0.015)
Graduation in semester 11-12	9.171**	0.000	0.422**	-0.051**
	(0.890)	(.)	(0.055)	(0.019)
Graduation in semester 13-14	10.610**	0.000	0.515**	-0.052**
	(0.942)	(.)	(0.061)	(0.015)
Graduation in semester 15 and above	11.146**	0.000	0.547**	-0.053**

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... table B1 continued

Variable	Coefficient Estimates Graduation	Coefficient Estimates Dropout	Marginal Effect, sample average Graduation	Marginal Effect, sample average Dropout
	(1.035)	(.)	(0.064)	(0.015)
Baseline Hazard Dropout				
(Base: Dropout in semester 1-2)				
Dropout in semester 3-4	0.000	1.798**	-0.021**	0.063**
	(.)	(0.323)	(0.007)	(0.023)
Dropout in semester 5-6	0.000	1.603**	-0.019**	0.056*
	(.)	(0.377)	(0.006)	(0.023)
Dropout in semester 7-8	0.000	3.166**	-0.039*	0.134**
	(.)	(0.554)	(0.018)	(0.042)
Dropout in semester 9-10	0.000	4.055**	-0.052*	0.193**
	(.)	(0.900)	(0.022)	(0.063)
Dropout in semester 11-13	0.000	6.447**	-0.071**	0.348**
	(.)	(0.871)	(0.018)	(0.063)
Dropout in semester 14 and above	0.000	8.450**	-0.083**	0.513**
	(.)	(1.054)	(0.018)	(0.073)
Constant	-5.601**	-7.462**		
	(1.573)	(1.880)		
Masspoints and their Probabilities				
ϵ^1	-2.916**			
	(0.373)			
ϵ^2	1.177**			
	(0.334)			
ϵ^3	-8.161**			
	(0.861)			
P(ϵ^1)	0.429**			
	(0.002)			
P(ϵ^2)	0.311**			
	(0.001)			
P(ϵ^3)	0.044**			
	(0.000)			
ϵ^4	5.7583			
P(ϵ^4)	0.216			
N	6063			
Log-Likelihood	-1244.21			
BIC	2941.327			

Significance levels: † : 10% $*$: 5% $**$: 1%
Standard Errors in parentheses
Source: Estimations based on SOEP 1984-2007

C Sensitivity Analysis

Table C1: Estimation without right-censored observations

Variable	Coefficient Estimates Graduation	Dropout	Marginal Effect, sample average Graduation	Dropout
Eligible for BAfoeG	-0.428	0.435	-0.024†	0.029
	(0.365)	(0.383)	(0.014)	(0.020)
BAfoeG	-1.487**	-1.507**	-0.031†	-0.043*
	(0.504)	(0.327)	(0.018)	(0.020)
Private transfers received	-1.802**	-1.302**	-0.047**	-0.029†
	(0.250)	(0.218)	(0.015)	(0.017)
Scholarship	-2.281**	-1.436**	-0.063*	-0.026
	(0.604)	(0.376)	(0.026)	(0.024)
Daily hours during week spend on				
Education	0.118**	-0.027	0.005*	-0.003
	(0.044)	(0.043)	(0.002)	(0.002)
Work	0.091	0.081†	0.002	0.002
	(0.059)	(0.047)	(0.002)	(0.002)
Work and BAfoeG eligible	0.174	0.097	0.005	0.001
	(0.112)	(0.070)	(0.004)	(0.003)
Individual characteristics				
Age when started studying	-0.012	0.060	-0.002	0.003
	(0.081)	(0.077)	(0.011)	(0.004)
Male	0.030	-0.254	0.005	-0.012
	(0.322)	(0.353)	(0.011)	(0.017)
First enrolled at a university	-2.906**	-2.297**	-0.079**	-0.065*
(not a univ. of appl. science)	(0.465)	(0.394)	(0.024)	(0.029)
Parental characteristics				
Mother has highschool-degree	0.439	0.090	0.016	-0.004
	(0.363)	(0.377)	(0.014)	(0.017)
Father has highschool-degree	-0.508	-0.314	-0.014	-0.006
	(0.464)	(0.410)	(0.014)	(0.017)
Parents are German born	-0.350	-0.808*	0.001	-0.034
	(0.409)	(0.388)	(0.014)	(0.022)
Subject in which degree is intended				
(Base: Law, Economics)				
n.a.	-2.750**	0.000	-0.112**	0.056**
	(0.391)	(.)	(0.027)	(0.017)
Medicine	0.245	0.000	0.010	-0.004
	(0.380)	(.)	(0.014)	(0.003)
Social Science,Humanities	1.385**	0.000	0.057**	-0.023**
	(0.395)	(.)	(0.021)	(0.007)
Engineering, Math, Informatics	0.964*	0.000	0.039†	-0.017**
	(0.490)	(.)	(0.021)	(0.004)
Art, Design	3.457	0.000	0.161	-0.049*
	(3.077)	(.)	(0.151)	(0.022)
Science	0.050	0.000	0.002	-0.001
	(0.432)	(.)	(0.016)	(0.007)
Language, Cultural Studies	1.344*	0.000	0.056*	-0.023**
	(0.561)	(.)	(0.026)	(0.007)
Baseline Hazard Graduation				
(Graduation in semester 1-6)				
Graduation in semester 7-8	4.530**	0.000	0.197**	-0.058**
	(0.565)	(.)	(0.039)	(0.015)
Graduation in semester 9-10	7.079**	0.000	0.353**	-0.081**
	(0.794)	(.)	(0.054)	(0.027)
Graduation in semester 11-12	9.334**	0.000	0.492**	-0.085**
	(0.988)	(.)	(0.058)	(0.029)
Graduation in semester 13-14	10.860**	0.000	0.586**	-0.086**
	(1.013)	(.)	(0.061)	(0.029)
Graduation in semester 15 and above	11.430**	0.000	0.617**	-0.087**
	(1.114)	(.)	(0.062)	(0.018)

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... table C1 continued

Variable	Coefficient Estimates Graduation	Dropout	Marginal Effect, sample average Graduation	Dropout
Baseline Hazard Dropout				
(Base: Dropout in semester 1-2)				
Dropout in semester 3-4	0.000	1.861**	-0.039**	0.102**
	(.)	(0.338)	(0.013)	(0.034)
Dropout in semester 5-6	0.000	1.584**	-0.032**	0.087**
	(.)	(0.383)	(0.011)	(0.033)
Dropout in semester 7-8	0.000	3.273**	-0.064**	0.205**
	(.)	(0.583)	(0.025)	(0.055)
Dropout in semester 9-10	0.000	4.277**	-0.080**	0.284**
	(.)	(0.902)	(0.026)	(0.071)
Dropout in semester 11-13	0.000	6.816**	-0.096**	0.461**
	(.)	(0.888)	(0.022)	(0.060)
Dropout in semester 14 and above	0.000	8.877**	-0.108**	0.616**
	(.)	(1.097)	(0.023)	(0.062)
Constant	-4.809**	-5.643**		
	(1.730)	(1.901)		
Masspoints and their probabilities				
ϵ^1	-4.238**			
	(0.453)			
ϵ^2	-0.029			
	(0.326)			
ϵ^3	-9.158**			
	(1.031)			
$P(\epsilon^1)$	0.310**			
	(0.002)			
$P(\epsilon^2)$	0.326**			
	(0.001)			
$P(\epsilon^3)$	0.025**			
	(0.000)			
ϵ^4	4.576			
$P(\epsilon^4)$	0.339			
N	3677			
Log-Likelihood	-1125.50			
BIC	2677.919			

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%
Standard Errors in parentheses
Source: Estimations based on SOEP 1984-2007

Table C2: Different specifications

	Specification 1		Specification 2		Specification 3		Specification 4	
	Graduation	**Dropout**	**Graduation**	**Dropout**	**Graduation**	**Dropout**	**Graduation**	**Dropout**
BAfoeG	-0.668	-1.165**	-0.750	-1.111**	0.296	1.936*	0.227	1.968*
	(0.531)	(0.248)	(0.714)	(0.269)	(1.141)	(0.976)	(0.905)	(0.938)
BAfoeG squared					-0.567	-1.668**	-0.609†	-1.720**
					(0.356)	(0.487)	(0.339)	(0.486)
Private transfers received	-1.641**	-1.177**	-1.582**	-1.167**	-0.063	0.546	-0.104	0.407
	(0.243)	(0.221)	(0.279)	(0.241)	(0.650)	(0.665)	(0.713)	(0.738)
Private transfers received squared					-0.803*	-0.830**	-0.779*	-0.777*
					(0.343)	(0.309)	(0.322)	(0.309)
Scholarship	-1.875**	-1.127**	-2.016*	-1.177**	-0.989	0.295	-1.075	0.082
	(0.699)	(0.350)	(0.789)	(0.396)	(1.401)	(1.112)	(1.636)	(1.047)
Scholarship squared					-0.700	-0.889	-0.763	-0.814
					(1.049)	(0.643)	(1.371)	(0.598)
Base: Started studying between 1992 and 1997								
Started studying before 1992			-0.151	-0.455			-0.243	-0.502
			(0.346)	(0.464)			(0.371)	(0.489)
Started studying after 1997			0.598	-0.267			0.612†	-0.236
			(0.446)	(0.420)			(0.367)	(0.395)
Akaike IC	2592.41		2593.44		**2578.37**		2579.41	
Bayesian IC	**2941.33**		2969.20		2967.55		2995.42	

Significance levels: $\dagger$: 10% $*$: 5% $**$: 1%

Standard Errors in parentheses

Source: Estimations based on SOEP 1984-2007

Table C3: Preferred specifications with different mass-points

Specification 1:

	Mlogit		2 MP		3 MP		4 MP	
	Grad.	Drop.	Grad.	Drop.	Grad.	Drop.	Grad.	Drop.
BAfoeG	-0.255	-0.624**	-0.646†	-0.858*	-0.897*	-1.033**	-0.668	-1.165**
	(0.183)	(0.206)	(0.375)	(0.358)	(0.380)	(0.228)	(0.531)	(0.248)
ε_1			1.997**		3.705**		-2.916**	
			(0.567)		(0.482)		(0.448)	
ε_2			*-1.4629*		-0.565†		1.177**	
					(0.330)		(0.444)	
ε_3					*-3.744*		-8.161**	
							(1.004)	
ε_4							*5.758*	
$P(\varepsilon_1)$			0.423**		0.270**		0.429**	
			(0.101)		(0.006)		(0.002)	
$P(\varepsilon_2)$			*0.577*		0.545**		0.311**	
					(0.032)		(0.001)	
$P(\varepsilon_3)$					*0.185*		0.044**	
							(0.000)	
$P(\varepsilon_4)$							*0.216*	
Akaike IC	2688.58		2653.99		2626.72		2592.41	
Bayesian IC	2997.23		2976.07		2962.22		2941.33	

Specification 3:

	Mlogit		2 MP		3 MP		4 MP	
	Grad.	Drop.	Grad.	Drop.	Grad.	Drop.	Grad.	Drop.
BAfoeG	0.374	1.454†	-0.336	1.436†	0.252	1.672*	0.296	1.936*
	(0.632)	(0.787)	(0.930)	(0.821)	(0.816)	(0.837)	(1.141)	(0.976)
BAfoeG squared	-0.254	-1.146*	-0.159	-1.312**	-0.451	-1.507**	-0.567	-1.668**
	(0.251)	(0.487)	(0.333)	(0.419)	(0.288)	(0.429)	(0.356)	(0.487)
ε_1			2.677**		-0.808**		5.535**	
			(0.553)		(0.224)		(0.580)	
ε_2			*-1.335*		3.593**		0.995*	
					(0.716)		(0.439)	
ε_3					*-4.314*		-3.008**	
							(0.508)	
ε_4							*-8.038*	
$P(\varepsilon_1)$			0.333**		0.675**		0.220**	
			(0.007)		(0.002)		(0.001)	
$P(\varepsilon_2)$			*0.667*		0.246**		0.330**	
					(0.002)		(0.001)	
$P(\varepsilon_3)$					*0.079*		0.411**	
							(0.002)	
$P(\varepsilon_4)$							*0.039*	
Akaike IC	2671.54		2632.81		2601.65		2578.37	
Bayesian IC	3020.46		2995.15		2977.40		2967.55	

Significance levels: $\dagger$: 10% $*$: 5% $**$: 1%
italic numbers are calculated values
Standard Errors in parentheses
Source: Estimations based on SOEP 1984-2007
[1]Estimation with 5 masspoints is not feasible for both of the specifications

Table C4: Estimation with different functional baseline hazards

	Time specified as							
	Dummy Variables		Logarithmic Function		linear Trend		linear and squared Trend	
	Graduation	Dropout	Graduation	Dropout	Graduation	Dropout	Graduation	Dropout
BAfoeG	-0.668	-1.165**	-0.849*	-1.228**	-0.840*	-1.149**	-0.768	-1.132**
	(0.531)	(0.248)	(0.410)	(0.237)	(0.353)	(0.235)	(0.750)	(0.320)
Graduation in semester 7-8	4.440**	0.000						
	(0.451)	(.)						
Graduation in semester 9-10	6.962**	0.000						
	(0.670)	(.)						
Graduation in semester 11-12	9.171**	0.000						
	(0.890)	(.)						
Graduation in semester 13-14	10.610**	0.000						
	(0.942)	(.)						
Graduation in semester 15 and above	11.146**	0.000						
	(1.035)	(.)						
Dropout in semester 3-4	0.000	1.798**						
	(.)	(0.323)						
Dropout in semester 5-6	0.000	1.603**						
	(.)	(0.377)						
Dropout in semester 7-8	0.000	3.166**						
	(.)	(0.554)						
Dropout in semester 9-10	0.000	4.055**						
	(.)	(0.900)						
Dropout in semester 11-13	0.000	6.447**						
	(.)	(0.871)						
Dropout in semester 14 and above	0.000	8.450**						
	(.)	(1.054)						
log(t)			6.371**	1.826**				
			(0.634)	(0.274)				
t					0.751**	0.416**	1.955**	0.522**
					(0.064)	(0.071)	(0.251)	(0.174)
t squared							-0.050**	-0.002
							(0.009)	(0.006)
Akaike IC	2592.409		2601.802		2632.059		2571.929	
Bayesian IC	2941.327		2890.330		2920.587		2873.877	

Significance levels: † : 10% * : 5% ** : 1%
Standard Errors in parentheses
Source: Estimations based on SOEP 1984-2007