Enrollment and Success in Higher Education

Structural Estimation and Simulation Evidence for Germany

INAUGURAL-DISSERTATION

zur Erlangung des Grades eines
Doktors der Wirtschaftswissenschaft
(doctor rerum politicarum)

am Fachbereich Wirtschaftswissenschaft
der Freien Universität Berlin

vorgelegt von

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Berlin, 2010

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Tag der Disputation: 25.10.2010

PREFACE

I had the opportunity to write my doctoral thesis as a research associate at the German Institute for Economic Research (DIW Berlin) in the Public Economics Department. I benefited immensely from working in this stimulating and dynamic environment.

First of all, I would like to thank my principle supervisor Viktor Steiner for his guidance and his support. During every stage of my dissertation project, he took the time to extensively discuss my work and gave me helpful comments and advice. I am also grateful to my second supervisor Irwin Collier for his interest in my topic and agreeing to supervise this thesis.

Chapter three and parts of chapter four of my dissertation thesis are based on joint work. I thank my co-author Frank Fossen for the fruitful and enjoyable collaboration. I learned a lot from him and this project, which also benefited my work outside our collaboration.

I am grateful to my colleagues and friends at the DIW Berlin for creating a motivating, supportive and enjoyable working atmosphere. I thank my officemate Johannes Geyer for econometric advice as well as sharing insights on tricky LaTeX and Stata questions, Katharina Wrohlich for helpful discussions about BAfoeG and Peter Haan for advice on Stata maximum likelihood programming. I also thank Stefan Bach, Hermann Buslei, Nadja Dwenger, Kai-Uwe Müller, Michal Myck, Richard Ochmann, Pia Rattenhuber, Davud Rostam-Afschar, Nicole Scheremet, Erika Schulz, Martin Simmler, Natasha Volodina, Florian Walch, Anne Zimmer, as well as the other colleagues at the DIW Berlin.

Being a member of the Graduate-Center at the DIW Berlin, I had the chance to share my thesis chapters in all stages of development with people experiencing the same challenges I had to face: I would like to thank especially Cathérine Müller and Eva Berger for their open door policy, sharing ideas, advice and coffee. Furthermore, I thank Frauke Braun, Astrid Cullmann, Burcu Erdogan, Marc Vothknecht and Nicolas Ziebarth.

Writing this thesis, I experienced up and downs. I was however always sure to find support and encouragement in my family and friends for which I am grateful. I especially

thank my parents Elisabeth and Herbert Glocker, as well as my brothers Andreas and Manuel Glocker for their unconditional support and their interest in my work. Experiencing a phase of stagnation, I was always sure to find distraction in my little niece, Isabel Glocker, which opened my mind for new approaches and gave me new strength to continue this thesis. Most importantly, I thank Alexander Lembcke for critically discussing my ideas and approaches, as well as constructively proof-reading my thesis at all stages. Throughout the whole time, I was sure of his patient encouragement and support, for which I am deeply grateful.

Finally I would like to thank the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) who financially supported my thesis as part of the project "Politische Ökonomie dezentraler Bildungsfinanzierung – Theoretische Analyse und empirische Anwendung für Deutschland (STE 681/6-2)".

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Chapter 1

Introduction

Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.

The Universal Declaration of Human Rights, Article 26 (1)

1.1 Motivation

The factors that encourage men and women to take up and successfully finish university studies have been of rising interest to academics and politicians (see e.g. Santiago et al., 2008). While education is considered to be a human right, which should be ensured, the focus is on the key function of education as a factor for economic and social development. It is therefore not only the individual who has an interest to obtain education based on his or her ability, but also the government in order to promote or maintain economic and social stability.

While there is a consensus on the free provision of elementary education, opinions diverge when considering the financing of higher education. From an individual perspective, persons invest in their human capital, if they expect the (discounted) returns to exceed the (discounted) costs (Becker, 1964). Since university graduates are the main beneficiaries of their investments in higher education in form of a higher income, they might be expected to pay for this additional education under equity aspects (see e.g. Barbaro, 2004, for a literature overview). In the US, costs for higher education are covered privately for the main part: high tuition costs are the standard. In Europe, many changes in financing institutions for higher education have occurred in the past decade. While higher education remains highly subsidized, many European countries introduced or increased tuition fees. This alters the incentives for high school graduates to enroll and to successfully complete tertiary education. If the increase in costs is not alleviated by an increase in returns, the share of students in higher education will decrease. But unlike in the US, the relative gain from higher education in European countries remains moderate (OECD, 2009).

Can developed countries afford a decrease in the demand for tertiary education? An aging population leaves the rising cost of pensions and medical expenses on the shoulders of fewer members in the workforce, more educated and therefore more productive workers would lessen this problem (Barr, 2004). Education is additionally argued to generate social externalities by promoting knowledge spillovers at the workplace (Moretti, 2004; Acemoglu and Angrist, 2000), by reducing the prevalence of crime (Lochner and Moretti, 2004) and by increasing the democratic stability through civic behavior (Dee, 2004). Thus, not only the individual benefits from its investment in higher education, but the society as a whole (see Wolfe and Haveman, 2002, for a discussion of the non-market and social benefits possibly associated with education).

Politicians therefore have an interest to create an environment, such that each individual receives conditional on his or her ability the optimal amount of education. This task comes with several difficulties concerning the access to, the financing and the organization of higher education. To understand the options the government has, it is important to analyze why prospective students, that is individuals who hold an university entrance qualification, take up or do not take up university studies. While knowing the determinants of enrollment in higher education is important, it is equally important to understand why students finish successfully or rather to understand why some of them do not. So the second step would be to analyze the factors that provoke students to finish university studies successfully or to drop out of university.

Considering the university enrollment decision from a normative point of view (e.g. under Rawl's veil of ignorance (Rawls, 1971)), university education should be available to everyone who is qualified, regardless of social background. But the literature on intergenerational transmission tends to find a strong positive correlation between a family's social status and the demand for higher education (see Solon, 1999 for an overview for the US; Dearden et al., 1997 for the UK; Heineck and Riphahn, 2007 for Germany). Especially in countries with (high) tuition fees, these findings are often argued to be due to capital market imperfections. As Becker (1964) pointed out, the capital market for college investment is likely to be imperfect. Potential students, and especially the ones from low income families, have only little or no collateral to borrow against. Potential students that are for this reason not able to take up higher education are referred to as "credit constrained". In the empirical literature enrollment probabilities that differ by financial background in the presence of student fees are often argued to be caused by credit market imperfections, see e.g Kane (1994). But as pointed out by Carneiro and Heckman (2002), credit constraints are not easily identifiable. This is because other factors that are partly captured by measures of credit constraints, also determine university enrollment. One of these factors is for example academic success in school, which is positively influenced by long-term investments that promote cognitive and non-cognitive ability of students, such as parental time or the purchase of market goods that are complementary to learning. Both of these factors are highly correlated with measures of (potential) credit constraints.

Although the existence of credit constraints is a controversial matter, student aid and loans schemes, as well as scholarships, are widely introduced, particularly in countries with high tuition costs to enable students from all social backgrounds to take up tertiary education. Even though in Germany, as well as in other European countries, student fees are a rather new feature, student aid schemes have been in place for several years and often even before the introduction of fees (e.g. in Germany). These student aid programs aim at qualified students from an economically disadvantaged background, to overcome possible credit constraints and ensure a minimum living standard during the time of study. Empirical studies evaluating the effect of student aid programs on university enrollment however tend to find only small effects (see e.g. Dynarski (2003) for a literature overview for the US and Steiner and Wrohlich (2008) for Germany).

As governments are facing tight budgets, an attractive option is to shift the burden of higher education financing to the students. Since students are assumed to benefit from their investments in education and their financial endowments do not seem to be a driving factor in the university enrollment decision, this would not change the conditions for equal access. In the past decade tuition fees were introduced or increased in an increasing number of European countries. In Germany, they were introduced under the condition that qualified individuals must not be deterred because of their financial means. The result of this condition is twofold, first the fees were set to a “socially compatible” amount of no more than 500 EUR per term (i.e. 1,000 EUR per year) and second new (not means tested) student loans were introduced. No data is available yet to appropriately evaluate the effect of student fees on the enrollment decision. Theoretical analysis conclude, that the introduction of tuition fees are likely to reduce enrollment modestly and that the existing system of higher education financing is probably regressive, meaning the burden is higher for poor students (see e.g. Janeba et al., 2007).

In practice there are several different loan schemes for students, which should alleviate the challenge of financing tertiary education. The design of the loan schemes differs and these differences may have important implications for the university enrollment decision. Accepting a loan results in accumulated debt when graduating from university. Since future income is uncertain, risk averse individuals may fear not to be able to repay the loan. But also high interest rates that results in a lower future income might deter qualified potential students from enrolling in higher education, especially if they expect their future income to be only marginally higher with a university degree. In the literature, the link between university enrollment and uncertainty about future outcomes dates back to Levhari and Weiss (1974). Their theoretical model suggests that the higher the uncertainty of the outcome of the investment in human capital, the lower the probability to invest. Therefore not only the expected net returns to education, but also the variance of the returns may have an impact on the university enrollment decision, depending on the individual risk attitude. The influence of income uncertainty on educational attainment has become of increasing interest in the empirical literature in recent years (see e.g. Hartog and Vijverberg, 2007; Belzil and Hansen, 2004). A related stream of literature analyses the effect of income taxation on human capital formation (see Alstadsæter, 2005, for a literature overview). Taxation influences on one the hand the expectations about net earnings, and on the other hand the income risk. Therefore taxation has two opposing effects: the income effect, and the insurance effect. A decrease in the marginal tax rate, increases the net income (positive income effect), but also increases the income risk (negative insurance effect), and vice versa. Which effect dominates over the other depends mainly on the individual's risk attitude.

The university enrollment decision therefore depends on various factors which can be partly influenced by the government: financing of university education by tuition fees and student loans; student aid to ensure the coverage of costs of living for poor students; and the expected value and the variance of net returns (which depend on taxation).

But analyzing the determinants of university enrollment is only the first step. Once students have taken up tertiary education, the aim is to give students the opportunity and to incentivize them to finish their studies successfully. What determines success differs, depending on the educational system. With a rigidly timed degree track, i.e. bachelor or master tracks, success means finishing within the regular study period (as opposed to dropping out) and obtaining a high mark. For the classical diploma or magister system, which was in place e.g. in Germany until recently, a third dimension is important: the time to degree.[1] Since the curriculum and the timing of courses is very flexible, the time it takes to obtain a diploma or magister degree differs strongly. A diploma is awarded upon reaching a certain amount of credit points, thus students decide on their own, how many credit points they want to acquire during each term. A third dimension of success is therefore the time it takes a student to graduate. The shorter the time the smaller the incurred costs associated with that course of study and therefore the financial burden. Before the introduction of the bachelors and masters degree a student could choose an optimal allocation between course work and working to make up for financial shortfalls. The system was flexible enough to accommodate individual choices. But the bachelor and master tracks follow a tight time schedule, which leaves not much time for additional work. If students' financial support is not sufficient, more students might eventually drop out of their course of study.

My thesis will consider all of the aspects mentioned above. I will analyze two dimensions of governmental funding policies on the determinants of the university enrollment decision: tuition fee schemes and taxation of future earnings. I will then evaluate the impact of funding on the success of university studies, focusing on the role of student aid. To be precise, I am asking (and answering) three questions in this thesis:

- What are the enrollment effects of different tuition fee schemes?
- How does taxation of future earnings affect enrollment?
- What is the impact of student aid on the success of studies?

[1] The same point can be made for doctoral studies.

1.2 Contributions and Main Findings of the Thesis

In this thesis I will focus on Germany. The advantage of using Germany as an example is twofold. First, the German Socio-Economic Panel Study (SOEP) provides a rich representative database of individual level data since 1984, which allows tracking persons from their high school graduation throughout the following years in which university enrollment as well as university graduation may occur. And second, ongoing changes in German higher education policies necessitate a more efficient higher education system. The German government aims on the one hand to increase university enrollment, and on the other hand to reduce the duration of study. It is motivated by demographic change and a fear of loss of skills, especially in the so called MINT-subjects (math, computer sciences, natural sciences and engineering). A shorter duration of study would reduce the cost caused by the students, and also increase the supply of high-skilled labor in the short run. In the long run the problem of scarce funding for higher education might worsen, given that the society as a whole is aging. Assuming that political parties design their program for their constituencies, the focus is taken away from educational investment (Oberndorfer and Steiner, 2007). The German government therefore faces the problem to increase the number of university graduates without increasing the resources allocated to higher education. When student fees came into public discussion, the main argument for them was that student fees would be used to increase the resources available. These additional resources should then be dedicated to increasing the quality of higher education. Given the problem of an aging population that the government faces, it seems more likely that spending by the government will be reduced in the future.

Before focusing on the specific questions I will describe the recent developments in higher education for Germany in the second chapter. I will sketch the institutional features that are important for this study. The chapter contains both descriptive results on trends in enrollment and funding which gives an indication of what to expect in the following empirical analysis.

In the third chapter, we[2] develop a structural university enrollment model which accounts for uncertainty by incorporating expectations about the after-tax returns to education and its variance. A high school graduate decides to enter university studies if expected lifetime utility from this choice is greater than the expected lifetime

[2]Based on joint work with Frank M. Fossen (Fossen and Glocker, 2009)

utility from other alternatives. We estimate ex-ante paths of the expectation and the variance of future after-tax income for German high school graduates, accounting for non-random selection based on multiple, potentially correlated, criteria. For the utility maximization problem we assume a utility function that satisfies constant relative risk aversion (CRRA) and explicitly account for university dropout and unemployment risks. Given the structural model we use data on high school graduates for up to five years after high school graduation and evaluate their decision to enroll at a university. This allows us to estimate the impact of expectations and the uncertainty of future income on the university enrollment probability as well as the Arrow-Pratt coefficient of risk aversion, controlling for individual and family background. The Arrow-Pratt coefficient is estimated to be 0.05, which indicates that high school graduates are risk averse, but only to a mild degree. The coefficient capturing the effect of the difference of the risk adjusted utilities of both alternatives on the enrollment probability is positive and significant. Thus, higher expected returns to an academic education increase the probability of university enrollment, whereas higher uncertainty of academic earnings decreases enrollment rates. Increasing the expected net earnings for academics by 10% increases the cumulative probability of enrolling by 6.2 percentage points, if the net wages for non-academics and the variance in both career paths do not change. In contrast, an increase in the variance of the net earnings for academics by 10% decreases the cumulative probability to enroll by 0.05 percentage points.

After estimating the structural model I use the obtained results to conduct several simulations to evaluate the impact of recently introduced tuition and funding schemes. It also allows me to consider alternative schemes that do not exist in German policy. These simulations are discussed in chapter four. In the first part of the chapter, I evaluate the effect of tuition fees which has been the topic in recent debates in German higher education policy. Since the introduction of fees is fairly recent, no detailed microdata are currently available. Here, using a structural model allows me to make predictions and conduct a first analysis. For the simulation I have to account for two effects of tuition fees. First they have a direct impact on the funds available to students, but also an effect on future earnings, e.g. through loan repayment obligations. I allow for various alternatives in when and how much students have to pay or repay in my simulations.

Before considering hypothetical scenarios, I analyze the current tuition fee system allowing for heterogeneous effects by financial background. In the following, I analyze three different financing schemes: a pure mortgage loan (a standard loan), income-contingent loans (repayment only if income exceeds a certain threshold) and graduate taxes (higher taxes for university graduates, no other loan repayments) at different levels of fees and controlling for student aid. As an extension, I do not only consider the effect of financing schemes on enrollment but also the effect on the expected distribution of earnings. The simulation results indicate that introducing student fees lowers the probability to enroll into higher education. This affects students from relatively poor families, as well as students with parents from the upper end of the income distribution. Although the three analyzed schemes all decrease the probability to enroll in higher education, income-contingent loans, as well as a graduate tax have a significantly lower effect than a student loan scheme. The effects of the financing schemes differ in their impact on the expected income distribution. Inequality increases moderately in all scenarios when student fees are in place. For the case of student loans, the increase in inequality is the highest (a Gini coefficient of 0.188 compared to the no-fees coefficient of 0.173). Overall, income-contingent loans perform best in terms of equal access to higher education as well as distributional effects. At current fee levels (1,000 EUR per year) the reduction in the average enrollment would be about 0.3 percentage points opposed to 0.6 percentage points where all students would have to take up a loan.

The second part of chapter four points out the indirect effect on university enrollment induced by changes in taxation.[3] Taxation affects the expected level and variance of future income through changes in income taxation. Germany underwent drastic changes in the income taxation system due to the Tax Reduction Act of 2000. The reform was implemented in three steps between 2000 and 2005. The basic allowance was markedly increased, together with a decrease in the introductory marginal tax rate from 22.9 to 15%. Additionally, the highest marginal tax rate was decreased by 20%, but accompanied by a reduction of the highest threshold of the progression zone. All together, the tax reform decreased the progressivity of income taxation, thus increasing the net income, but also decreasing the insurance effect. I evaluate the effects of that reform on university enrollment by comparing the estimated enrollment probabilities under the actual tax system with the probabilities that would have occurred under the pre-reform tax schedule. I find a significant positive effect for implementing the tax reform of 2000. Thus, due to the reform, the annual enrollment probability increases by 0.6 percentage points for men and for women by 0.8 percentage points.

Furthermore, I evaluate the effect of possible flat-rate tax reforms. Flat-rate taxes

[3]This part of chapter four extends joint work with Frank M. Fossen (Fossen and Glocker, 2009).

have been widely discussed in Germany; Kirchhoff (2003), Mitschke (2004), and the Council of Economic Advisors to the Ministry of Finance (2004) all have presented proposals for tax policy reforms with (almost) flat-rate schedules. Although they do not intend to influence university enrollment, these proposals might have an effect on the university enrollment probability. I apply two variations of revenue-neutral flat-rate tax reforms as suggested by Fuest et al. (2008), one with an unchanged basic allowance and a tax rate of 26.9% which establishes revenue neutrality. The second scenario allows for a higher basic allowance and therefore a higher revenue neutral flat tax rate of 31.9%. I find that that the first alternative with an unchanged basic allowance leads to an increase in the enrollment rates for men in Germany by 0.6 (0.9) percentage points in the average annual (cumulative after 5 years) probability. In this scenario the effects on women are negative, albeit only significant for the average enrollment probability. Moving to a flat tax with an unchanged basic allowance is predicted to decrease enrollment by 0.4 percentage points. This can be explained by the location of women in the income distribution. Women are more prevalent at the lower end of the income distribution, given that they are more likely to work part-time than men. At the lower end the flat tax exceeds the marginal tax rate in the basic scenario. The scenario with a higher basic allowance and thus a higher tax rate exhibits no significant changes for men and women.

Increasing university enrollment is one step when aiming for higher graduation rates. But this alone is not sufficient. As discussed above, the second step is to have students successfully graduate from university once they have started studying. In chapter five, I therefore analyze the factors that affect two dimensions of success in university studies: the fast and the successful completion of the course of study. Obtaining data on the third dimension of success, final grades, is usually not feasible, and even if this data is available it is usually impossible to link it to individual or family characteristics. The advantage of focusing on the German diploma and magister system is that it is easy to observe whether a student dropped out and if not, how long it took the student to obtain his or her degree. So it is practical to analyze the determinants that influence a successful course of study.

The duration of study does depend on the specifics of the course of study, but also on the ability of the students to finance their studies. Financing schemes have a direct and important effect on academic success. As mentioned above, various studies analyze the effect of student aid on university enrollment, but as to my knowledge, no study analyzes the relationship between student aid and the duration of study or the successful course of study itself. A study by Amann (2005) does analyze the impact of working on the duration of study and finds a negative correlation, but does not control for the students' financial background. This however is an important aspect. If the amount of student aid does not suffice to cover the costs of living, financially disadvantaged students may only have the choice between taking up work or dropping out of university studies.

Until recently the time-unconstrained diploma and magister tracks were the standard in German higher education. This changed with the Bologna Process. The advantage of the diploma and magister track for my study is that students are able to decide on their own how many courses they want to take each term and therefore how much time they want to allocate to university studies. If students spend more time working than studying, their time to degree is likely to be extended. Reasons for working could e.g. be to cover the costs of living in case no other financial resources are available to the student. Student aid would alleviate this problem. In the last part of this work, I therefore 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. I estimate a discrete-time duration model allowing for competing risks to account for different exit states (graduation and dropout). 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.

Chapter six concludes with the main results from this thesis, an overview of policy implications and suggestions for further research.

Chapter 2

Higher Education in Germany

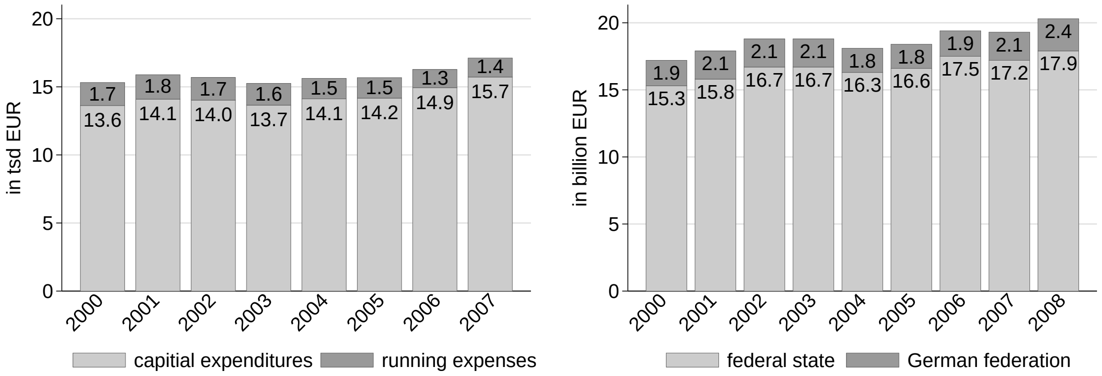
The aim of this chapter is twofold. First, I sketch the institutional background of higher education in Germany and give an outline of the funding and financing schemes in place. Second, using descriptive statistics, I show the development and trends of higher education in Germany. In line with the focus of my thesis I discuss the changes in the population eligible for higher education, the uptake of and enrollment in tertiary education, as well as statistics on graduations. I show developments in returns to education both in terms of income, as well as the unemployment rate (a major source of income risk) for academics and non-academics.

2.1 Institutional Features

In Germany, higher education policy is decentralized, thus higher education institutions are subject to each federal state's legislation. There are some exceptions, where decisions are made jointly by the federal government and the federal states. Increasing costs in higher education during the 1960s and 1970s led to financial distress of the federal states. As a result, the Federal Law on Higher Education Guidelines (*HochschulRahmenGesetz*: HRG) was passed in 1976. It determines that several aspects of higher education—construction of universities; educational planning and research—should be jointly legislated by the federal states and the federal government. Furthermore the federal government receives the authority to establish a legislative framework for higher education, where details of the implementation

Figure 2.1: Spending for and by higher education institutions per year

(a) Spending of universities per student (b) Spending for universities by public body



Source: Statistisches Bundesamt (2007a): Fachserie 11 Reihe 4.3.2; Statistisches Bundesamt (2009): Bildungsfinanzbericht; both in prices of 2005

are left to the federal states. Figure 2.1 shows the spending of higher education institutions per student per year as well as the spending for universities by public bodies. The spending per students per years includes all the costs that arise for the universities and can be divides in capital expenses (buildings, etc.) and running expenses. As is shown in figure 2.1(a) the spending per student remains fairly stable during the five years from 2000 to 2005 and is slightly increasing in the following two years. Since the number of students does not dramatically change (see figure 2.5(b)), this actually translate to more spending per student by the universities. The second panel (figure 2.1(b)) shows the development of spending on higher education institutions by public body. It is obvious, that the federal states are the main contributor in financing universities. They bear more than 80% of the cost. The federal government's main contribution is towards the construction costs for university buildings, but generally no operating expenses are covered. The total amount spent has slightly increased from 2000 to 2008, although spending from 2003–2005 stagnated and even decreased. The dip in spending is due to a cutback in spending both by the federal states, as well as the federal government.

The figure however shows only the funds the federal government pays directly to universities. But the numbers would increase if indirect spending, e.g. research grants by the German Research Foundation (DFG) or financial aid given directly to the students, would be taken into account.

2.1.1 Federal Government

One of the core tasks of the federal government with respect to higher education is the provision of financial 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 or her 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 or her 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.[1] In both steps, the act defines a minimum, the fundamental allowance (*Freibetrag*), for the amount of wealth and income[2] which are excluded in the calculations. In the final step, a pre-defined amount of basic financial need[3] (*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 or she is considered to be eligible for transfers according to BAfoeG. The amount of the transfers is 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, is subject to a yearly re-evaluation of the financial need of the student.

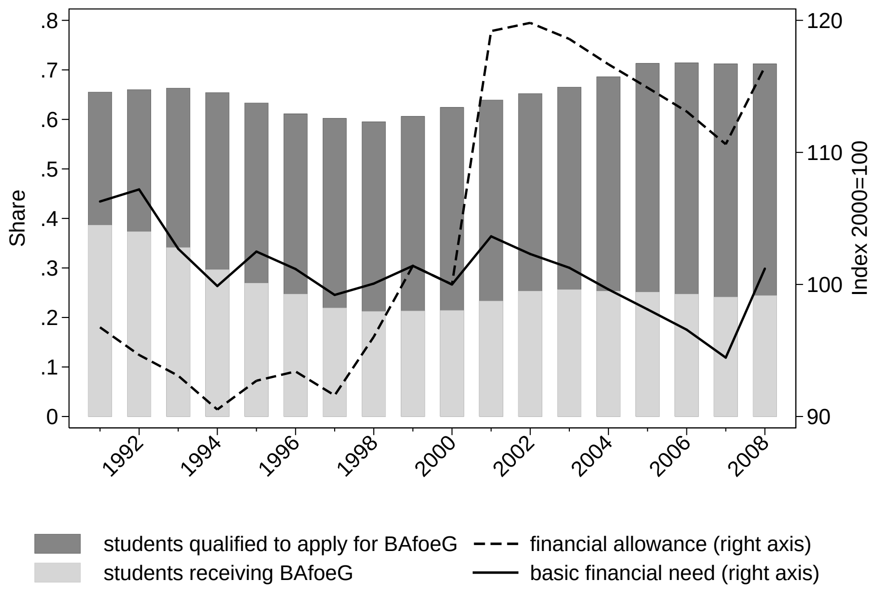
[1] Expenditures that are considered are e.g. if the parents have to take care of other children, or other household members

[2] The gross income is adjusted by deduction of a lump sum to account for social security payments and potential alimony payments

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

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 2.2). 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 the income exemption was increased in 2001 by about 20%. This led to an increase of eligible students and therefore of students receiving BAfoeG. Nevertheless, the amount of financial aid decreased in real terms. In 2008 the financial allowance, as well the basic financial need were

Figure 2.2: Development of amount of basic financial need, fundamental allowance, share of students qualified to apply for BAfoeG and share of BAfoeG recipients



Source: Deutscher Bundestag (2007)

adjusted and both increased by roughly 10%. As the figure shows, the increase does not level out the previous decline.

2.1.2 Federal States

Although competencies of the federal states and the federal government were defined in the HRG, the federal government regularly interfered with the competency of the federal states.

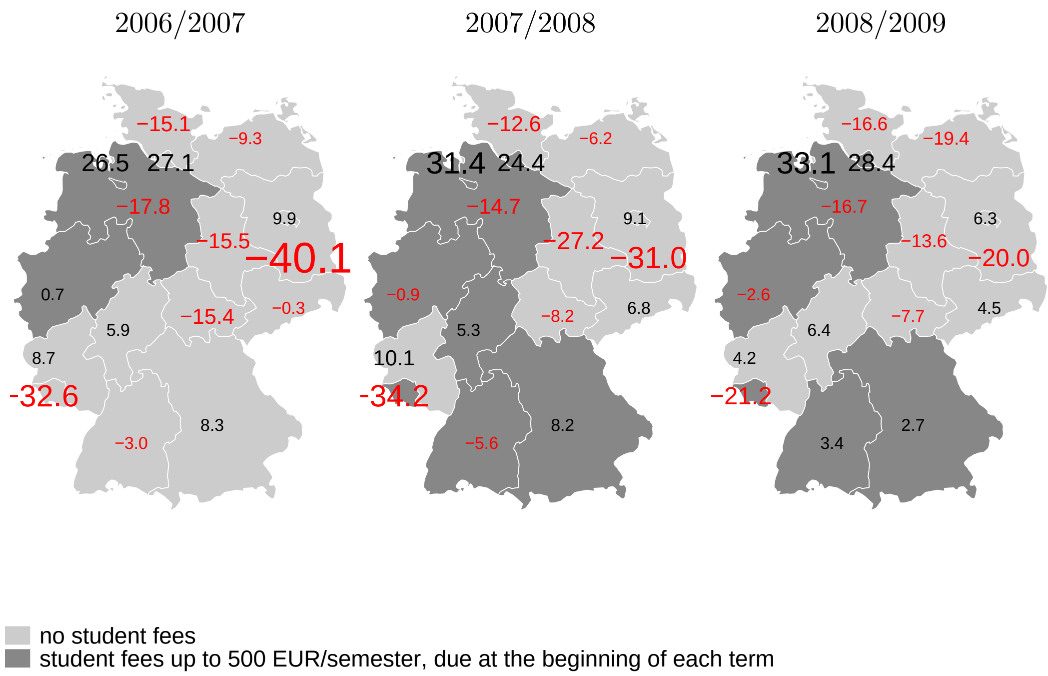
In 1968 the federal government signed the International Covenant on Economic, Social and Cultural Rights (ICESCR) which postulates that "Higher education shall be made equally accessible to all, on the basis of capacity, by every appropriate means, and in particular by the progressive introduction of free education" (ICESCR, Article 13.2(c)). Although this did not rule out the introduction of student fees by the federal states, the ministers agreed not to introduce them. But the prohibition of student fees did not become part of German law until 2002. In the HRG revision the federal government included explicitly that the first course of study should remain free of charge for the student. The federal states felt that this interfered with their sovereignty. Seven out of 16 federal states filed a lawsuit, arguing that the authority for financing education lies with them and not with the federal government. In 2005, the highest German court ruled in their favor. Although this ruling was not about the legitimacy of the introduction of student fees, it did not prohibit the introduction of fees, as long as equal access to higher education was ensured.

After the ruling, Lower Saxony and North Rhine-Westphalia were the first states to introduce tuition fees for the academic year 2006/2007. More states followed shortly after. As of today, Lower-Saxony, Saarland, North Rhine-Westphalia, Baden-Wuerttemberg, Bavaria and Hamburg, i.e. six out of 16 federal states charge student fees. In Hesse student fees were introduced in 2007, but after a year, they were abolished by the political majority in the Hesse parliament of SPD, Gruene and Die Linke.

As long as there is no evidence that equal access to higher education is prohibited, the Federal Constitutional Court has no reason to change its ruling on student fees. The available data show the effect of student fees only imperfectly, as they are a rather new development and not fully captured by official data. Although changes in the enrollment rate can not be interpreted as a causal impact of student fees, descriptive statistics reveal first insights on this topic. Figure 2.3 shows the development of the introduction of student fees in, as well as university student in- and outflows for the federal states.

Some federal states are "export" states (e.g. Lower-Saxony and Baden-Wuerttemberg), in the sense that more high school students graduating in this state choose to enroll at a university in another federal state than students from other states enrolling at a university in this state. The figure shows huge "migration" flows even before student fees were introduced e.g. Saarland had more than 30% less students

Figure 2.3: Migration flows and tuition fees by federal state



Note: numbers in percent for the respective winter term
black (positive): migration into this federal state exceeds migration out of this state
red(negative): migration out of this federal state exceeds migration into this state

Source: Statistisches Bundesamt (2008): Fachserie 11 Reihe 4.3.1

enrolling than high school graduates enroll in other federal states. It is hard to see a clear pattern when student fees are introduced since some of the states exhibit high variation in the flows. The introduction of student fees seems to have an influence on the migration when fees are introduced, especially if the neighboring state does not charge student fees, but there do not seem to be lasting effects. For example for Saarland, which introduced student fees in 2007, a decrease in the migration balance by 1.6 percentage points is observable. At the same time the neighbor Rheinland-Pfalz exhibits an increase in inflows by 1.4 percentage points. But one year after the introduction the trend is reversed and the inflow into Rheinland-Pfalz is reduced by 5.9 percentage points and the outflow from Saarland reduced by 13 percentage points. Bavaria, which introduced student fees in 2007, was in the last four years always a state which had a positive migration balance. This did not change with the introduction of student fees, but the share was slightly decreasing the following years. Other states, that always had a negative migration balance (Brandenburg) still are "exporting" more students than "importing" but this share halves from 2006 to 2008. Although the numbers are purely descriptive, they exhibit interesting patterns. Student fees seem to have a small impact on the migration of university freshmen in the short run, but the pattern seems to follow much more complex dynamics. In a first study, Dwenger et al. (2009) analyze this complex pattern. Using administrative data of applicants for medical schools in Germany, they find a small but significant effect: mobility increases when student fees were introduced in the applicants "home" state. This effect however differs by school achievement. High school graduates with better grades are even attracted by fee states, whereas high school graduates with lower grades show higher mobility.

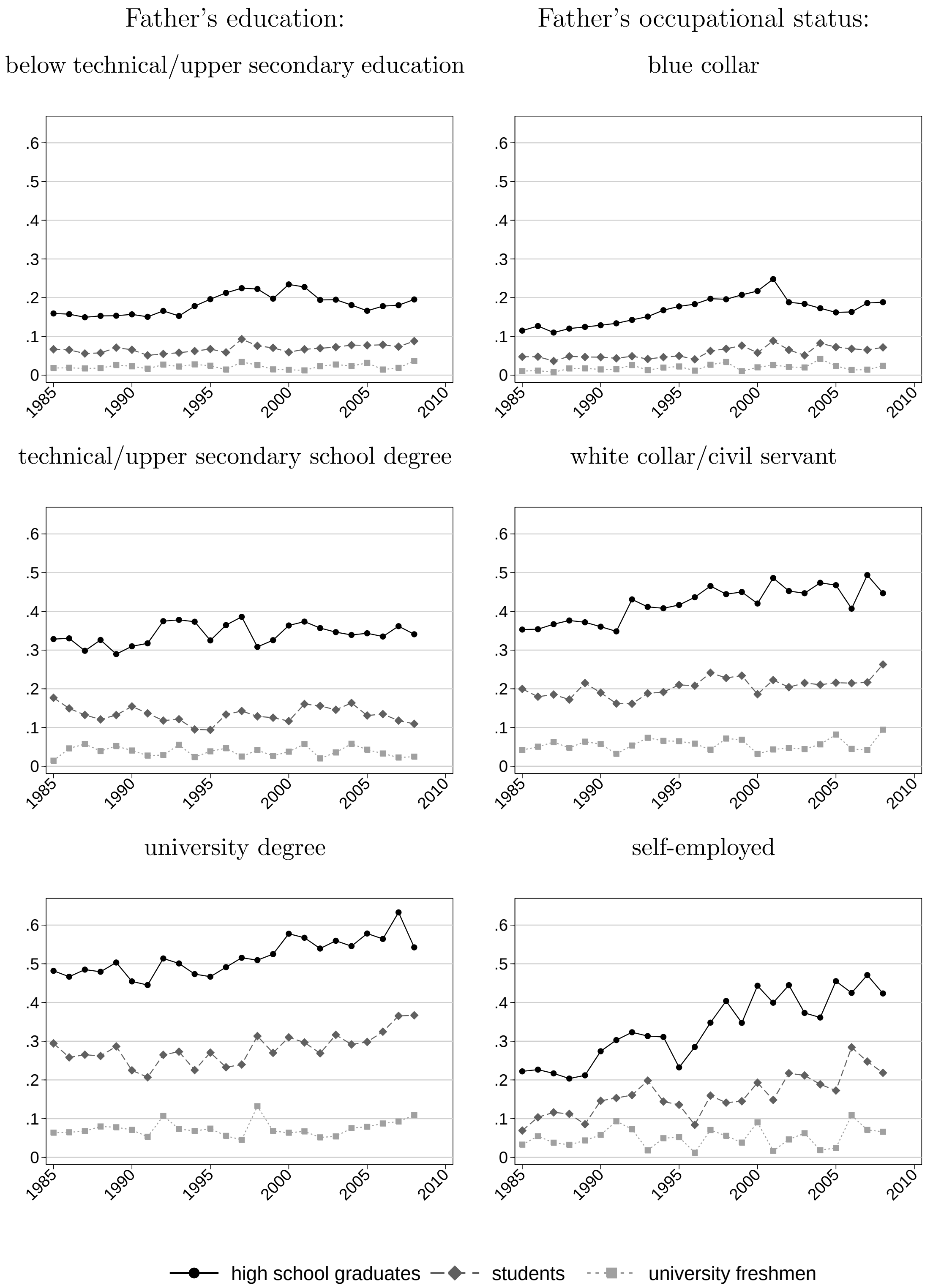
2.2 Developments in Germany

2.2.1 Enrollment and Graduation rates

The overall share of high school graduates, i.e. individuals that hold an university entrance qualification, is increasing from around 28% of all individuals of the same age in 1985 to 41% in 2008 (Statistisches Bundesamt, 2008). At the same time, the university enrollment rate rose form 20 to 40%. Figure 2.4 shows the trends in graduation and enrollment decomposed by the father's level of education and occupational status for men and women aged 18 to 25 years. The top line in each sub-graph shows the share of high school graduates (i.e. the share that is eligible for university enrollment), the middle line show the share of those who are studying, and the bottom line the share of those who enroll in that year.

The first observable pattern is that the share of high school graduates increases with father's education, the same holds for the share of students. Those individuals whose father's educational attainment is below technical/upper secondary school degree are less likely to graduate with a secondary school degree and, as a result, also less likely to enroll and to study at a university. In 1985 the share was 16%, slightly increasing throughout the years reaching its peak in 2000 with 24%. In 2008 only 20% of the chosen age group whose father had a low level of education graduated from high school with a university entrance qualification. In contrast between 30% and 40% of men and women whose father had at an upper secondary degree finished high school and for those whose father holds a university degree the share is even higher by about 50% to 60%.

Figure 2.4: Developments in high school graduation, university enrollment and number of students by father's education and occupational status



Source: SOEP, weighted: own calculations based on observations aged 18 to 25

The same pattern is apparent for the participation in university studies. Between 1985 and 2008 the share of university students who had a father with a low level of education rose from 6 to 10%. The share is about double that for intermediate levels of father's education and more than three times as high when the father graduated from university himself. The trends over time however differ. The share of students shows a dip in the early 90s and is fairly stable otherwise.

The second important pattern is that even among those who hold the necessary qualification less than half are studying among those with fathers with low or intermediate levels of education. But more than 50% who are eligible are enrolled at a university when their father graduated from a university himself.

The figure shows clearly, that there is strong dependence between the child's and the father's level of education. The same point can be made for the occupational status of the father, which is likely to be highly correlated to the fathers education. But it also shows, that the divergence between children already happens at the high school level and not in the selection into university studies. Most of the children with father's that have low levels of educational attainment do not achieve the necessary university entrance qualification in the first place (see Dustmann, 2004).[4]

In 2007 the high school graduation rates exhibit small peaks for all children but for those with father's who are blue collar workers or have a low level of educational attainment. This can be explained by the adjustment process from a shortening of the number of years of high school. In 2007 two cohorts of high school students graduated. This peak however does not translate into an increase in the share of students or university freshman for graduates with low or intermediate levels of father's education. These numbers even decline.

Focusing on the last three to four years, the time student fees became a topic in higher education policies, the share of high school graduates with fathers with low or intermediate levels of education who enroll at universities as well as who are studying is slightly decreasing. This pattern is also observable for children with fathers with upper secondary education. This might indicate that student fees have a negative impact on university enrollment, especially for these high school graduates. As mentioned above, during the same time-period, the amount of student aid was

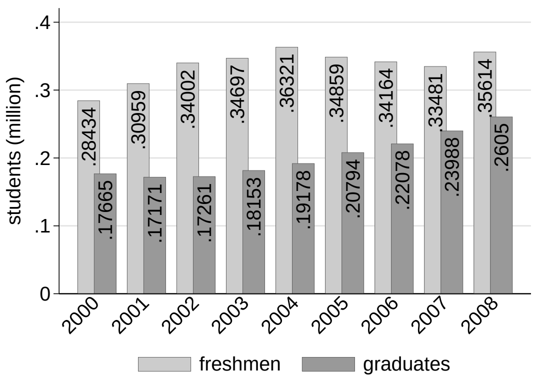
[4]After elementary school, different schooling tracks are suggested by the elementary school teachers: the *Gymnasium* which leads to the *Abitur* or *Fachabitur* after 12 to 13 years of schooling, the middle school (*Realschule*) which leads to the *mittlere Reife* a vocational degree after 10 years of schooling, or the *Hauptschule* after nine years of schooling. Only the Gymnasium track allows for direct access to the university system.

decreasing in real terms. Together with an introduction of student fees, financial concerns might have gained in importance. In contrast, children with fathers with higher education are unaffected by these developments, moreover their share is even increasing during these years, indicating differences in the acceptance of student fees. Thus rich students might expect better learning environment and are willing to pay for it, but poor students do not have the means to finance it.

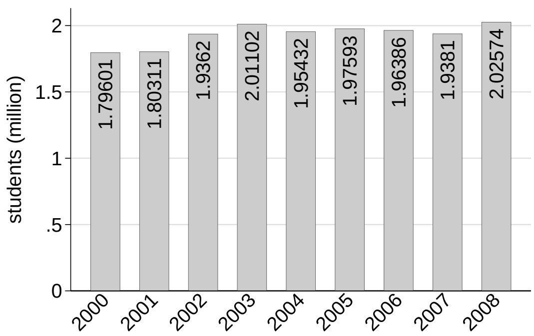
Figure 2.5 reports the developments in the student numbers, as well as the in- and outflow of university. The number of university freshmen is increasing from 2000 to 2004, where it reaches its peak. The years after are followed by a decline until 2008, where the trend reverses. The number of university graduates is steadily increasing in the chosen time frame (figure 2.5(a)). The average duration until graduation over the reported time is stable at five years (Statistisches Bundesamt, 2008). Comparing the numbers of graduates with the freshmen cohort five years earlier can therefore be used as proxy for the graduation rate, which the is between 70% and 75% without any clear trend over time. Since the number of persons studying remains fairly stable

Figure 2.5: Developments in student numbers

(a) University freshmen and graduates



(b) Students



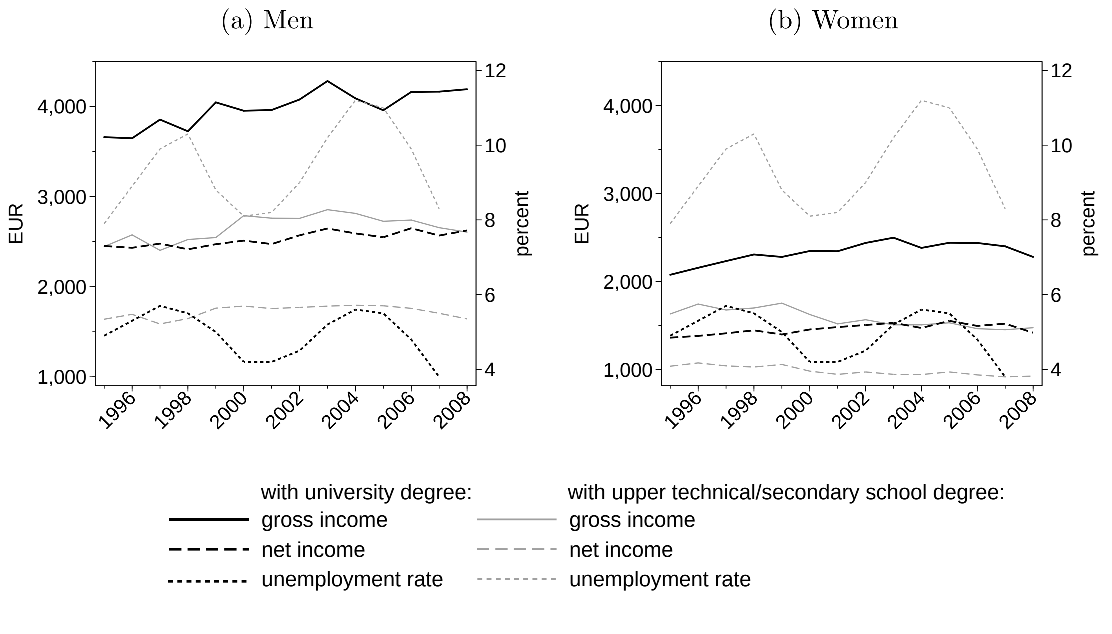
Source: Statistisches Bundesamt (2008): Fachserie 11 Reihe 4.3.1

over time (figure 2.5(b)), the gap between freshmen and graduates (five years after enrollment) seems a good estimate of the share of students that leave university without a degree which is about 25% to 30%. If the time to degree changed there would be variation in the number of enrolled students, which is not the case.

2.2.2 Returns to Education

The returns to education are a key component in the decision to enroll in higher education (see e.g. Kodde, 1988). Figure 2.6 depicts the earnings differential between university graduates and non-graduates conditional on holding a high school degree, as well as the average unemployment rate for both groups. For men the earnings differential is huge, university graduates earn between 3,600 and 4,200 EUR, while high school graduates who did not graduate from a university earn between 2,500 and 2,800 EUR per month. That means gross earnings are about 50% higher for university graduates and the differential is stable over time. Progressive taxation closes the gap slightly, as for net earnings the mark-up for university graduates is less than 50%. Another advantage for men holding a university degree is the low unemployment rate. It varies cyclically between 4% and 5.5% and is about half of the unemployment rate for men without a university degree.

Figure 2.6: Earnings and unemployment by education and gender



Source: SOEP, weighted: own calculations based on working individuals, real wages in prices of 2005

The same low unemployment rate applies to women with university education and also to the relationship to women without university education. But for earnings the picture is markedly different. On average women earn about 1,800 EUR per month with a university degree, even less than men without tertiary education. The earnings differential between men and women can however be explained by women being more likely to work part-time. Since the figure only depicts the monthly earnings and not the hourly earnings, this is the most reasonable explanation. Another explanation might be selection of women into jobs that pay less but might offer non-monetary benefits, e.g. personal fulfillment or social approval. And finally the data show only earnings of women and men who are working, in Germany married women with children often exit the labor force which means that compared to men, the women who are working are on average younger with less experience and therefore at a lower point in their age-earnings profile. But the relative gain for women with a university degree compared to women without university education (average of about 1,200 EUR) is still around 50% (gross as well as net).

Earnings are an important determinant of the enrollment decision, but the unemployment rate—which is substantially lower for persons with a university degree—also influence the university enrollment decision (Lauer, 2002). If individuals are risk averse and gain utility from job security, then a low unemployment rate would increase enrollment (see chapter 3).

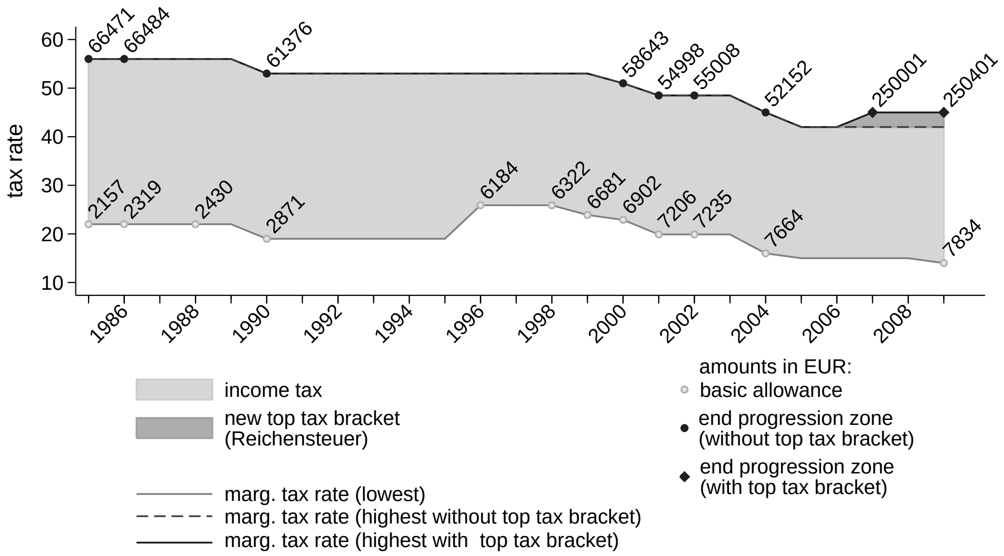
As net returns to education (as opposed to gross returns) are the appropriate determinant in the university enrollment decision process, figure 2.7 shows the developments of the German income tax system. As university graduates are likely to have a higher income, they might prefer lower marginal tax rates especially for high income. As the figure shows, the marginal tax rate at the top end steadily decreased over the last 30 years, from 56% in 1985 to 42% (45% at the top tax bracket which applies to an income of above 250,000 EUR) in 2009. At the same time, the level of earnings at which the highest tax rate has to be paid, i.e. end of the progression zone, decreased from 66,471 EUR to 52,152 EUR. This amount is in 2008 about 10% higher than the average earnings of a male university graduate.

Between 1999 and 2005 major changes occurred in the income taxation which resulted from the Tax Reduction Act 1999 and the Tax Reduction Act 2000.[5] During that period, the marginal tax rate at the higher end was successively decreased from 53% in 1999 to 42% in 2005 where it remained until today. The amount at the end of the progression zone was adjusted accordingly, decreasing from 61,376 EUR to 52,152. Simultaneously the basic allowance was increased by 983 EUR, accompanied

[5]The Tax Reduction Act of March 24, 1999, defined tax reductions for the years 1999/2000/2002. In the framework of the Tax Reduction Act 2000 (which comprises the Tax Reduction Act of October 23, and the Supplementary Tax Reduction Act of December 19, 2000), however, the last step was pulled forward by one year and thus started with January 1, 2001, and is therefore often accounted to be part of the reform of 2000.

by a decrease in the lowest marginal tax rate from 23.9 to 15 percent in 2005, and was further reduced in 2009 by one percentage point.

Figure 2.7: Development of tax rates and basic allowance in income taxation



Source: EinkommensSteuerGesetz (EStG) and Bundesministerium für Finanzen (2010)

The tax system might indirectly play an important role for the university enrollment decision, since it influences the net returns to higher education. On the one hand, a lower tax rate for high incomes increases the net income a person receives which might positively influence the decision to take up higher education (positive income effect). On the other hand, income smoothing and therefore the insurance effect becomes smaller. Especially for risk averse persons this might reduce the attractiveness of a university degree.

Chapter 3

Structural University Enrollment Model

3.1 Introduction

When high school graduates decide between enrolling in a university and starting to work right away, they likely consider both the returns to a higher education and income uncertainty associated with both alternatives. To estimate the impact of these components on university enrollment rates, we[1] develop and estimate a structural microeconometric model of the university enrollment decision. A high school graduate chooses to study if his or her expected lifetime utility from an academic career exceeds that anticipated from an alternative career. Utility in this model therefore depends on the ex-ante expectation and variance of net income; we estimate both values for each high school graduate for the two alternative career paths, based on information available at the time of the enrollment decision. This approach avoids a reliance on ex-post income realizations to explain education decisions, as in some prior literature, which has prompted some criticisms (Cunha et al., 2005; Cunha and Heckman, 2007). We take into account non-random selection based on multiple correlated criteria. The structural parameters that we estimate include the Arrow-Pratt coefficient of constant relative risk aversion.

Germany provides an interesting context for studying the interaction of expected risk adjusted net returns and university enrollment for various reasons. The enroll-

[1]The model developed in this chapter is based on a joint study with Frank M. Fossen (Fossen and Glocker, 2009)

ment rates in Germany are considerably lower than those in other developed countries. According to the OECD (2007), 35% of young Germans will enter tertiary education (university or university of applied science), compared with an OECD-average of 56%.[2] The German environment is marked by comparably high and progressive taxes, and thus by comparatively low gains from high earnings. Are the low enrollment rates a consequence of too low after-tax returns to education and an income risk which is by way of comparison still considerably high?

In contrast with the existing literature on education and income uncertainty, we explicitly model taxation by integrating a microsimulation model of the German tax and social security legislation.

Although the focus of this study is income risk, we also include two other important sources of risk in the model: the risk of dropping out of university, and unemployment risk, which is much higher for non-academics in Germany. Furthermore, we control for the possibility that would-be university students may face financial constraints by including information about their financial and social background. To conduct our analysis, we use a large, representative, panel data survey, the German Socio-Economic Panel Study (SOEP), which not only provides detailed information on the working-age population, but also on financial resources, social background, and high school achievements of high school graduates.

The results from the estimation of our enrollment model are consistent with expectations: Higher expected risk-adjusted returns from an academic career path in comparison with a non-academic career path increase high school graduates' probability of enrolling in a university. Furthermore, young people are moderately risk averse when deciding to enroll in higher education. Consequently, higher income risk associated with an academic career path discourages potential students from enrolling.

Literature pertaining to the effect of uncertainty on the decision to pursue a tertiary education, without an explicit consideration of taxes, dates back to Levhari and Weiss (1974). They introduce a two-period model, where in the first period the choice between getting schooling or going to work is made, and in period 2 there is only work. The payoff for time spent in school is ex-ante uncertain but revealed at the beginning of the second period. These authors find that increasing risk, i.e. the variance in the payoff for education, reduces investments in education. Subsequent

[2] No standardized system for job qualification exists in the OECD countries, so the same job may demand a different form of training (e.g., apprenticeship, university degree) in different countries, thus these numbers should be interpreted with care.

studies by Eaton and Rosen (1980) and Kodde (1986) build on this model and similarly conclude that uncertainty is a main determinant of the decision to invest in education. Hartog and Serrano (2007) analyze the effect of stochastic post-school earnings on the desired length of schooling and find that greater post-schooling earnings risk requires higher expected returns. Explicitly modeling the choice for college enrollment, Carneiro et al. (2003) reanalyze a model introduced by Willis and Rosen (1979) by accounting for uncertainty in the returns to education. They show that reducing uncertainty in returns increases college enrollment. Although these models differ somewhat in their conceptualization of risk, they all essentially consider the effect of changes in the variance of the post-school wages and find that more risk in the returns reduces the investment.

A related stream of literature investigates the strong correlation of higher education with parental income. Becker (1964) pointed out, that the capital market for college investment is likely to be imperfect. Prospective students, especially the ones from low income families, have only little or no collateral to borrow against. In the empirical literature credit constraints are not easily identifiable as pointed out by Carneiro and Heckman (2002). Other factors, partly captured by measures of credit constraints, determine university enrollment. Thus university enrollment results from academic success in school which is due to the effect of long-term factors that may promote cognitive and non-cognitive ability of students, such as parental time or the purchase of market goods that are complementary to learning (see also Esping-Andersen, 2008).

As the German higher education system was highly subsidized and the recent introduction of student fees were accompanied with special student loans where no collateral is necessary, credit constraints should be eliminated. Thus lower enrollment rates for potential students with little financial resources should not be due to (short-run) credit constraints. Empirical evidence for Germany is scarce. Lauer (2002) analyzes the effect of economic incentives on university enrollment. Applying a microeconometric choice model on SOEP data, the author finds that expectations about costs and returns of education do have an impact on the uptake of higher education. Higher expected wages, as well as a lower unemployment risk increase the probability of university enrollment. Focusing on the student aid scheme, she also finds that entitlement to student aid has a stronger effect than the actual amount transferred to the student. She concludes that this is due to the student aid repayment obligations. The higher the share of repayment of the student loan, the lower the probability to enroll as it lowers the returns to education. Focusing on this aspect, Baumgartner and Steiner (2004) analyze a change in the student aid loan share. In 1990 the loan share of BAFoeG decreased from a full loan scheme to a partial loan-grant system. The authors treat this reform as natural experiment, applying a difference-in-differences approach. They do however find no significant impact of the indirect increase in the returns to education on university enrollment. As these analyses were based on the SOEP, student aid eligibility is only observable for students who are already enrolled, which leads to small sample size. To circumvent this problem as well as possible endogeneity, Steiner and Wrohlich (2008) simulate BAfoeG entitlement as well as the amount of BAfoeG prospective students are entitled to. They do find a small positive and significant effect. An increase of student aid increases the probability of university enrollment. The estimated coefficient is higher than the effect found for parental income which is also significant and positive. However they disregard the increased repayment obligations that are associated with an increase in BAfoeG, which reduce the returns of university education.

3.2 Modeling the University Enrollment Decision

The university enrollment decision can be modeled econometrically in a discrete time hazard rate framework. The sample 'at risk of enrollment' consists of high school graduates who left school with a university entrance qualification (*Abitur* or *Fachabitur*)[3] , have not yet started studying, and are between 18 and 25 years of age, which is the usual age range for university enrollment in Germany. We model spells in yearly steps, such that the enrollment decision is made every year. A hazard rate model has the advantage of consistently taking into account censored spells, which refer to people not fully observed in the relevant period of their lives.[4]

We establish the model as follows: After obtaining an *Abitur* or *Fachabitur*, a high school graduate rationally chooses to enroll at a university to pursue an academic career or to start working right away. In the latter case it is assumed

[3]In Germany, leaving high school with the degree *Abitur* (or *Fachabitur*) is the only means to directly qualify for enrollment at a university (or university of applied science, respectively). In the following, we do not distinguish between general universities and universities of applied science.

[4]Left-censored spells can be taken into account consistently, because retrospective biographical data reveal the spell duration.

he or she will first take an apprenticeship, if he or she has not already finished one. Our model captures the choice of 97% of all German high school graduates, because only 3% choose to neither go to college nor take up an apprenticeship (see Heine et al., 2008). When making the decision between studying and working, prospective students are forward looking, i.e. they calculate their future utility gains of a university degree. Individual i in observation year t decides to undertake tertiary education ($\delta_{it} = 1$) if the expected utility of lifetime earnings is higher with a university degree (lifetime utility V_{1it}) than without (lifetime utility V_{2it}):

$$\delta_{it} = \begin{cases} 1, & \text{if} \quad E(V_{1it}) > E(V_{2it}), \\ 0, & \text{otherwise.} \end{cases} \tag{3.1}$$

Lifetime utility V_{sit} in both states $s \in \{1; 2\}$ depends on the discounted sum of the period-specific utilities $U(y_{si,t+\tau})$ in each future period τ (counting from period t) over the lifecycle, which are determined by future income $y_{si,t+\tau}$, which is ex-ante forecasted by the high school graduate. In addition, V_{sit} is a function of the current characteristics x_{it} of the high school graduate at the time of the enrollment decision as well as of the duration since his or her high school graduation d_{it}. These variables may shift tastes or costs with respect to university enrollment. The lifetime utility thus can be written as

$$V_{sit} = \sum_{\tau=0}^{T} \frac{1}{\gamma^{\tau}} U(y_{si,t+\tau}) + x_{it}'\beta_1 + \varphi_s(d_{it}) + \epsilon_{sit}, \tag{3.2}$$

where $\varphi_s(d_{it})$ is a function of the duration since graduation (baseline hazard)[5] , $\gamma > 1$ is the time discount factor for utility (time preference rate), and ϵ_{sit} captures preferences for enrollment known to the members in the sample but unobservable to the researcher, such that they are treated as a random variable.

We also recognize $y_{1i,t+\tau}$ and $y_{2i,t+\tau}$ as random variables from the perspectives of both the high school graduates and the researcher, because future income is uncertain. In this model, we assume that people know the probability distribution of their future income for both career options but not the future realizations.

The vector x_{it} notably controls for credit constraints, specifically, student aid eligibility to directly control for credit constraints, and parental education and parental

[5] In the estimation, $\varphi_s(d_{it})$ is specified flexibly by dummy variables that capture the time since high school graduation.

net income to capture long- and short-term credit constraints indirectly. We simulate the eligibility of high school graduates for student aid, according to German legislation, by taking their financial resources into account. If a potential student cannot cover at least his or her living expenses by drawing money from his or her own wealth or through support from her parents, he or she is eligible for student aid. In addition, x_{it} includes the age at which the person finished high school, whether he or she has no, one, or more than one siblings, if the person has finished an apprenticeship, best high school grade obtained out of the subjects math and German, and the persons individual intention to pursue a university degree at age 17 years. Furthermore, the explanatory variables include gender, time dummies and if the individual was affected by student fees.

Beyond income risk, we assume that high school graduates are aware of the risks of unemployment and dropping out of the university. Unemployment risk varies by state s. When unemployed, a person receives unemployment benefits at the unemployment benefit rate (UBR) set at 60% (67% for parents) of the net wage the person would otherwise receive. This value represents a moderately simplified model of the German legislation for temporary unemployment.[6] The assumption is that agents expect potential unemployment to last no longer than the period during which the unemployment benefit can be received, usually one year.[7] Drawing on figures reported in chapter 2.2, we assume university graduates in Germany face a annual unemployment risk $risk_1^u$ of the respective year (average over the years is approx. $risk_1^u = 5\%$), whereas those without a university degree, including university dropouts, have on average a higher risk of $risk_2^u = 9\%$. Taking unemployment risk into account reduces expected wages in both alternatives, but more so for the non-academic career path because of the higher unemployment risk. Income adjusted for the risk of unemployment (y^u) then can be written as:

$$\text{In general: } y^u_{si,t+\tau} = ((1 - risk^u_s) + risk^u_s UBR) y_{si,t+\tau}, \tag{3.3}$$

$$\text{For university drop-outs: } y^u_{1i,t+\tau} = ((1 - risk^u_2) + risk^u_2 UBR) y_{1i,t+\tau}. \tag{3.4}$$

The risk of not finishing the university successfully can be modeled as follows:

[6] Unemployment benefits in Germany (Arbeitslosengeld I) depend on the last net earnings of an unemployed person, where net wage is calculated using a lump sum social security contribution rate.

[7] Shorter periods of benefit entitlement apply to people who previously have not contributed to unemployment insurance for a sufficient number of months, whereas longer periods are available for older people with a sufficient contribution record.

A student who drops out suffers a deduction from the gross income he or she would receive as a successful university graduate. The dropout risk in Germany is assumed to be $risk_1^d = 18\%$ (see chapter 5), accompanied by a wage reduction of $\psi = 21\%$ of gross income (see Heublein et al., 2003). A university dropout thus receives adjusted income $y_{1i,t+\tau}^{ud} = (1-\psi) * y_{1i,t+\tau}^{u}$. For the non-academic career path, $risk_2^d = 0\%$. While unemployment is modeled as an independent year-to-year risk, the dropout risk refers to an entire lifetime income path.

Accounting for unemployment and dropout risk, equation 3.2 becomes

$$\begin{aligned} V_{sit} &= (1-risk_s^d)\sum_{\tau=0}^{T}\frac{1}{\gamma^\tau}U(y_{si,t+\tau}^{u}) + risk_s^d\sum_{\tau=0}^{T}\frac{1}{\gamma^\tau}U(y_{si,t+\tau}^{ud}) \\ &\quad + x_{it}'\beta_s + \varphi_s(d_{it}) + \varepsilon_{sit}. \end{aligned} \tag{3.5}$$

To evaluate this equation further, we have to take the expectation with respect to the random variables $y_{si,t+\tau}$:

$$\begin{aligned} E(V_{sit}) &= (1-risk_s^d)\sum_{\tau=0}^{T}\frac{1}{\gamma^\tau}E_{t+\tau}\left[U(y_{si,t+\tau}^{u})\right] + risk_s^d\sum_{\tau=0}^{T}\frac{1}{\gamma^\tau}E_{,t+\tau}\left[U(y_{si,t+\tau}^{ud})\right] \\ &\quad + x_{it}'\beta_s + \varphi_s(d_{it}) + \varepsilon_{sit}. \end{aligned} \tag{3.6}$$

The expectation of $U(y_{si,t+\tau})$ can be approximated by a second-order Taylor series expansion around $\mu_{si,t+\tau} = E(y_{si,t+\tau})$:

$$\begin{aligned} E(U(y_{si,t+\tau})) &\approx U(\mu_{si,t+\tau}) + U'(\mu_{si,t+\tau})E(y_{si,t+\tau} - \mu_{si,t+\tau}) \\ &+ \frac{1}{2}U''(\mu_{si,t+\tau})E((y_{si,t+\tau} - \mu_{si,t+\tau})^2) \\ &= U(\mu_{si,t+\tau}) + \frac{1}{2}U''(\mu_{si,t+\tau})\sigma_{si,t+\tau}^2, \end{aligned} \tag{3.7}$$

where $\sigma_{si,t+\tau}^2 = Var(y_{si,t+\tau})$. We must specify a functional form for $U(.)$. In the following, we assume a constant relative risk aversion (CRRA), as in Hartog and Vijverberg (2007), which implies that the utility function must satisfy

$$-\frac{yU''(y)}{U'(y)} = \rho, \tag{3.8}$$

where the parameter ρ is the coefficient of CRRA (Pratt, 1964).[8] The utility function we choose satisfies the CRRA condition and is increasing in the money ($U'(y_{si,t+\tau}) > 0$):

$$U(y_{si,t+\tau}) = \begin{cases} \alpha_s \frac{y_{si,t+\tau}^{1-\rho}}{1-\rho}, & \text{if } \rho \neq 1. \\ \alpha_s \ln y_{si,t+\tau}, & \text{if } \rho = 1. \end{cases} \tag{3.9}$$

This specification therefore implies a risk preference for $\rho < 0$, risk neutrality for $\rho = 0$, and risk aversion for $\rho > 0$. The structural risk preference parameter ρ will be estimated econometrically, along with the coefficients of risk-adjusted income α_s and the control variables using the maximum likelihood method.

Plugging $U(.)$ and its second derivative into the Taylor approximation (equation 3.7) enables us to evaluate equation 3.6:

$$E(V_{sit}) = \alpha_s W_{sit} + x'_{it}\beta_s + \varphi_s(d_{it}) + \varepsilon_{sit}, \tag{3.10}$$

where W_{sit} is defined as follows ($\rho \neq 1$):[9]

$$\begin{aligned} W_{sit} = (1 - risk_s^d) & \sum_{\tau=0}^{T} \frac{1}{\gamma^\tau} \left(\frac{\mu_{usi,t+\tau}^{1-\rho}}{1-\rho} - \frac{1}{2}\rho\mu_{usi,t+\tau}^{-\rho-1}\sigma_{usi,t+\tau}^2 \right) \\ +risk_s^d & \sum_{\tau=0}^{T} \frac{1}{\gamma^\tau} \left(\frac{\mu_{udsi,t+\tau}^{1-\rho}}{1-\rho} - \frac{1}{2}\rho\mu_{udsi,t+\tau}^{-\rho-1}\sigma_{udsi,t+\tau}^2 \right). \end{aligned} \tag{3.11}$$

The parameter $\alpha_s > 0$ reflects the weight of the risk-adjusted income in the enrollment decision. For $\alpha_s > 0$ and $\mu_{si\tau} > 0$, the equation implies that for risk-averse agents, expected lifetime utility decreases with greater variance of income, whereas for risk-neutral agents, the variance does not matter.

[8] Alternatively we could assume constant absolute risk aversion (CARA). The advantage of the CARA utility is that a closed-form representation of expected utility exists if y is normally distributed, and no Taylor approximation is needed. Prior literature prefers CRRA though as the more realistic specification, as exemplified by Keane and Wolpin (2001), Sauer (2004), Belzil and Hansen (2004), and Brodaty et al. (2006).

[9] When $\rho = 1$, W_{sit} can be written as:

$$\begin{aligned} W_{sit} = (1 - risk_s^d) & \sum_{\tau=0}^{T} \frac{1}{\gamma^\tau} \left(\ln \mu_{usi,t+\tau} - \frac{1}{2\mu_{usi,t+\tau}^2}\sigma_{usi,t+\tau}^2 \right) \\ +risk_s^d & \sum_{\tau=0}^{T} \frac{1}{\gamma^\tau} \left(\ln \mu_{udsi,t+\tau} - \frac{1}{2\mu_{udsi,t+\tau}^2}\sigma_{udsi,t+\tau}^2 \right). \end{aligned}$$

Referring back to equation 3.1, the probability of enrolling in higher education equals:

$$P(\delta_{it} = 1) = P(E(V_{1it}) > E(V_{2it})) = F(\alpha(W_{1it} - W_{2it}) + x'_{it}\beta + \varphi(d_{it})), \quad (3.12)$$

with $\alpha = \alpha_1 - \alpha_2$, $\beta = \beta_1 - \beta_2$, and F is the cumulative distribution function of the error difference $\varepsilon_{2it} - \varepsilon_{1it}$. The likelihood function therefore can be written as:

$$\begin{aligned} L = \quad & \textstyle\prod_{i=1}^{N} \prod_{t \in T_i} F(\alpha(W_{1it} - W_{2it}) + x'_{it}\beta + \varphi(d_{it}))^{\delta_{it}} \\ & \times (1 - F(\alpha(W_{1it} - W_{2it}) + x'_{it}\beta + \varphi(d_{it})))^{(1-\delta_{it})}, \end{aligned} \quad (3.13)$$

where T_i is the set of years in which individual i is observed.

To estimate the model, we next need to specify the cumulative distribution function of the error difference F. Following McFadden's (1974) random utility model, we assume that the error terms ε_{sit} are i.i.d. type-I extreme value distributed. As McFadden shows, F is therefore the cumulative logistic probability distribution function.

To predict the future wages, we make several additional assumptions about the two different career paths. The first assumption relates to income while studying at a university. We assume that it takes five years to graduate, which is the approximate mean in Germany. Because students generally receive monetary transfers, whether from their parents or as student aid from the government, assuming no income during university attendance would be unrealistic. Instead, we assume that these transfers equal the officially announced minimum cost of living, which each student is entitled to receive according to German legislation. During the observation period, these costs were 565 EUR per month (e.g., Deutscher Bundestag, 2007). We distinguish between students who receive this income from their own or their parents' wealth and students who rely on student aid. Although the amount of income remains the same, transfers from parents versus student aid are subject to different repayment rules. We therefore assume no repayments if the income is drawn from the students' own or their parents' wealth, whereas students who draw money from student aid must consider repayment obligations when calculating their expected lifetime utility. The German Federal Training Assistance Scheme states that half of the amount of student aid received must be repaid (interest free) as soon as the borrower's monthly net income exceeds 1040 EUR. The other half is a subsidy. We model the eligibility and repayment rules for student aid accordingly.[10] Furthermore, we realize that many university students work in some kind of part-time job. As university students already "work" full-time on their education and additional moonlighting further reduces leisure time, we assume the additional utility from this moonlighting is small and can be neglected when comparing lifetime utility between the academic and non-academic career paths.

3.3 Data

This analysis is based on the German Socio-Economic Panel Study (SOEP) which is provided by the German Institute for Economic Research (DIW Berlin). The SOEP is a representative yearly panel survey that gathers detailed information about the socio-economic situation of (currently) more than 21,000 persons living in approximately 12,000 households in Germany. Wagner et al. (2007) provide a detailed description of the SOEP. This analysis draws on the most recent waves (2000 to 2008)[11]. One of the advantages of the SOEP is that in addition to the information collected in the annual interviews, it provides retrospective information about the respondents' youth and socialization period, such as school grades, which are important control variables in the university enrollment model. Since 2000, an additional youth biography questionnaire has been implemented for 17 year olds, which provides additional information on schooling and career plans at that age.

We estimate the university enrollment model for the subsample of secondary school graduates who have obtained a university admission qualification (*Abitur/ Fachabitur*) and are between 18 and 25 years of age (1,053 observations). Table B3.1 in the Appendix lists the descriptive statistics about these potential university entrants. The sample consists of 569 individuals who are observed on average for 1.85 years in the sample. Approximately 51% of the individuals (290 individuals) enroll at a university during the five years after their high school graduation. The average time until they enroll is 1.7 years after high school graduation. With 268 compared to 301, there are slightly more women than men in the sample, but with 55%, compared to 48%, relatively more men are taking up higher education.

Table B3.2 shows the descriptive statistics for the full sample used to estimate

[10] For a detailed description of the calculation of student aid eligibility and the amount of student aid see chapter 2.1.1 and chapter 5.3.2.

[11] The 2008 wave is used to obtain retrospective income information for 2007 only.

earnings, thus including all the observations from the working age population with university entrance qualification. We estimate level and variance of wages separately for men and women because of the well-documented differences in male and female wage equations. All monetary variables, and therefore all monetary results, are deflated by the Consumer Price Index (2005 = 100).

3.4 Estimation of Expectation and Variance of Earnings

The first step in our analysis of the enrollment decision is to predict individual wage profiles and the variance of wages over lifetime in the alternative states, with and without university degrees. In this section, we present the wage and variance estimations, which are based on the full sample of working age people with a high school degree.

3.4.1 Selection

To control for selection effects in the earnings regressions, we apply the Heckman-Lee method of estimating simultaneous equations with multiple sample selection (Heckman, 1976; Lee, 1976). The first selection equation is based on each person's educational attainment, since we want to estimate wages separately for academic and non-academic careers. The second selection occurs because we only observe wages for people who are working. Ignoring these two selection processes would lead to a selectivity bias in the wage equation (e.g. Fishe et al., 1981). The first selection equation captures the individual choice to be a university graduate:

$$I^*_{1it} = z_{1it}\eta_1 + v_{1it}, \tag{3.14}$$

$$\text{with} \quad I_{1it} = \begin{cases} 1, & \text{if} \quad I^*_{1it} > 0. \\ 0, & \text{else.} \end{cases} \tag{3.15}$$

The second selection equation models the person's decision to work:

$$I^*_{2it} = z_{2it}\eta_2 + I_{1it}\iota + v_{2it}, \tag{3.16}$$

$$\text{with} \quad I_{2it} = \begin{cases} 1, & \text{if} \quad I^*_{2it} > 0, \\ 0, & \text{else.} \end{cases} \tag{3.17}$$

The vector z_{1it} includes only information that is available to the person at the time of the enrollment decision, such as most recent high school grades in German and math, the degree to which parents showed interest in the graduate's school performance, size of the city in which the person grew up, parents' high school degree and employment status, and whether the parents were born in Germany. The vector z_{2it} in the work participation equations features relevant contemporaneous information: age, unemployment experience and time being housewife/men (level and square terms), region, education, unemployment rate in the region, year fixed effects, and whether the individual is married, has young children, was born in Germany, or is physically handicapped.

We allow the two selection processes to be correlated, as is reflected in the error terms $(cov(v_{1it}, v_{2it}) = \rho_{v_{1it}v_{2it}} \neq 0)$.

We estimate the selection equation using a bivariate probit (Maddala, 1986) and allow for a structural shift by including the outcome of the first selection process, university education, as a dummy variable in the second step (Heckman, 1978), with coefficient ι. Appendix 3.7.A describes the method. The estimated parameters $\hat{\eta}_1$, $\hat{\eta}_2$, and $\hat{\rho}_{v_1v_2}$ can then be used to calculate selection correction terms for the wage equations for academic and non-academic careers as follows (neglecting individual and time indices):

Academic	Non-Academic
$M_{ab} = (1-\rho^2_{v_1v_2})^{-1}(P_a - \rho_{v_1v_2}P_b)$,	$M_{cd} = (1-\rho^2_{v_1v_2})^{-1}(P_c - \rho_{v_1v_2}P_d)$,
with	
$a, b = 1, 2$ and $a \neq b$,	$c, d = 3, 4$ and $c \neq d$,
where	
$P_1 = \frac{\int_{-(z_2\eta_2+I_1\iota)}^{\infty}\int_{-z_1\eta_1}^{\infty} v_1 f(v_1v_2)dv_1dv_2}{F(-z_1\eta_1,-(z_2\eta_2+I_1\iota),\rho)}$	$P_3 = \frac{\int_{-(z_2\eta_2+I_1\iota)}^{\infty}\int_{-\infty}^{-z_1\eta_1} v_1 f(v_1v_2)dv_1dv_2}{F(z_1\eta_1,-(z_2\eta_2+I_1\iota),-\rho)}$
$P_2 = \frac{\int_{-z_1\eta_1}^{\infty}\int_{-(z_2\eta_2+I_1\iota)}^{\infty} v_2 f(v_1v_2)dv_2dv_1}{F(-z_1\eta_1,-(z_2\eta_2+I_1\iota),\rho)}$	$P_4 = \frac{\int_{-\infty}^{-z_1\eta_1}\int_{-(z_2\eta_2+I_1\iota)}^{\infty} v_2 f(v_1v_2)dv_2dv_1}{F(z_1\eta_1,-(z_2\eta_2+I_1\iota),-\rho)}$.

Table B3.3 in the Appendix shows the estimation results for the bivariate probit estimations, separately for men and women. For each gender, the results in the first column refer to the probability of earning a university degree (being an academic), and the second column indicates the probability of working. The estimated value of $\rho_{v_1 v_2}$ is positive and significant for both, men and women, which suggests a positive correlation between education and work decisions.

As expected, better grades in secondary school increase the probability of earning a university degree. Higher parental education, growing up in a large city and having a working father have a positive impact as well. This holds for both men and women, unlike the nationality of the parents. Here women with German parents are less likely to have university education, for men the estimated coefficient is statistically insignificant. But the interpretation of the estimates should not carry too much weight, since for roughly 45% (43%) of the female (male) respondents no information about the parents' nationality is available (see table B3.2 in the appendix). Thus, the real impact of "parental nationality" will be a combination of the estimated coefficient for German parents and the statistically significant and positive coefficient of "parental nationality n.a.". The majority of respondents with missing information on parents' place of birth have German born parents. First the share of 2nd generation immigrants is small and second, the sample is selected on successfully obtaining an university entrance qualification, here the share of second generation immigrants is even lower (see Riphahn, 2003). Therefore the true effect of parents' ancestry will be a mix of the two estimated coefficients. How the effects aggregate is not clear, but it seems likely that the coefficient of "parental nationality n.a." will be mainly driven by children of German parents and this would cancel out the negative coefficient of the dummy indicating German parents.

For the employment selection the picture is far less homogenous. For both men and women the likelihood to work is positive increasing in age, but the similarities stop there. Having small children decreases the probability of work participation for women, and increases it for men. Similarly married women are less and married men more likely to work. Previous spells of unemployment matter more for men and make current employment less likely.

3.4.2 Estimation of Expected Wages

For each person in the sample, we must estimate expected net wages for careers with and without a university degree. Separately for the two subsamples of academics

($s = 1$) and non-academics ($s = 2$), we regress the hourly gross wages[12] (y^g_{sit}) on a vector of demographic and human capital and work-related variables z^{wage}_{it}:

$$\begin{aligned} y^g_{1it} &= \theta_1' z^{wage}_{it} + \lambda_{11} M_{12it} + \lambda_{12} M_{21it} + u_{1it}, \textit{ and} \\ y^g_{2it} &= \theta_2' z^{wage}_{it} + \lambda_{21} M_{34it} + \lambda_{22} M_{43it} + u_{2it}. \end{aligned} \tag{3.18}$$

There are four parts to the sum, the first are the controls multiplied with the coefficient vector θ_s, the second and third part control for selection (as discussed above) and the last part, u_{sit} is the error term. Conceptually, human capital variables clearly determine gross, but not net, wages, because the latter depend on the tax legislation. Thus, we estimate gross wages here and derive net wages subsequently (see section 3.4.5). The variable vector z^{wage}_{it} includes work experience (in years, as level, and squared), year dummies, 15 federal state dummies, 9 industry dummies, and dummies indicating self-employment (academics working as free lance professionals as well as other self-employment), a completed apprenticeship (*Lehre*), and current service in an apprenticeship, completed higher technological college (*Berufsfachschule*) or other vocational education, educational requirements for the current job position, as well as German nationality, physical handicap, and an intercept.

Table B3.4 in the Appendix provides the estimation results of the wage equations for academics and non-academics, separately for men and women. Wages increase with work experience, reflecting the typical profile. For men the experience profile is steeper for academics than for non-academics, not so for women. The educational requirement for a job is an indicator for different job profiles and duties. The higher the educational requirements, the higher are the hourly wages. Academics working self-employed or as free-lance professionals have significantly higher hourly earnings. At lower education levels only self-employment women earn more than female employees, for men the earnings are (statistically) the same. In all earnings regressions, at least one of the selection terms is significantly different from zero; thus non-random selection is relevant for the wage estimations.

[12]Wages in year t are obtained from retrospective questions in wave $t + 1$ about a respondent's monthly gross income in t, divided by the actual number of hours worked in the month before the interview in t.

3.4.3 Estimation of Variance of Wages

In addition to the expectation, we require the variance of wages to estimate the enrollment model. To estimate this variance, we use flexible heteroscedasticity functions of the residual variance from the wage equations. Specifically, the natural logarithms of the squared residuals from the wage regressions are regressed on the explanatory variables of the earnings model z_{it}^{wage} and the selection terms M_{abit} and M_{cdit} to control for selection, separately for academics and non-academics:

$$\begin{aligned} \ln(\hat{u}_{1it}^2) &= \pi_1' z_{it}^{wage} + \lambda_{11} M_{12it} + \lambda_{12} M_{21it} + e_{1it}, \textit{ and} \\ \ln(\hat{u}_{2it}^2) &= \pi_2' z_{it}^{wage} + \lambda_{21} M_{34it} + \lambda_{22} M_{43it} + e_{2it}, \end{aligned} \tag{3.19}$$

where e_{sit} is the error term.[13] In contrast with the estimation of a population parameter, this approach allows the predicted second moment of wages to vary not only between academics and non-academics but also with individual characteristics and covariates, just like the predicted first moment.

The results of the variance estimation for academic and non-academic men and women appear in Table B3.5 in the Appendix. The explanatory variables are jointly significant in each of the four estimations, which confirms the hypothesis that wages are heteroskedastic (Breusch-Pagan test)[14]. For non-academic men and women, as well as for academic men, some of the selection terms are significantly different from zero, but none of them are for academic women.

3.4.4 Forecasting Wage Profiles

For each observation in the sample of high school graduates, we use the estimated wage and variance equations to forecast individual profiles of the expected value and the variance of their wages over the lifecycle, separately for the two alternatives of an academic versus a non-academic career path. This step is required because the full profiles enter the decision model of university enrollment. For the academic career path, the first five years are assumed to be spent at the university, and students are

[13]To obtain consistent predictions for the squared residuals, the predicted values from the log model must be exponentiated and multiplied by the expected value of $\exp(e_{sit})$. A consistent estimate for the expected value of $\exp(e_{sit})$ can be obtained from a regression of the squared residuals on the exponentiated predicted values from the log model through the origin. This procedure does not require normality of e_{sit}.

[14]See e.g. Wooldridge (2003)

assumed to receive monetary transfers from their parents or student aid (see section 3.2). In the sixth year, the university graduate is assumed to start working, and work experience is increased successively to forecast the complete wage profile. In the non-academic career path, people are assumed to start working right away, and work experience is increased from the first year on. We assume that those who have not yet finished an apprenticeship plan to pursue an apprenticeship during the first two years of their non-academic career path. In the wage and variance equations, we capture lower wages during the apprenticeship with a dummy variable indicating that someone is currently an apprentice. This variable is negative and significant in the wage equation; see table B3.4. After two years, we assume the apprenticeship is finished. When forecasting the wage profiles, in addition to increasing each person's work experience and adjusting the information about apprenticeships, we assign the marital status and number of children information, as well as industry sectors, self-employment and requirements for the job according to the aggregate distributions, conditional on age and gender. The end of the individual time horizon occurs at the age of 65 years, the legal retirement age in Germany during the observation period.

3.4.5 Microsimulation Model of Income Taxation

Because individual utility depends on net (after-tax) income, the relevant variables in the enrollment model refer to the expected value and the variance of net wages. To derive the net from the gross wages, we use a microsimulation model of the German income tax and social security system. Based on a taxpayer's gross income, age, region of residence (there are some regional specifics in the relevant laws), and the legislation in the year of observation, the tax model calculates the income tax according to the progressive German income tax schedule, the solidarity surcharge, the social security contributions (i.e., contributions to statutory pension, health, long-term care, and unemployment insurance), and finally net income.[15]

Because we predict gross incomes for the future of current high school graduates, the household context (marital status, spouse's income, number of children) and other relevant information, such as extraordinary future expenses at the time when gross incomes will be earned and taxed, are unknown. In this respect, this application of microsimulation differs from others where the full information available

[15]We convert estimated real hourly gross wages into nominal yearly gross earnings for these calculations, and the resulting nominal yearly net earnings are converted back to real hourly net wages, using the average number of hours worked in the sample and the Consumer Price Index.

in a dataset about the actual current household context, incomes, and expenses, can be used for a full household-specific tax-benefit simulation, as in the tax-benefit model STSM (Steiner et al., 2008). Here, instead, for simplicity, we assume that the net incomes are calculated for an unmarried person without children, who does not receive one-off payments and does not pay church tax. The assumption of being unmarried has the same tax implications as the assumption of being married to a spouse at the same income level. Net income is then derived exactly equal to the net income paid to an employee after the deduction of the wage withholding tax, which is equivalent to assuming that someone does not file an income tax report. This procedure takes into account the provisional allowance and the allowance for professional expenses, assuming that actual expenses do not exceed these lump sum allowances. It seems plausible that high school graduates, who are usually unmarried and in most cases do not yet have children, make similar simplifying assumptions when they calculate their future taxes and social security contributions.

3.5 Estimation Results of the Enrollment Decision Model

Table 3.1 provides the estimation results of the structural enrollment decision model. The four columns provide the results from different specifications of the discount parameter γ, which is set at 1.02, 1.05, 1.08, and 1.1, respectively. In general, the results are not sensitive to the choice of γ.

The point estimate for the structural parameter of constant relative risk aversion ρ does not significantly differ from 0.05 for all γ. It is significant at the 5% level except for $\gamma = 1.02$. The positive ρ indicates risk-averse agents, though the degree of risk aversion is low. Holt and Laury (2002) estimate a higher degree of risk aversion, that is, around 0.3-0.5. The agents in our sample may be less risk averse than the population at large because of their particularly young age at the time of their decision about university enrollment; Dohmen et al. (forthcoming) provide some evidence that risk aversion increases with age.

The parameter of risk-adjusted income α is positive and significant at the 1% level. As expected, higher risk-adjusted returns from an academic career path in comparison with a non-academic career path increase the probability of university enrollment.

Table 3.1: Transition to tertiary education

	$\gamma = 1.02$ Coef.	$\gamma = 1.05$ Coef.	$\gamma = 1.08$ Coef.	$\gamma = 1.10$ Coef.
Eligible for student aid	−1.670**	−1.681**	−1.670**	−1.661**
	(0.433)	(0.432)	(0.434)	(0.434)
Eligible for student aid x parental net income	0.323**	0.319**	0.313**	0.310**
	(0.113)	(0.113)	(0.113)	(0.113)
Parental net income (1,000 EUR)	0.103†	0.105†	0.105†	0.105†
	(0.060)	(0.060)	(0.060)	(0.060)
Mother has university degree	0.148	0.131	0.116	0.111
	(0.264)	(0.264)	(0.263)	(0.262)
Father has university degree	0.355	0.353	0.351	0.347
	(0.271)	(0.271)	(0.272)	(0.272)
Affected by student fees	−0.076	−0.055	−0.043	−0.038
	(0.457)	(0.458)	(0.458)	(0.457)
Affected by student fees x student aid eligible	−1.112	−1.091	−1.083	−1.078
	(0.724)	(0.727)	(0.729)	(0.731)
Male	−0.801*	−0.807*	−0.809*	−0.812*
	(0.318)	(0.320)	(0.320)	(0.320)
Baseline hazard: time since high school graduation (Base: up to one year)				
Two years	0.148	0.118	0.075	0.042
	(0.382)	(0.383)	(0.384)	(0.384)
Three years	−0.696	−0.744	−0.795	−0.832
	(0.618)	(0.622)	(0.623)	(0.621)
Four years	−0.980	−1.007	−1.042	−1.072
	(0.710)	(0.709)	(0.706)	(0.704)
Five years	−2.001*	−2.050*	−2.093*	−2.124*
	(0.879)	(0.885)	(0.889)	(0.890)
Two years x male	2.267**	2.273**	2.294**	2.313**
	(0.505)	(0.508)	(0.510)	(0.511)
Three years x male	1.360†	1.356†	1.347†	1.345†
	(0.770)	(0.768)	(0.765)	(0.760)
Four years x male	2.103*	2.073*	2.034*	2.012*
	(0.896)	(0.896)	(0.893)	(0.890)
Five years x male	2.352*	2.339*	2.305*	2.282*
	(0.999)	(1.001)	(0.998)	(0.994)
Constant	−3.908**	−3.754**	−3.546**	−3.396**
	(0.642)	(0.631)	(0.616)	(0.607)
ρ	0.048	0.050**	0.039*	0.031†
	(0.034)	(0.019)	(0.017)	(0.017)
α	0.009**	0.014**	0.019**	0.022**
	(0.002)	(0.002)	(0.003)	(0.004)
Observations	1053	1053	1053	1053
Average probability	0.218	0.218	0.218	0.218

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%

Note: Clustered standard errors in parentheses

Other control variables are year dummies, best recent grade out of math and German, one sibling, more siblings, highest intended degree at age 17. See table B3.6

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

The coefficient of the dummy variable for student aid eligibility of the high school graduate (“Eligible for student aid”) is significant and negative. The coefficient for parental net income is positive and significant at the 10% level. The same holds for the interaction term of student aid eligibility and parental net income, indicating that parental income matters even more for high school graduates from a low financial background. The coefficients for parental education are positive but not significantly different from zero. All these variables capture the social background of a person and are hard to interpret separately. Student aid eligibility depends mostly on parental income and wealth, which in turn is highly correlated with education. Together, the results indicate that children from a socially disadvantaged background (i.e., eligible for student aid, low parental income and education) are less likely to enroll at a university. Since the sample includes the years 2006 and 2007, I include a dummy variable controlling for the presence of student fees in the federal states where they have been introduced, as well as an interaction term with student aid eligibility. Both variables are negative, but not statistically significant.

Gender differences are captured by the “male” dummy, as well as its interaction with the dummy variables indicating the time elapsed since high school graduation. The results show that men exhibit a lower enrollment probability in the first year after high school graduation but a higher one in the following years, which reflects that German young men often serve a mandatory military or alternative civil service term immediately after their high school graduation.

The estimated coefficients of the additional control variables, in table B3.6, indicate that good grades at the age of 17 years have a positive effect on the probability of university enrollment. The same holds for the variable indicating if a future high school graduate had the intention to obtain a university degree in the future at the age of 17 years. This variable might capture preferences for certain career choices that form at an earlier age.

Since the sample contains two years in which student fees are present in some federal states, the question of how to deal with the observations affected by them arises. To check the robustness of the results, table C3.1 shows two alternative specifications where the presence of student fees is reflected in the expectations of future income; in one we assume that all students regardless of their financial resources have to take up a student loan, in the second only students with no financial means, i.e. who are student aid eligible, have to take up a loan in order to meet the tuition payments. Since only few observations are affected by the possible payments of student fees, the coefficient estimates do not change. The effects captured by the student fee dummy, as well as the interaction with student aid eligibility show slight variation across specifications, but remain statistically insignificant. Furthermore, we restrict the sample to the years where student fees were not in place. This has the drawback that we lose some observations, but the parameter estimates of the relevant variables remain unaffected (see table C3.2).

Because our estimates are not sensitive to the choice of γ, in the following we focus on the estimates derived using the specification for which γ is 1.05. We conducted all the calculations for the other choices of γ as well and consistently find very similar results. The results for the time restricted sample, i.e. for the years 2000 to 2005, are reported in the appendix (table C3.2 and C3.3).[16]

At the mean values of the explanatory variables, the estimated hazard of university enrollment for a high school graduate in the sample in a given year is 22%. The cumulative probability of enrollment after five years is estimated to be approx. 51%. The estimates reflect the descriptive statistics (see table B3.1 in the appendix) and given the size of the standard error, are not different from other findings in the literature. For example, Steiner and Wrohlich (2008) estimate similar probabilities based on a non-structural model of university enrollment, also using SOEP data.

These estimate are, however, smaller than the official statistics, which report an average yearly university enrollment rate of 37% for a German high school graduate and a total enrollment of 75% of the graduates within five years of leaving high school in 2004 (Statistisches Bundesamt, 2007c). But this is not much of a concern since, first the enrollment rate has been increasing over the sample period and was fairly high by 2004 and my prediction is an average over the sample years. Calculating the predicted probability for 2004 alone leads to an average enrollment of 31% and a cumulative enrollment of 70%. Second the official statistic considers German and foreign students, while I use only high school graduates who obtained their degree in Germany.

Based on the estimated structural model, we can calculate how much the enrollment probability reacts to a change in the expected value or variance of net wages in the academic or non-academic career path. Table 3.2 shows the estimated changes in the average and cumulative enrollment probabilities that result from a 10% increase in the respective variables. The average changes in the yearly enrollment probabilities are calculated by predicting the estimated hazard rate for each observation in the sample before and after changing the income variables. Likewise,

[16]Follow up results for other choices of γ and different time periods are available upon request.

Table 3.2: Induced changes in university enrollment

	Average annual		Cumulative (after 5 years)	
	in percent	in percentage points	in percent	in percentage points
Increase by ten percent of				
Academic net income	25.305**	3.870**	17.889**	6.150**
	(5.951)	(1.320)	(5.693)	(2.141)
Non academic net income	−16.267**	−2.345**	−12.927**	−4.467**
	(3.012)	(0.860)	(3.244)	(1.520)
Variance academic net income	−0.198**	−0.030**	−0.153**	−0.051**
	(0.041)	(0.010)	(0.042)	(0.017)
Variance non academic net income	0.298**	0.057**	0.213**	0.089**
	(0.063)	(0.020)	(0.063)	(0.029)
Significance levels: † : 10% ∗ : 5% ∗∗ : 1%				

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

the average changes in the cumulative enrollment probabilities (five years after high school graduation) are calculated after evaluating the cumulative failure function, which is derived from the estimated hazard rate model, for each observation in the sample. Increasing one of the income variables or the variances leads to significant changes in the enrollment probabilities. All reactions have the expected sign, which indicates that higher expected net wages as an academic attract people to enroll in a university, but the higher income variance for academics deters people from doing so. A 10% rise in expected net wages for academics increases the cumulative probability of enrolling by 6.2 percentage points, if the net wages for non-academics and the variance in both career paths do not change. A 10% rise in wages for non-academics decreases the probability by 4.5 percentage points, ceteris paribus. The elasticities are not equal in absolute terms because of the different mean variances in the two career paths. If the wage variance in the academic path increases by 10%, the enrollment probability decreases by 0.05 percentage points, everything else being equal. An increase in the wage variance in the non-academic path leads to an increase in the enrollment probability by 0.09 percentage points.

3.6 Conclusion

The aim of this chapter is to develop a structural microeconometric model of university enrollment, which can be used as the basis for policy simulations. High school graduates are assumed to decide to enroll in tertiary education based on a comparison of the present value of the discounted utility from career paths with and without a university degree. In the model, utility in each future period depends on expected income and on income risk. The ex-ante future earnings paths of the expectation and variance of after-tax income for high school graduates are estimated individually, taking into account non-random selection based on multiple correlated criteria. Furthermore, I adjust the expectations of income and income risk by unemployment risk associated with the different career paths. The career path for university education also accounts for dropout risk, i.e. the probability to not finish university studies successfully. Additionally, individual characteristics at the time the enrollment decision is made are taken into account.

The estimation results are consistent with the expectations. Higher risk-adjusted expected wages as a university graduate, relative to non-academics, increase the probability of enrollment. Increasing the net income of the academic career path by 10%, increases the average annual enrollment probability by 3.8 percentage points, and the cumulative enrollment probability after five years by 6.1 percentage points. High school graduates are estimated to be risk averse, which is depicted by the Arrow-Pratt coefficient of constant relative risk aversion that is included in the structural model as a parameter. The estimate is roughly 0.05 and statistically significant. Thus, high school graduates exhibit a mild degree of risk aversion. The small coefficient might potentially be due to their young age. Consequently, a higher variance of net wages for academics, ceteris paribus, discourages high school graduates from pursuing tertiary education.

As found in several previous studies, the results indicate that high school graduates from a socially disadvantaged background, reflected in the coefficients of parental net income and education, as well as student aid eligibility, are less likely to enroll in higher education (see e.g. Steiner and Wrohlich, 2008). As the data partly captures the introduction of student fees in some federal states, a dummy captures the effect for the few persons who were affected by student fees. Since the coefficient estimate for that dummy is not statistically significant, the simple presence of student fees does not change enrollment behavior in the first year after the introduction. The advantage of the model developed in this chapter is the explicit consideration of expectations about future income and its risk. This allows student fees to affect university enrollment through this channel (in form of lower expected future income due to possible loan repayments), which will be discussed in the following chapter in detail.

3.7 Appendix

3.7.A Technical Appendix: Multiple Criteria Selection Model

Starting from the wage equations (3.18) and disregarding the selection correction, we obtain (time indices are neglected):

$$\begin{aligned} y^g_{1i} &= \theta_1' z_i^{wage} + u_{1i} \; and \\ y^g_{2i} &= \theta_2' z_i^{wage} + u_{2i}. \end{aligned} \tag{3.20}$$

A person earns wage y_{1i} if she has a university degree and is working:

$$y^g_{1i} = \begin{cases} 0 & \text{if } I^*_{1i} > 0 \quad I^*_{2i} < 0, \\ y^* & \text{if } I^*_{1i} > 0 \quad I^*_{2i} > 0, \end{cases} \tag{3.21}$$

whereas a person who has no university degree and is working is observed with wage y_{2i}:

$$y^g_{2i} = \begin{cases} 0 & \text{if } I^*_{1i} \leq 0 \quad I^*_{2i} < 0, \\ y^* & \text{if } I^*_{1i} \leq 0 \quad I^*_{2i} > 0. \end{cases} \tag{3.22}$$

When incorporating the selection process, which is described by equations (3.14) and (3.16), into the wage equations (3.20), we derive the following conditional expected wages:

$$\begin{aligned} E(y^g_{1i}|I^*_{1i} > 0, I^*_{2i} > 0) &= E(y^g_{1i}|v_{1i} > -z_{1i}\eta_1, v_{2i} > -(z_{2i}\eta_2 + I_1\iota)) \\ &= \theta_1' z_i^{wage} + E(u_{1i}|\epsilon_1 > -z_{1i}\eta_1, v_{2i} > -(z_{2i}\eta_2 + I_1\iota)). \\ E(y^g_{2i}|I^*_{1i} \leq 0, I^*_{2i} > 0) &= E(y^g_{2i}|v_{1i} < -z_{1i}\eta_1, v_{2i} > -(z_{2i}\eta_2 + I_1\iota)) \\ &= \theta_2' z_i^{wage} + E(u_{2i}|v_{1i} < -z_{1i}\eta_1, v_{2i} > -(z_{2i}\eta_2 + I_1\iota)). \end{aligned} \tag{3.23}$$

The two decisions—to obtain a university degree and working—are allowed to be correlated. The correlation is reflected in the error terms ($cov(v_1, v_2) = \rho_{v_1 v_2} \neq 0$).

The error terms are assumed to have a normal distribution with zero mean and $var(v_1) = var(v_2) = 1$ (in addition, person indices will be neglected in the following),

$$\begin{pmatrix} u_1 \\ u_2 \\ v_1 \\ v_2 \end{pmatrix} \sim N\left(0, \begin{pmatrix} \sum uu & \sum uv \\ \sum vu & \sum vv \end{pmatrix}\right).$$

Following Maddala (1986), the second term on the right-hand side of equation (3.23) can be expressed as:

$$\begin{aligned} E(u_1 | v_1 > -z_1\eta_1, v_2 > -(z_2\eta_2 + I_1\iota)) &= \lambda_{11}M_{12} + \lambda_{12}M_{21} \\ E(u_2 | v_1 < -z_1\eta_1, v_2 > -(z_2\eta_2 + I_1\iota)) &= \lambda_{21}M_{34} + \lambda_{22}M_{43}, \end{aligned} \tag{3.24}$$

where

$$\begin{aligned} \lambda_{sj} &= cov(u_s, v_j) \\ cov(v_1, v_2) &= \rho \\ M_{ab} &= (1-\rho^2)^{-1}(P_a - \rho P_b) \\ \text{with } a, b = 1, 2 \qquad \text{and } a \neq b & \\ M_{cd} &= (1-\rho^2)^{-1}(P_c - \rho P_d) \\ \text{with } c, d = 3, 4 \qquad \text{and } c \neq d & \end{aligned}$$

with

$$\begin{aligned} P_1 &= \frac{\int_{-(z_2\eta_2+I_1\iota)}^{\infty} \int_{-z_1\eta_1}^{\infty} v_1 f(v_1 v_2) dv_1 dv_2}{F(-z_1\eta_1, -(z_2\eta_2 + I_1\iota), \rho)} \\ P_2 &= \frac{\int_{-z_1\eta_1}^{\infty} \int_{-(z_2\eta_2+I_1\iota)}^{\infty} v_2 f(v_1 v_2) dv_2 dv_1}{F(-z_1\eta_1, -(z_2\eta_2 + I_1\iota), \rho)} \\ P_3 &= \frac{\int_{-(z_2\eta_2+I_1\iota)}^{\infty} \int_{-\infty}^{-z_1\eta_1} v_1 f(v_1 v_2) dv_1 dv_2}{F(z_1\eta_1, -(z_2\eta_2 + I_1\iota), -\rho)} \\ P_4 &= \frac{\int_{-\infty}^{-z_1\eta_1} \int_{-(z_2\eta_2+I_1\iota)}^{\infty} v_2 f(v_1 v_2) dv_2 dv_1}{F(z_1\eta_1, -(z_2\eta_2 + I_1\iota), -\rho)}. \end{aligned}$$

According to Rosenbaum (1961) the truncated bivariate normal distribution can be solved numerically, which leads to:

$$
\begin{aligned}
M_{12} &= \frac{\phi(z_1\eta_1)\Phi\left(\frac{(z_2\eta_2+I_1\iota)-\rho(z_1\eta_1)}{\sqrt{1-\rho^2}}\right)}{\Phi_2(z_1\eta_1, z_2\eta_2+I_1\iota, \rho)} \\
M_{21} &= \frac{\phi(z_2\eta_2+I_1\iota)\Phi\left(\frac{z_1\eta_1-\rho(z_2\eta_2+I_1\iota)}{\sqrt{1-\rho^2}}\right)}{\Phi_2(z_1\eta_1, z_2\eta_2+I_1\iota, \rho)} \\
M_{34} &= \frac{\phi(-z_1\eta_1)\Phi\left(\frac{(z_2\eta_2+I_1\iota)-\rho(-z_1\eta_1)}{\sqrt{1-\rho^2}}\right)}{\Phi_2(-z_1\eta_1, z_2\eta_2+I_1\iota, -\rho)} \\
M_{43} &= \frac{\phi(z_2\eta_2+I_1\iota)\Phi\left(\frac{-z_1\eta_1-\rho(z_2\eta_2+I_1\iota)}{\sqrt{1-\rho^2}}\right)}{\Phi_2(-z_1\eta_1, z_2\eta_2+I_1\iota, -\rho)},
\end{aligned}
$$

where ϕ is the standard normal density function, Φ denotes the standard, and Φ_2 is the bivariate normal cumulative distribution. Controlling for the selection terms, the wage equations can now be expressed in the form of equation (3.18).

3.7.B Additional Tables and Figures

Table B3.1: Descriptive statistics, high school graduates

	Total		Men		Women	
Variable Names	mean	sd	mean	sd	mean	sd
Eligible for student aid	0.35	0.48	0.31	0.46	0.38	0.49
Eligible for student aid x parental net income	0.83	1.47	0.73	1.44	0.92	1.48
Parental net income (1,000 EUR)	3.66	2.25	3.76	2.34	3.57	2.17
Mother holds a university degree	0.27	0.44	0.28	0.45	0.26	0.44
Father holds university degree	0.38	0.48	0.41	0.49	0.34	0.48
Finished apprenticeship	0.13	0.34	0.10	0.29	0.16	0.37
Intended a university degree at age 17	0.35	0.48	0.33	0.47	0.37	0.48
Intended degree at age 17 n.a.	0.40	0.49	0.41	0.49	0.40	0.49
Best school grade out of the subjects math and German at age 17:						
Very Good (1)	0.08	0.27	0.09	0.28	0.08	0.27
Good (2)	0.29	0.45	0.26	0.44	0.31	0.46
Satisfactory (3)	0.19	0.39	0.19	0.39	0.19	0.39
Poor (4-6)	0.03	0.17	0.04	0.20	0.02	0.14
Grades n.a.	0.41	0.49	0.42	0.49	0.40	0.49
Respondent has one sibling	0.33	0.47	0.31	0.46	0.36	0.48
Respondent has more than one sibling	0.09	0.29	0.07	0.26	0.11	0.31
Affected by student fees	0.11	0.31	0.10	0.30	0.12	0.33
Affected by student fees x student aid eligible	0.03	0.16	0.03	0.16	0.03	0.17
Observations (person-year)	1052		511		542	
Individuals	569		268		301	
Time of observation	1.85	1.11	1.91	1.08	1.80	1.14
Transition to university within five years	0.51	0.50	0.55	0.49	0.48	0.50
Time to university enrollment	1.72	0.97	1.97	0.98	1.47	0.89

Source: SOEP 2000-2008, own calculations

Table B3.2: Descriptive statistics, full sample

	Men		Women	
Variable Names	mean	sd	mean	sd
Parental education				
High school degree	0.36	0.48	0.38	0.48
N.a.	0.04	0.20	0.04	0.21
Last grade in subject German				
Very good (1)	0.04	0.19	0.07	0.26
Good (2)	0.18	0.38	0.22	0.42
Satisfactory (3)	0.19	0.39	0.13	0.33
Poor (4-6)	0.05	0.22	0.02	0.13
N.a.	0.54	0.50	0.56	0.50
Last grade in subject math				
Very good (1)	0.09	0.29	0.07	0.26
Good (2)	0.19	0.39	0.16	0.36
Satisfactory (3)	0.13	0.34	0.14	0.35
Poor (4-6)	0.06	0.24	0.08	0.28
N.a.	0.52	0.50	0.55	0.50
Parents show(ed) interest in school performance (at age 15)				

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... table B3.2 continued

Variable Names	Men mean	Men sd	Women mean	Women sd
Not at all	0.02	0.13	0.02	0.13
Not very much	0.14	0.35	0.13	0.34
Quite a lot	0.23	0.42	0.21	0.41
Very much	0.10	0.30	0.10	0.30
N.a.	0.51	0.50	0.53	0.50
Place where grew up (at age 15)				
Medium city (20,000-100,000 inh.)	0.18	0.39	0.18	0.38
Small city (5,000-20,000 inh.)	0.21	0.41	0.23	0.42
Countryside (<5,000 inh.)	0.28	0.45	0.28	0.45
Large city (more than 100,000 inhabitants)	0.24	0.43	0.24	0.43
N.a.	0.08	0.27	0.08	0.27
Father working (at age 15)				
Working	0.83	0.37	0.83	0.38
N.a.	0.12	0.32	0.12	0.33
Mother working (at age 15)				
Working	0.26	0.44	0.28	0.45
N.a.	0.52	0.50	0.55	0.50
Parental nationality				
German born	0.53	0.50	0.50	0.50
N.a.	0.43	0.50	0.45	0.50
Experienced years of ... since first started working				
Being housewife/men	0.12	0.85	2.86	6.07
Unemployment	0.45	1.17	0.49	1.17
Unemployment rate	7.35	4.93	9.72	4.86
Age	40.68	11.72	38.21	11.40
German born	0.95	0.21	0.94	0.23
Married	0.61	0.49	0.58	0.49
Children aged 5 years and under	0.16	0.36	0.17	0.38
Children aged 6 to 16 years	0.24	0.43	0.26	0.44
Disabled	0.06	0.23	0.04	0.20
Further education after high school				
In training (apprenticeship) (Lehre)	0.02	0.13	0.03	0.16
Finished apprenticeship (Lehre)	0.24	0.43	0.21	0.41
Other vocational education	0.31	0.46	0.37	0.48
Vocational education n.a.	0.01	0.09	0.01	0.09
University of applied science (FH)	0.14	0.35	0.14	0.35
University degree	0.46	0.50	0.39	0.49
Self-employment				
Free-lance professional	0.06	0.24	0.04	0.20
Other self-employment	0.08	0.27	0.04	0.19
Educational requirements for current job				
None	0.09	0.29	0.10	0.30
Apprenticeship	0.32	0.47	0.34	0.47
Higher education	0.41	0.49	0.23	0.42
N.a.	0.18	0.39	0.33	0.47
Observations	17,636		17,198	

Source: SOEP 2000-2008, own calculations

Table B3.3: 1st step Bivariate Probit estimation

	Men		Women	
Variables	Academic	Working	Academic	Working
Parental education				
High school degree	0.207**		0.249**	
	(0.030)		(0.030)	
N.a.	−0.364**		−0.344**	
	(0.077)		(0.075)	
Last grade in subject German (Base: Good (2))				
Very good (1)	0.199**		0.277**	
	(0.076)		(0.062)	
Satisfactory (3)	−0.071		−0.109*	
	(0.045)		(0.050)	
Poor (4-6)	−0.109†		−0.267*	
	(0.065)		(0.120)	
N.a.	0.647**		0.690**	
	(0.120)		(0.105)	
Last grade in subject math (Base: Good (2))				
Very good (1)	0.223**		0.199**	
	(0.054)		(0.065)	
Satisfactory (3)	−0.350**		−0.166**	
	(0.048)		(0.051)	
Poor (4-6)	−0.412**		−0.254**	
	(0.062)		(0.062)	
N.a.	−0.337*		−0.741**	
	(0.148)		(0.137)	
Parents show(ed) interest in school performance (at age 15) (Base: Very much)				
Not at all	0.240*		−0.330**	
	(0.102)		(0.108)	
Not very much	0.233**		−0.009	
	(0.056)		(0.056)	
Quite a lot	0.101†		−0.184**	
	(0.052)		(0.054)	
N.a.	−0.693**		−0.427**	
	(0.128)		(0.127)	
Place where grew up (at age 15)(Base: Large city (more than 100,000 inh.))				
Medium city (20,000-100,000 inh.)	−0.148**		−0.119**	
	(0.042)		(0.045)	
Small city (5,000-20,000 inh.)	−0.187**		−0.108**	
	(0.040)		(0.041)	
Countryside (<5,000 inh.)	−0.263**		−0.190**	
	(0.039)		(0.039)	
N.a.	−0.127†		−0.202**	
	(0.066)		(0.063)	
Father working (at age 15) (Base: not working)				
Father Working	0.398**		0.526**	
	(0.078)		(0.084)	
N.a.	0.697**		0.525**	
	(0.089)		(0.095)	
Mother working (at age 15) (Base: not working)				
Mother Working	−0.194**		−0.297**	
	(0.041)		(0.045)	
N.a.	−0.368**		−0.543**	
	(0.060)		(0.068)	
Parents nationality				
German born	−0.080		−0.262**	

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... table B3.3 continued

Variables	Men Academic	Men Working	Women Academic	Women Working
	(0.079)		(0.068)	
N.a.	0.434**		0.319**	
	(0.090)		(0.077)	
Age		0.351**		0.259**
		(0.014)		(0.014)
Age squared		−0.004**		−0.003**
		(0.000)		(0.000)
Married		0.113*		−0.307**
		(0.056)		(0.044)
Children aged 5 years and under		0.180*		−1.028**
		(0.078)		(0.048)
Children aged 6 to 16 years		0.050		−0.036
		(0.072)		(0.045)
German born		0.079		0.001
		(0.073)		(0.076)
Experienced years of ... since first started working				
Unemployment		−0.503**		−0.378**
		(0.025)		(0.027)
Unemployment squared		0.023**		0.014**
		(0.002)		(0.003)
Being housewife/men		−0.271**		−0.097**
		(0.035)		(0.008)
Being housewife/men squared		0.009**		0.000
		(0.002)		(0.000)
Unemployment rate		−0.015*		−0.013**
		(0.006)		(0.004)
Respondent has university degree		−0.563**		−0.575**
		(0.118)		(0.138)
Regional dummies		YES		YES
Year dummies		YES		YES
Constant	−0.261*	−5.739**	−0.140	−3.910**
	(0.118)	(0.281)	(0.119)	(0.277)
$\rho_{v_1 v_2}$	0.504**		0.316**	
	(0.087)		(0.095)	
Observations	17,311		16,878	
χ^2	2498.9		2746.9	

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%
Note: Robust standard errors in parentheses
Regional dummies: north, south, east, city state, west (base category)

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

Table B3.4: 2nd step regression of wages per hour

	Men		Women	
Variables	Academic	Non-Academic	Academic	Non-Academic
Work experience	0.603**	0.391**	0.284**	0.229**
	(0.067)	(0.050)	(0.090)	(0.042)
Work experience squared	−0.009**	−0.007**	−0.004†	−0.005**
	(0.002)	(0.001)	(0.002)	(0.001)
Education (Base: no vocational education after high school)				
In training (apprenticeship)	0.000	−6.652**	0.000	−6.266**
	(.)	(0.644)	(.)	(0.541)
Finished apprenticeship	−1.116*	−0.684	−1.465*	0.581
	(0.523)	(0.465)	(0.590)	(0.522)
other vocational education	−2.242**	−0.042	−1.780**	−0.879†
	(0.628)	(0.521)	(0.490)	(0.528)
N.a.	−0.496	−1.382	−3.745**	−0.325
	(2.048)	(0.971)	(1.013)	(0.738)
University of applied science (FH)	−2.143**	0.000	−1.492**	0.000
	(0.390)	(.)	(0.378)	(.)
German born	2.203**	0.396	2.048	−0.971†
	(0.829)	(0.552)	(1.312)	(0.535)
Disabled	−3.803**	−0.081	−0.339	1.067
	(0.842)	(0.444)	(1.117)	(0.653)
Self-employment				
Free-lance professional	7.811**	1.939	6.831**	0.996
	(1.228)	(1.280)	(1.303)	(1.152)
Other self-employment	1.747	0.971	0.139	2.815**
	(1.491)	(0.683)	(1.302)	(1.071)
Educational requirements for current job (Base: apprenticeship)				
None	−1.634	−1.855**	−4.735**	−1.481**
	(1.407)	(0.438)	(0.798)	(0.434)
Higher education	4.914**	4.088**	4.092**	2.370**
	(0.486)	(0.417)	(0.524)	(0.493)
N.a.	5.415**	−0.291	2.770	0.190
	(1.675)	(0.978)	(1.925)	(0.719)
Fed. state dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES
Constant	15.316**	15.747**	14.686**	13.724**
	(1.510)	(0.882)	(1.782)	(1.072)
Selection-terms				
M12	0.067		−1.636†	
	(0.923)		(0.885)	
M21	−10.079**		−2.370**	
	(1.128)		(0.899)	
M34		−0.387		0.507
		(0.475)		(0.610)
M43		−1.863**		−1.834**
		(0.467)		(0.268)
Observations	7304	7152	5202	6438
R^2	0.186	0.193	0.136	0.155
Mean(wage)	23.03	16.46	17.19	12.72

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%

Note: Robust standard errors in parentheses

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

Table B3.5: Estimation of gross wage variance

	Men		Women	
Variables	Academic	Non-Academic	Academic	Non-Academic
Work experience	−0.021	−0.063**	−0.002	−0.036*
	(0.016)	(0.014)	(0.017)	(0.015)
Work experience squared	0.001**	0.001**	0.000	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
Education (Base: no vocational education after high school)				
In training (apprenticeship)	0.000	−1.170**	0.000	−1.701**
	(.)	(0.240)	(.)	(0.177)
Finished apprenticeship	−0.116	−0.357**	−0.247*	−0.050
	(0.099)	(0.124)	(0.124)	(0.126)
other vocational education	−0.026	−0.187	0.098	−0.515**
	(0.119)	(0.125)	(0.123)	(0.126)
N.a.	−1.061	0.227	−0.954*	−0.897*
	(0.693)	(0.358)	(0.486)	(0.409)
University of applied science (FH)	−0.338**	0.000	−0.495**	0.000
	(0.094)	(.)	(0.105)	(.)
German born	−0.168	0.189	−0.453*	0.014
	(0.175)	(0.222)	(0.198)	(0.192)
Disabled	−0.383*	0.033	0.638**	0.505*
	(0.195)	(0.188)	(0.200)	(0.198)
Self-employment				
Free-lance professional	1.754**	1.569**	2.056**	1.050**
	(0.128)	(0.209)	(0.120)	(0.277)
Other self-employment	1.548**	1.255**	1.086**	1.531**
	(0.118)	(0.108)	(0.188)	(0.140)
Educational requirements for current job (Base: apprenticeship)				
None	0.463**	0.374**	−0.589**	0.400**
	(0.167)	(0.120)	(0.170)	(0.123)
Higher Education	0.099	0.486**	0.211†	0.306*
	(0.114)	(0.112)	(0.112)	(0.155)
N.a.	0.858**	0.545†	0.451	0.449†
	(0.306)	(0.279)	(0.292)	(0.242)
Fed. state dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES
Constant	3.332**	3.255**	3.035**	2.949**
	(0.332)	(0.351)	(0.422)	(0.318)
Selection-terms				
M12	−0.009		0.076	
	(0.198)		(0.200)	
M21	−0.545*		0.117	
	(0.239)		(0.173)	
M34		0.274†		0.324†
		(0.141)		(0.172)
M43		−0.181		−0.126
		(0.143)		(0.094)
Observations	7304	7152	5202	6438
R^2	0.114	0.0782	0.173	0.0961
Mean(log(variance))	3.373	2.835	2.976	2.425

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%

Note: Robust standard errors in parentheses

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

Table B3.6: Transition to tertiary education: Full results (sample 2000-2007)

	$\gamma = 1.02$	$\gamma = 1.05$	$\gamma = 1.08$	$\gamma = 1.10$
	Coef.	Coef.	Coef.	Coef.
Eligible for student aid	-1.670^{**}	-1.681^{**}	-1.670^{**}	-1.661^{**}
	(0.433)	(0.432)	(0.434)	(0.434)
Eligible for student aid x parental net income	0.323^{**}	0.319^{**}	0.313^{**}	0.310^{**}
	(0.113)	(0.113)	(0.113)	(0.113)
Parental net income (1,000 EUR)	$0.103^{\dagger}$	$0.105^{\dagger}$	$0.105^{\dagger}$	$0.105^{\dagger}$
	(0.060)	(0.060)	(0.060)	(0.060)
Mother has university degree	0.148	0.131	0.116	0.111
	(0.264)	(0.264)	(0.263)	(0.262)
Father has university degree	0.355	0.353	0.351	0.347
	(0.271)	(0.271)	(0.272)	(0.272)
Finished apprenticeship	1.256^{**}	1.239^{*}	1.175^{*}	1.117^{*}
	(0.487)	(0.486)	(0.479)	(0.472)
Intended degree at age 17				
University degree	0.950^{**}	0.954^{**}	0.948^{**}	0.943^{**}
	(0.266)	(0.265)	(0.265)	(0.264)
N.a.	1.457^{*}	1.463^{*}	1.465^{*}	1.463^{*}
	(0.598)	(0.604)	(0.604)	(0.602)
School grades in math and German at age 17				
(Best grade out of these two subjects, base: good (2))				
Very Good (1)	0.319	0.313	0.307	0.303
	(0.351)	(0.354)	(0.354)	(0.355)
Satisfactory (3)	$-0.575^{\dagger}$	$-0.574^{\dagger}$	$-0.567^{\dagger}$	$-0.563^{\dagger}$
	(0.303)	(0.303)	(0.304)	(0.304)
Poor (4-6)	-1.652^{**}	-1.612^{**}	-1.550^{*}	-1.517^{*}
	(0.620)	(0.613)	(0.615)	(0.615)
N.a.	−0.705	−0.702	−0.702	−0.701
	(0.555)	(0.560)	(0.560)	(0.559)
Respondent has one sibling	$-0.471^{\dagger}$	$-0.473^{\dagger}$	$-0.469^{\dagger}$	$-0.464^{\dagger}$
	(0.242)	(0.242)	(0.242)	(0.242)
Respondent has more than one sibling	−0.081	−0.069	−0.053	−0.042
	(0.397)	(0.399)	(0.399)	(0.399)
Affected by student fees	−0.076	−0.055	−0.043	−0.038
	(0.457)	(0.458)	(0.458)	(0.457)
Affected by student fees x student aid eligible	−1.112	−1.091	−1.083	−1.078
	(0.724)	(0.727)	(0.729)	(0.731)
Male	-0.801^{*}	-0.807^{*}	-0.809^{*}	-0.812^{*}
	(0.318)	(0.320)	(0.320)	(0.320)
Baseline hazard: time since high school graduation (Base: up to one year)				
Two years	0.148	0.118	0.075	0.042
	(0.382)	(0.383)	(0.384)	(0.384)
Three years	−0.696	−0.744	−0.795	−0.832
	(0.618)	(0.622)	(0.623)	(0.621)
Four years	−0.980	−1.007	−1.042	−1.072
	(0.710)	(0.709)	(0.706)	(0.704)
Five years	-2.001^{*}	-2.050^{*}	-2.093^{*}	-2.124^{*}
	(0.879)	(0.885)	(0.889)	(0.890)
Two years x male	2.267^{**}	2.273^{**}	2.294^{**}	2.313^{**}
	(0.505)	(0.508)	(0.510)	(0.511)
Three years x male	$1.360^{\dagger}$	$1.356^{\dagger}$	$1.347^{\dagger}$	$1.345^{\dagger}$
	(0.770)	(0.768)	(0.765)	(0.760)
Four years x male	2.103^{*}	2.073^{*}	2.034^{*}	2.012^{*}
	(0.896)	(0.896)	(0.893)	(0.890)
Five years x male	2.352^{*}	2.339^{*}	2.305^{*}	2.282^{*}

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... table B3.6 continued

	$\gamma = 1.02$ Coef.	$\gamma = 1.05$ Coef.	$\gamma = 1.08$ Coef.	$\gamma = 1.10$ Coef.
	(0.999)	(1.001)	(0.998)	(0.994)
Year dummies (Base: 2002)				
Year 2000	0.505	0.555	0.593	0.611
	(0.486)	(0.491)	(0.493)	(0.494)
Year 2001	−0.062	−0.007	0.048	0.074
	(0.417)	(0.422)	(0.427)	(0.429)
Year 2003	0.438	0.429	0.434	0.436
	(0.454)	(0.452)	(0.457)	(0.460)
Year 2004	1.353**	1.347**	1.335**	1.327**
	(0.428)	(0.428)	(0.428)	(0.429)
Year 2005	1.691**	1.668**	1.632**	1.603**
	(0.455)	(0.456)	(0.455)	(0.453)
Year 2006	1.249*	1.228*	1.199*	1.177*
	(0.517)	(0.519)	(0.522)	(0.523)
Year 2007	1.178†	1.153†	1.137†	1.127†
	(0.630)	(0.632)	(0.632)	(0.630)
Constant	−3.908**	−3.754**	−3.546**	−3.396**
	(0.642)	(0.631)	(0.616)	(0.607)
ρ	0.048	0.050**	0.039*	0.031†
	(0.034)	(0.019)	(0.017)	(0.017)
α	0.009**	0.014**	0.019**	0.022**
	(0.002)	(0.002)	(0.003)	(0.004)
Observations	1053	1053	1053	1053
Average probability	0.218	0.218	0.218	0.218

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%

Note: Clustered standard errors in parentheses

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

3.7.C SENSITIVITY ANALYSIS

Table C3.1: Transition to tertiary education: Full results (sample 2000-2007), alternative adjustments regarding student fees

	Student fees adjusted in future income		
	not adjusted	only for student aid eligible	for all
	Coef.	Coef.	Coef.
Eligible for student aid	−1.681**	−1.681**	−1.681**
	(0.432)	(0.432)	(0.432)
Eligible for student aid x parental net income	0.319**	0.319**	0.319**
	(0.113)	(0.113)	(0.113)
Parental net income (1,000 EUR)	0.105†	0.105†	0.105†
	(0.060)	(0.060)	(0.060)
Mother holds university degree	0.131	0.131	0.131
	(0.264)	(0.264)	(0.264)
Father holds university degree	0.353	0.353	0.353
	(0.271)	(0.271)	(0.271)
Finished apprenticeship	1.239*	1.239*	1.238*
	(0.486)	(0.486)	(0.486)
Intended degree at age 17			
University degree	0.954**	0.954**	0.954**
	(0.265)	(0.265)	(0.265)
N.a.	1.463*	1.463*	1.463*
	(0.604)	(0.604)	(0.604)
School grades in math and German at age 17 (Best grade out of these two subjects, base: good (2))			
Very Good (1)	0.313	0.313	0.313
	(0.354)	(0.353)	(0.354)
Satisfactory (3)	−0.574†	−0.574†	−0.574†
	(0.303)	(0.303)	(0.303)
Poor (4-6)	−1.612**	−1.612**	−1.612**
	(0.613)	(0.613)	(0.613)
N.a.	−0.702	−0.702	−0.702
	(0.560)	(0.560)	(0.560)
Respondent has one sibling	−0.473†	−0.473†	−0.472†
	(0.242)	(0.242)	(0.242)
Respondent has more than one sibling	−0.069	−0.069	−0.069
	(0.399)	(0.399)	(0.399)
Male	−0.807*	−0.807*	−0.809*
	(0.320)	(0.320)	(0.320)
Affected by student fees	−0.055	−0.055	−0.004
	(0.458)	(0.458)	(0.460)
Affected by student fees x Eligible for student aid	−1.091	−1.040	−1.091
	(0.727)	(0.726)	(0.727)
Baseline hazard: time since high school graduation (Base: up to one year)			
Two years	0.118	0.118	0.118
	(0.383)	(0.383)	(0.383)
Three years	−0.744	−0.744	−0.745
	(0.622)	(0.622)	(0.622)
Four years	−1.007	−1.007	−1.008
	(0.709)	(0.709)	(0.709)

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... table C3.1 continued

	Student fees adjusted in future income		
	not adjusted	only for student aid eligible	for all
	Coef.	Coef.	Coef.
Five years	−2.050*	−2.051*	−2.051*
	(0.885)	(0.885)	(0.885)
Two years x male	2.273**	2.273**	2.273**
	(0.508)	(0.508)	(0.508)
Three years x male	1.356†	1.356†	1.356†
	(0.768)	(0.768)	(0.768)
Four years x male	2.073*	2.073*	2.073*
	(0.896)	(0.896)	(0.895)
Five years x male	2.339*	2.339*	2.339*
	(1.001)	(1.001)	(1.001)
Year dummies (Base: 2002)			
Year 2000	0.555	0.554	0.554
	(0.491)	(0.491)	(0.491)
Year 2001	−0.007	−0.007	−0.007
	(0.422)	(0.422)	(0.422)
Year 2003	0.429	0.429	0.429
	(0.452)	(0.452)	(0.452)
Year 2004	1.347**	1.347**	1.346**
	(0.428)	(0.428)	(0.428)
Year 2005	1.668**	1.668**	1.667**
	(0.456)	(0.456)	(0.456)
Year 2006	1.228*	1.228*	1.228*
	(0.519)	(0.519)	(0.519)
Year 2007	1.153†	1.154†	1.153†
	(0.632)	(0.632)	(0.632)
Constant	−3.754**	−3.754**	−3.752**
	(0.631)	(0.631)	(0.630)
ρ	0.050**	0.050**	0.050**
	(0.019)	(0.019)	(0.019)
α	0.014**	0.014**	0.014**
	(0.002)	(0.002)	(0.002)
Observations	1053	1053	1053

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%

Note: Clustered standard errors in parentheses

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

Table C3.2: Transition to tertiary education: Full results (sample 2000-2005)

	$\gamma = 1.02$ Coef.	$\gamma = 1.05$ Coef.	$\gamma = 1.08$ Coef.	$\gamma = 1.10$ Coef.
Eligible for student aid	−1.097*	−1.116*	−1.109*	−1.101*
	(0.507)	(0.505)	(0.508)	(0.509)
Eligible for student aid x parental net income	−0.066	−0.069	−0.073	−0.076
	(0.161)	(0.161)	(0.162)	(0.162)
Parental net income (1,000 EUR)	0.052	0.054	0.055	0.055
	(0.063)	(0.063)	(0.063)	(0.063)
Mother has university degree	0.274	0.254	0.238	0.234
	(0.306)	(0.306)	(0.304)	(0.303)
Father has university degree	0.176	0.166	0.158	0.149
	(0.309)	(0.309)	(0.308)	(0.308)
Finished apprenticeship	0.973	0.960	0.899	0.843
	(0.634)	(0.634)	(0.627)	(0.620)
Intended degree at age 17				
University degree	1.119**	1.129**	1.124**	1.117**
	(0.333)	(0.334)	(0.335)	(0.335)
N.a.	1.447*	1.453*	1.450*	1.441*
	(0.668)	(0.677)	(0.676)	(0.672)
School grades in math and German at age 17				
(Best grade out of these two subjects, base: good (2))				
Very Good (1)	0.237	0.230	0.221	0.216
	(0.423)	(0.425)	(0.426)	(0.427)
Satisfactory (3)	−0.566	−0.566	−0.564	−0.563
	(0.382)	(0.381)	(0.381)	(0.382)
Poor (4-6)	−3.121**	−3.082**	−3.002**	−2.964**
	(1.167)	(1.156)	(1.151)	(1.149)
N.a.	−0.589	−0.588	−0.588	−0.586
	(0.608)	(0.616)	(0.613)	(0.607)
Respondent has one sibling	−0.270	−0.274	−0.266	−0.259
	(0.271)	(0.270)	(0.270)	(0.269)
Respondent has more than one sibling	0.425	0.437	0.459	0.475
	(0.381)	(0.381)	(0.380)	(0.379)
Male	−0.808*	−0.822*	−0.831*	−0.837*
	(0.337)	(0.338)	(0.338)	(0.339)
Baseline hazard: time since high school graduation (Base: up to one year)				
Two years	−0.158	−0.184	−0.228	−0.262
	(0.435)	(0.434)	(0.434)	(0.434)
Three years	−1.189†	−1.250†	−1.309*	−1.342*
	(0.646)	(0.650)	(0.655)	(0.653)
Four years	−0.955	−0.980	−1.022	−1.057
	(0.741)	(0.738)	(0.730)	(0.726)
Five years	−1.909†	−1.947†	−2.002†	−2.044†
	(1.073)	(1.080)	(1.086)	(1.088)
Two years x male	2.478**	2.483**	2.509**	2.533**
	(0.557)	(0.557)	(0.558)	(0.559)
Three years x male	1.390†	1.401†	1.394†	1.380†
	(0.834)	(0.833)	(0.833)	(0.828)
Four years x male	1.654†	1.625†	1.586†	1.563
	(0.962)	(0.962)	(0.958)	(0.956)
Five years x male	1.595	1.591	1.584	1.585
	(1.179)	(1.185)	(1.189)	(1.190)
Year dummies (Base: 2002)				
Year 2000	0.612	0.652	0.677	0.687
	(0.469)	(0.473)	(0.474)	(0.473)

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... table C3.2 continued

	$\gamma = 1.02$	$\gamma = 1.05$	$\gamma = 1.08$	$\gamma = 1.10$
	Coef.	Coef.	Coef.	Coef.
Year 2001	0.069	0.117	0.160	0.179
	(0.421)	(0.426)	(0.429)	(0.431)
Year 2003	0.425	0.410	0.417	0.422
	(0.428)	(0.424)	(0.428)	(0.430)
Year 2004	1.320**	1.317**	1.305**	1.297**
	(0.418)	(0.418)	(0.418)	(0.418)
Year 2005	1.722**	1.697**	1.659**	1.628**
	(0.437)	(0.438)	(0.435)	(0.433)
Constant	−3.499**	−3.355**	−3.147**	−2.997**
	(0.676)	(0.663)	(0.646)	(0.635)
ρ	0.050	0.057**	0.046*	0.037*
	(0.040)	(0.020)	(0.018)	(0.018)
α	0.008**	0.013**	0.017**	0.020**
	(0.002)	(0.003)	(0.004)	(0.005)
Observations	821	821	821	821
Average probability	0.213	0.213	0.213	0.213

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%

Note: Clustered standard errors in parentheses

Source: SOEP 2000-2006 (2006 used to obtain retrospective income information for 2005 only), own calculations; weighted

Table C3.3: Induced changes in university enrollment (sample 2000-2005)

	Average annual		Cumulative (after 5 years)	
	in percent	in percentage points	in percent	in percentage points
Increase by ten percent of				
Academic net income	23.187**	3.431**	16.111**	5.538*
	(6.227)	(1.289)	(5.823)	(2.152)
Non academic net income	-15.177**	-2.085*	-11.787**	-4.121**
	(3.268)	(0.838)	(3.486)	(1.589)
Variance academic net income	-0.193**	-0.031**	-0.144**	-0.052**
	(0.047)	(0.011)	(0.047)	(0.020)
Variance non academic net income	0.346**	0.063*	0.243**	0.095*
	(0.084)	(0.025)	(0.080)	(0.039)

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%

Source: SOEP 2000-2006 (2006 used to obtain retrospective income information for 2005 only), own calculations; weighted

Chapter 4

Simulations of higher education financing schemes and taxation policies

4.1 Financing Schemes

4.1.1 Introduction

The question whether students should contribute to the incurred costs of their university study is controversially discussed. While student fees are the standard in a large number of countries, European countries remained in favor of free access to education until recently.[1] This attitude is reflected in the International Covenant on Economic, Social and Cultural Rights (ICESCR) which states that higher education should be made equally accessible to all by the progressive introduction of free education (Article 13.2.c). In Germany, an interesting case arose in 2002, when the federal government explicitly stated in the *HochschulRahmenGesetz* (HRG) that student fees must not be charged. Because education, and therefore also its financing, is subject to the federal states' jurisdiction, several of them took legal action, in order to stop the intervention of the federal government in their legislative competence. In January 2005 the Federal Constitutional Court agreed with the federal

[1] Fees were e.g. introduced in France (2003), Germany (2006) and in the UK (introduced 1998 and increased in 2005)

states. As an indirect effect of this ruling, the introduction of student fees was not prohibited, as long as equal access to higher education was maintained. Since then, several federal states started to introduce student fees.

Although the justification for student fees in a world with progressive taxation is itself a controversially discussed topic in the academic literature (see e.g. Barbaro (2004) for an overview), I will in the following analysis focus on the question, whether the introduction of student fees does have an impact on the individual enrollment probability into higher education. For that analysis I will put special emphasis on potentially heterogenous effects of student fees that vary by students' financial backgrounds.

From a normative point of view (e.g. under Rawl's veil of ignorance (Rawls, 1971)), university education should be available to all qualified persons, regardless of their economic or social background. The literature on intergenerational transmission tends to find the opposite; children from wealthy families attend universities and children from poorer families do not, even if they hold the necessary qualifications (see Heineck and Riphahn, 2007, for an overview). In Germany, the majority of high school graduates come from households where at least one parent holds a university degree, and therefore is more likely to be at the higher end of the income distribution (Riphahn and Schieferdecker, 2008). In addition, the data show that high school graduates from blue-collar families are less likely to enroll in higher education.[2]

Credit constraints as an explanation can be ruled out since special student loans have been introduced in Germany that do not require any collateral. Therefore short-run credit constraints should not cause lower enrollment rates for prospective students with little financial resources.

A more reasonable explanation for the lower enrollment rates might be that the student loans are unattractive, e.g. because the prospective students exhibit risk aversion. Accepting a loan results in accumulated debt when graduating from university. Since future income is uncertain, especially risk averse person may fear not to be able to repay the loan. But also a high interest rate that results in a lower available income in the future might deter high school graduates from enrolling in higher education, especially if they expect their future income to be only marginally higher with a university degree. Both possible causes could be limited in a different design of higher education financing. I therefore analyze different financing schemes

[2]See also the discussion in chapter 2.2.1

with respect to their effect on the university enrollment rate, as well as distributional effects on the ex-post income. A system of income contingent loans is often suggested, and has already been successfully introduced in Australia, New Zealand and the United Kingdom (Chapman, 2006). A more hypothetical system dates back to Friedman (1955) and is referred to as “graduate tax”, basically a different income tax rate for university graduates.

In Germany, student fees have been introduced very recently, thus data and empirical evidence on this subject are limited. Assuming that the introduction of student fees in some federal states was exogenous, Hübner (2009) uses a difference in difference approach on aggregated data to identify the effect of student fees on enrollment behavior. He finds a significant negative effect. Due to the aggregation of the data, individual differences that might be of interest for policy analysis can not be analyzed further. As mentioned above, Dwenger et al. (2009) do find that mobility resulting from student fees differs e.g. by individual school achievement. Although their findings are based on a selective sample, it seems reasonable that they might translate to general enrollment behavior. As I am interested in the enrollment effects not only on average, but also for specific groups, I use the results derived in chapter 3 to simulate the changes induced by different financing schemes, i.e. the changes for the currently existing schemes in Germany, as well as the changes for more hypothetical financing schemes, like a graduate tax or tuition fees that are higher than the current amount. The results show that the university enrollment probability declines with increasing tuition costs. In the currently existing student fee scheme for Germany with an amount of 500 EUR per semester, the effects are estimated to be rather moderate (between 0.6 (average annual) and 1.1 (cumulative after five years) percentage points). For disadvantaged groups I find that income contingent loans perform best. They provide the best results both in terms of expected future income equality as well as equal access to higher education.

4.1.2 Financing Schemes for Higher Education

The main problem of transferring a share of the financial burden of higher education to the students is that the students' demand for education occurs at a time in their life when their own income is comparatively low. Therefore they must be able to defer the payments to a later point in life. Depending on the institutional background, three different schemes are possible:

- a mortgage type loan scheme
- income contingent loans
- a graduate tax

which are the basic concepts for the simulations and described in the following. Table 4.1 shows an overview of the simulations conducted. The main differences between the schemes are the timing of payments, the payment-to-cost relationship and repayment obligations.

A mortgage type loan scheme

In a higher education system where student fees are imposed, the general case is that these payments are due at the beginning of each term. To cover the costs, students may either draw money from their own or their parents' wealth, or they have to defer this payment to a later point in life by taking up a loan. If equal access to higher education is a sustained goal, it must be ensured that each prospective student has the ability to take up a loan regardless of his or her financial background. Special student loans, as established in many student fee countries, should alleviate the problem of the above mentioned credit constraints.

If students have to take up a loan to cover their student fees, they will have to repay the borrowed amount plus interest. As future income is uncertain, especially risk averse high school graduates may be deterred from studying because they fear they are not able to repay their debt. A quarter of surveyed students state that they fear not to be able to repay their student loans, students from low income families fear it more than students from wealthy families (Ebcinoglu and Gersch, 2008).[3]

Several Federal States adopted this student fee scheme. An amount of 500 EUR has to be paid at the beginning of each semester. With average cost of 15.000 EUR per student per year (see chapter 2.1), this relates to a subsidization rate of approximately 90%. To avoid the exclusion from higher education for students from poor families, student loan schemes were introduced. Compared to a "normal" loan, student loans are paid out in monthly installments and the maximum interest rate is capped at the start of the loan contract.

[3]Results also vary by subject, i.e. students studying social sciences and welfare, linguistics, cultural sciences or sports have greater doubts about the ability to repay the debts than students from other subjects.

Table 4.1: Specifications for the simulation of different financing schemes

	General Model		ICL		Graduate Tax
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	General	German Scheme	General	Hamburg Scheme	General
Student Fees					
Amount per semester:	$t - st$	500 EUR	$(1+d) \times (t_i - st_i)$	375 EUR	not cost related
Payment:	up-front	up-front	deferred	deferred	deferred
Due only when annual gross-income exceeds	–	–	30,000 EUR	30,000 EUR	–
Repayments up to:	borrowed amount (+interest)	borrowed amount (+interest)	borrowed amount+share of shortfall	borrowed amount	$\neq$ caused costs
Share of repayment:	–	–	9%	–	$\geq \frac{1}{N}\sum_{i=1}^{N} \frac{t_i - st_i}{lifetimeinc_i}$
Student aid recipients[1]:					
Interest rate for student loan/ICL:	4.28%	4.28%	4.28% (0%)	0 %	0%
Non student aid recipients:					
Alt. 1:					
Interest rate for student loan/ICL:	4.28%	4.28%	4.28% (0%)	0 %	0%
Alt. 2: No loan needed, receive interest	0	0		4.0	

Base scenario: No student fees, but needs-based BAfoeG available.

[1] Student aid recipients receive BAfoeG according to the German Law; repayment is half of the amount received, but not more than 10,000 EUR; max 20 years; only if monthly gross income exceeds 1040 EUR

Note: alternative calculation where made with numbers in parentheses; t: tuition fees, s: subsidization rate, d: shortfall probability

For the simulations I consider two alternatives where I assume the same behavior for students from a financially constrained background. Since these students do not have other resources, they will have to cover the student fees by taking up a student loan. Students with wealthy parents have more choices. First, I assume that they can pay the student fees "out of their or their parents pockets", i.e. without the need for a loan. Second, I impose that all students have to take up a loan, regardless of their financial background. For the student loan, I assume that the loan covers only the student fees, i.e. monthly payments are approx. 83 EUR[4]. The student expects to study 10 semesters, afterwards he or she has the option to defer payment for one year. The repayment period is assumed to last 20 years (similar to BAfoeG, the means-tested student aid), and monthly repayment rates can be calculated accordingly. The student loan is assumed to bear an interest rate of 4.28%.[5] Furthermore, I vary the subsidization rate s, and therefore the amount of student fees, in order to translate the special "German" model into the general mortgage type model.

Income Contingent Loans

Income contingent loans allow prospective students to borrow (for tuition) with the condition that the repayment depends on their future income. They agree upfront to repay their student fees as soon as their yearly gross income exceeds a specific limit. For the creditor the income contingent loan (ICL) scheme offers default protection by placing the responsibility for repayment not only on one single individual but on a group of people. Depending on the design of the ICL, members of the same predefined cohort, e.g. same year of enrollment or taxpayers, cover the default of the individuals who are not able to repay. For the single individual, this design therefore has an insurance effect and allows for consumption smoothing. Depending on design of the income contingent loan scheme, there may be behavioral adjustments though.

To point this out, I sketch two different types of ICL. The first is known as "risk-pooling" income contingent loan. In this design, the students agree ex-ante to repay the debt their cohort will cause. The cohort is usually defined by the student's year of enrollment, the amount that has to be repaid is determined ex-post. A student's debt therefore does not only depend on his or her own loan, but also on the borrowing and repayment behavior of all other members in the cohort. The debts that are not

[4]This amount is a simplification of student loans, where the minimum borrowing amount is in general 100 EUR per month.

[5]Source: KfW-Student Loan, terms and conditions in summer 2009

repaid by some part of the cohort, i.e. the debt of those students that earn less than the limit, are redistributed among the members of the cohort whose income exceeds the limit. As pointed out by Nerlove (1975) and Hanushek et al. (2004) this design of an ICL suffers from adverse selection and moral hazard issues.

Another design of the income contingent loan is “risk-sharing”, where the risk is shared with the taxpayers. These forms of ICL have been successfully introduced in Australia (1989), New Zealand (1991) and the United Kingdom (1997). The amount that a student agrees to repay is announced ex-ante. The debt is defined as the tuition costs, adjusted by a shortfall probability d:

$$ICL = (1 + d) \times (t_i - st_i) \tag{4.1}$$

where t are the tuition fees and s is the subsidized share of the tuition costs. An interest rate might be applied as in the case with student loans. Students that earn more than the specified limit, pay more than the tuition costs and therefore cover the default of the students who are below that limit and pay less than the tuition costs. If the probability d is correctly specified, the total repayment equals the total costs. In this case, the taxpayers do not have to cover any repayments. This version of the income contingent loan has an insurance effect. Although a risk-sharing ICL avoids to some part adverse selection and moral hazard, these behavioral effects cannot completely be avoided. As Chapman (2006) stresses, prospective students who expect to be high earners may prefer to use different financing opportunities, to avoid the additional costs of $d(t_i - st_i)$.

The main advantage of an income contingent loan over a mortgage type loan is, from the individual’s perspective, the insurance effect. Should the prospective university graduate experience periods of low income, no repayments have to be made. Therefore even risk averse persons might be attracted to this scheme. Furthermore, the amount that must be repaid relates to the costs a student has incurred, which creates incentives to not delay the time of study. Since the shortfall probability has to be set up when the student agrees on the ICL, the “goodness of fit” depends on the estimates of the shortfall probability. If this shortfall probability is determined correctly, this scheme of ICL is also favored over other schemes from an institutional perspective: The costs are shared between the students, and the creditors are protected against financial default of university graduates. But if the default probability is not determined correctly, the taxpayers have to cover the excess costs.

Only recently, the Federal State of Hamburg introduced a special version of ICL.

Starting with the winter term 2008/2009, students have the choice to defer payments (interest free). The amount is 375 EUR per semester, and after 10 semesters the student loses the option to defer payment. After graduation, the student has to repay the whole amount as soon as his or her yearly gross income exceeds 30,000 EUR.

To model this specific scenario I assume that each student chooses to defer the payments of student fees, since there is no advantage in paying up front. Students, who would be able to pay their fees up front, are better off to invest the money and earn at least some interest. They even end up with a positive balance, by the time they have to repay their tuition fees. Students who do not have the means right away will chose to repay the student fees after graduation anyway. Modeling this scenario, I explicitly differentiate between those two groups of students. While for wealthy students, the student fee system has no negative impact, poor students are expected to be better off than in a mortgage type loan scheme but still worse off than in a system without student fees. The main advantage compared to the prevailing fee system is the insurance effect. Since repayments have to be made when gross income exceeds a certain threshold, students who are risk averse would prefer this scheme.

Again, I vary the subsidization rate s, and therefore the amount of tuition fees, in order to generalize the special "Hamburg" model to an universal income contingent loan scheme.

GRADUATE TAX

The idea that university graduates are taxed differently than non-graduates, i.e. the idea of a graduate tax, dates back to Friedman (1955). He states that the government should offer financial help for any qualified student who in return agrees to pay each future year a predefined share of his or her future earnings. To minimize administrative expenses, the payment should be combined with the payment of income tax and therefore has the character of a higher tax for university graduates. For the practical implementation the revenue from the tax should at least cover the average costs of university studies for a student:

$$GT \geq \frac{1}{N} \sum_{i=1}^{N} \frac{t_i - st_i}{lifetimeinc_i} \tag{4.2}$$

The graduate tax combines the attributes of risk-pooling and risk-sharing income contingent loans, since the share of income is adjusted ex post (after graduation the student knows what share he or she has to repay depending on the costs the cohort has caused) and due to its character, high earners pay a higher amount in absolute terms. There are however significant differences between a graduate tax and income contingent loans. First, it is not based on cost recovery, i.e. it does not relate to the costs someone has incurred. Second, the tax applies for the rest of the working life, which especially for high earners may results in higher work disincentives than with risk-sharing income contingent loans (see Barr, 2003). People with a high post-university income who finished quickly (and therefore cheaply), get penalized in the sense that they repay more than the costs they have incurred. Third, the revenue of graduate taxes do not reflect marginal cost pricing rules, neither do the transferred resources have any allocative implications since the revenue from the graduate tax is not earmarked for educational spending. Barr (2003) as well as Greenaway and Haynes (2003) point out the incapability of a graduate tax to achieve economic efficiency. On the other hand the "major advantage" of a graduate tax is "[...] that the arrangement has the potential to deliver considerable resources to the public sector, much more than is the case with respect to ICLs."(Chapman, 2006; pp 1459).

When implementing a graduate tax, the major concern for a policy maker is, to whom the tax should apply. First, as the name suggests, only university graduates could face a graduate tax. This, however, might result in behavioral adjustments: Students, who expect an income loss from not obtaining a degree that is less than the graduate tax, drop out of university (shortly) before they finish their degree. To prevent this strategic behavior, the policy maker can assign the graduate tax to persons who were enrolled in a university, thus including university graduates and dropouts. This however implies a weaker insurance effect, which might be the crucial factor for a risk averse person to take up university studies. For the simulation, I allow for both implementations of a graduate tax. As before, I vary the subsidization rate s.

4.1.3 Results

In the following section, I will first present the results for the simulations based on financing scenarios that are currently in place. As described above, there are two basic scenarios: first, a pure mortgage type loan scheme where students have to take up a loan at market conditions; and second a deferred payment scheme as it is newly implemented in Hamburg. For the simulations, I vary repayment obligations and the group of students for whom the simulated scheme applies, i.e. I am grouping the prospective students by their financial backgrounds.

With student loans, I first assume, that in order to cover the student fees of 500 EUR, “rich” or more broadly speaking, students who are not eligible for student aid, do not have to take up a student loan, but are able to pay the additional costs out of their pocket. Students, who are eligible for student aid, do not have any other resources, so their only option is to take up a student loan. For the second alternative, I treat all students the same, i.e. they all have to take up a student loan.

For the second scheme, the income contingent loan implemented in Hamburg, I also model two alternatives. Again, I differentiate between persons by their eligibility for financial student aid. Student aid eligible persons accrue debt of 375 Euros per semester and have to repay the whole amount after their graduation.[6] Students that are not eligible for student aid use the same option of deferred payment. But unlike to financially disadvantaged high school graduates, they would be able to pay the student fees right away. Since the deferred payment is an interest free loan, they are better off investing the money at a fixed interest rate. Thus, by the time of their graduation, they are able to repay the loan and have earned interest i during that time. For the second alternative I assume that student aid ineligible persons are not treated differently, i.e. are not aware of the option of investing their money. For a better comparison between the two basic schemes, I additionally consider the income contingent loan scheme of Hamburg for the hypothetical case of 500 EUR per semester. Therefore the two schemes do not differ in the amount of student fees, but only in their repayment schedules and conditions.

For all scenarios I will first present the changes in the enrollment probability, overall and then decomposed by financial background. For the decomposition, I divide the potential students by income quartiles with respect to their parents’ net income. This will give a rough idea of potential intergenerational effects and an indication whether students from low income households are deterred from entering university. In a second step I evaluate and discuss the impact of the different existing financing schemes on the expected income distribution. Using an equality criterion helps to answer the question whether there is an alternative to the prevalent student

[6] If their studies take more than 10 semesters, students lose the option of deferred payment and have to repay the accumulated debt of 3750 EUR plus 375 Euros per each additional semester right away. Since students are assumed to not study longer than 10 semesters, this can be neglected in the simulations.

Table 4.2: Simulations of currently existing financing schemes

Scenario	Average (annual)			Cumulative (after 5 years)		
	Probability	Δ ppt. Base: no SF	Δ ppt. Base: SL,all	Probability	Δ ppt. Base: no SF)	Δ ppt. Base: SL,all
No Student Fees:	21.832**	-		50.941**	-	
	(7.040)	-		(11.243)	-	
Student Loan (500 EUR/semster):						
all:	21.188**	−0.644**	-	49.832**	−1.109**	-
	(6.903)	(0.222)	-	(11.233)	(0.380)	-
only BAfoeG eligible:	21.608**	−0.224*	0.420**	50.477**	−0.464**	0.645**
	(6.979)	(0.087)	(0.134)	(11.182)	(0.162)	(0.219)
Income contingent loan:						
Hamburg Model (375 EUR/semester):						
all:	21.631**	−0.201**	0.443**	50.605**	−0.336**	0.773**
	(7.000)	(0.070)	(0.152)	(11.234)	(0.112)	(0.268)
non student aid eligible invest:	21.800**	−0.033	0.611**	50.864**	−0.077	1.032**
	(7.030)	(0.035)	(0.206)	(11.220)	(0.057)	(0.353)
Hamburg Model A1 (500 EUR/semester):						
all :	21.564**	−0.268**	0.376**	50.492**	−0.449**	0.660**
	(6.986)	(0.093)	(0.129)	(11.230)	(0.150)	(0.230)

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%
SF: Student fees; SL: Student loan

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

fee schemes in Germany. I discuss the distributional effects these schemes might have in a dynamic setting, i.e. the expected future income is adjusted for the estimated enrollment probabilities.

Simulation results of currently existing schemes in Germany

Based on the results of the enrollment model (chapter 3), table 4.2 shows the average annual and the cumulative enrollment probability in the first row for the base case where no student fees apply. In columns 2 and 5, I estimate the percentage point changes in the enrollment probability for the loan scenarios compared to the base case of no student fees. To analyze if the simulated alternative financing schemes are better than the existing scheme of a mortgage type loan scheme, columns 3 and 6 compare the applied simulation schemes to the alternative where all students have to take up a student loan to cover their fees. As can be seen in table 4.2, introducing student fees of 500 and 375 EUR respectively per semester, slightly lowers the average annual enrollment probability by up to 0.6 percentage points (student loan applies to all individuals), which translates to a decrease in the university enrollment of up to 3%. This negative effect is carried forward to the cumulative enrollment rate which decreases by up to one percentage point, if students have to cover part of the costs directly. Only in the scenario of income contingent loans, where high school graduates not eligible for student aid invest their money and earn interests until the time the fees are due, the estimated change in the enrollment rate is not significant different from the base scenario.

To compare the alternatives, I also consider changes with respect to student loans rather than the base case of no student fees. For all scenarios with student fees, the income contingent loans exhibit the lowest effect on enrollment rates. Even with the increased fee amount of 500 EUR (as opposed to 375 EUR) per semester, the enrollment probabilities are 0.4 and 0.7 percentage points higher for the annual and the cumulative probability respectively. This effect might occur for two reasons; first, payments are interest free, and second, installments only need to be paid if the gross income in a year exceeds 30,000 EUR. Since the high school graduates exhibit risk aversion (albeit to a small degree), this insurance effect might play an important role in the enrollment decision process.

A major concern in the policy debate about student fees is the exclusion of prospective university students from poor families. I therefore decompose the enrollment effect for different parental income quartiles (table 4.3). Differences in the enrollment probabilities are shown in the first and third row of the second panel. These values indicate whether students' enrollment behavior differs by parental income. The second and fourth row of the second panel shows the difference of the effect of the simulated scenario compared to the base case of no student fees. With these numbers it can be analyzed whether equality in access to higher education would change by introducing student fees.

Without student fees (the base scenario), the average annual probability of university enrollment differs by 17.2 percentage points between students with parents in the lowest (Q1) and in the highest income quartile (Q4). This difference remains fairly stable across financing scenarios. This indicates that students from poorer families tend to enroll less often than students who are financially better off. In terms of equal access to higher education, these numbers indicate, that even in a student-fee free environment, equal access to education is not guaranteed. However, this effect might also result from the student aid repayment obligations that student aid recipients have. With the same expected gross income in the future, they would still have a lower net income. At the margin, this might result in lower enrollment

Table 4.3: Differences in the enrollment probabilities by parental income quartile

	Base	**Student Loan**		**Income Contingent Loan**		
		German Scheme		Hamburg Scheme		
Amount per semester:	0 EUR	500 EUR		375 EUR		500 EUR
Scheme applies to:		All	BAfoeG eligible	All	BAfoeG eligible/ others invest	All
$P(Q1)$	12.545**	12.125**	12.271**	12.442**	12.486**	12.407**
	(4.667)	(4.543)	(4.575)	(4.635)	(4.648)	(4.625)
$\Delta PPT(Q1)$		−0.420*	−0.274*	−0.103*	−0.059*	−0.138*
		(0.164)	(0.110)	(0.041)	(0.030)	(0.055)
$P_{cum}(Q1)$	32.885**	31.955**	32.197**	32.654**	32.747**	32.577**
	(10.090)	(9.947)	(9.952)	(10.045)	(10.060)	(10.030)
$\Delta PPT_{cum}(Q1)$		−0.930**	−0.688**	−0.231**	−0.138*	−0.308**
		(0.339)	(0.242)	(0.089)	(0.066)	(0.119)
$P(Q4)$	29.730**	28.961**	29.589**	29.484**	29.734**	29.402**
	(8.360)	(8.255)	(8.352)	(8.332)	(8.369)	(8.323)
$\Delta PPT(Q4)$		−0.769**	−0.141*	−0.246**	0.004	−0.328**
		(0.248)	(0.060)	(0.082)	(0.034)	(0.109)
$P_{cum}(Q4)$	64.398**	63.241**	64.159**	64.047**	64.393**	63.929**
	(10.590)	(10.683)	(10.579)	(10.618)	(10.573)	(10.628)
$\Delta PPT_{cum}(Q4)$		−1.157**	−0.239**	−0.351**	−0.005	−0.469**
		(0.381)	(0.083)	(0.118)	(0.045)	(0.158)
Differences between first and last quartile						
$P(Q1) - P(Q4)$	−17.185**	−16.835**	−17.318**	−17.042**	−17.248**	−16.994**
	(0.588)	(0.579)	(0.585)	(0.586)	(0.588)	(0.585)
$\Delta P(Q1) - \Delta P(Q4)$		0.349**	−0.133**	0.142**	−0.063**	0.190**
		(0.018)	(0.008)	(0.006)	(0.003)	(0.008)
$P_{cum}(Q1) - P_{cum}(Q4)$	−31.513**	−31.286**	−31.962**	−31.393**	−31.647**	−31.352**
	(0.899)	(0.897)	(0.892)	(0.898)	(0.897)	(0.898)
$\Delta P_{cum}(Q1) - \Delta P_{cum}(Q4)$		0.228**	−0.449**	0.120**	−0.133**	0.161**
		(0.031)	(0.016)	(0.009)	(0.005)	(0.012)
Significance levels: † : 10% ∗ : 5% ∗∗ : 1%						

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

probability because the alternative of working right away becomes more attractive.

Assuming this is the reason for a lower enrollment rate for students from a financially weak background, and therefore that the equal access condition is satisfied, I can evaluate the decomposition of the change by parental income quartiles. To be specific, I evaluate the difference between the fee scenarios compared to the base case of no student fees and the lowest and highest quartile ($\Delta PPT(Q1) - \Delta PPT(Q4)$) of parental income. A positive value implies a stronger decrease in the university enrollment rate in the top quartile than in the bottom quartile. In this case, equal access to university education increases. This effect is found for all scenarios in the annual enrollment changes, with the exception of those scenarios in which only financial aid eligible students are affected by the student fees, and thus have to take up a loan (student loan or income contingent loan). The results for these scenarios are different because here "rich" students are facing a decrease in future income due to repayment obligations. In the other scenarios I assume that they either pay the cost of student fees out of their pocket (student loans are taken up only by student aid eligible) or that they invest the money not spend on student fees and earn interest (ICL applies to student aid eligible, rich invest). The results do not significantly change for the cumulative enrollment probability.

DISTRIBUTIONAL EFFECTS OF CURRENTLY EXISTING SCHEMES IN GERMANY

To evaluate the distributional effects of the financing schemes, I calculate the gross lifetime income for university students and non-students weighted by the estimated enrollment probabilities.[7] So changes result from two sources: First, the financing schemes directly affect future net income (due to repayment obligations) and second, the enrollment probabilities differ. The distributional effects for the currently existing schemes are shown in table 4.4. Compared to the base scenario of no student fees the currently prevailing student loan scheme (first column of table 4.4) with student fees up to 500 EUR per semester is expected to lower the net income over the life cycle by 0.3% (D10) up to 2% (D1) (see also figure 4.1). The high school graduates who expect to have a lower gross income over the life cycle tend to enroll less in higher education. As shown, the effect is stronger for students with parents in low income deciles than for those whose parents are in the high deciles. These effects are shown in figure 4.1: the left panel shows the changes in the expected net income over the lifecycle without adjustments for the enrollment probability, the right panel the dynamic case with adjusted enrollment probabilities. Comparing the two shows that enrollment drives the change in inequality; the dynamic distribution is less compressed and therefore less equal.

A common equality measure of the distribution of income is the Gini coefficient. A value of zero indicates a perfectly equal distribution, the closer to one, the less equal the distribution. The Gini coefficient for Germany as reported by the OECD for the mid-2000s is 0.43 for the whole working age population. In my model the estimated Gini coefficient of gross predicted earnings is 0.22 and therefore markedly

[7] I also tabulated the results without behavioral adjustments, i.e. without changes in enrollment probabilities, the effects are much smaller, which shows that university enrollment is the driving factor of the distributional effects (see tables A4.1-A4.2 in the appendix).

Table 4.4: Distributional effects of currently existing financing schemes - dynamic

	Base	**Student Loan**		**Income Contingent Loan**	
		German Scheme		Hamburg Scheme	
Amount/semester	0 EUR	500 EUR		375 EUR	500 EUR
Scheme applies to	All	All	BAfoeG eligible	All	All
Income (in 1,000 EUR): Gross income Deciles	net	net	net	net	net
D1	207.542	203.793	205.431	207.511	207.500
D2	329.014	325.536	327.308	328.530	328.370
D3	383.112	378.908	381.317	382.224	381.930
D4	424.527	421.671	423.566	423.678	423.397
D5	452.711	448.583	451.219	451.339	450.884
D6	488.747	484.792	488.131	487.333	486.864
D7	544.183	540.804	543.050	542.759	542.285
D8	601.462	599.269	601.180	600.581	600.287
D9	634.590	632.429	634.344	633.683	633.382
D10	698.620	696.383	697.934	697.718	697.420
Total	475.975	472.738	474.869	475.060	474.757
Gini	0.173	0.175	0.174	0.173	0.173

All: Scheme applies to all who choose to enroll at a university, i.e. in case of graduation as well as dropping out

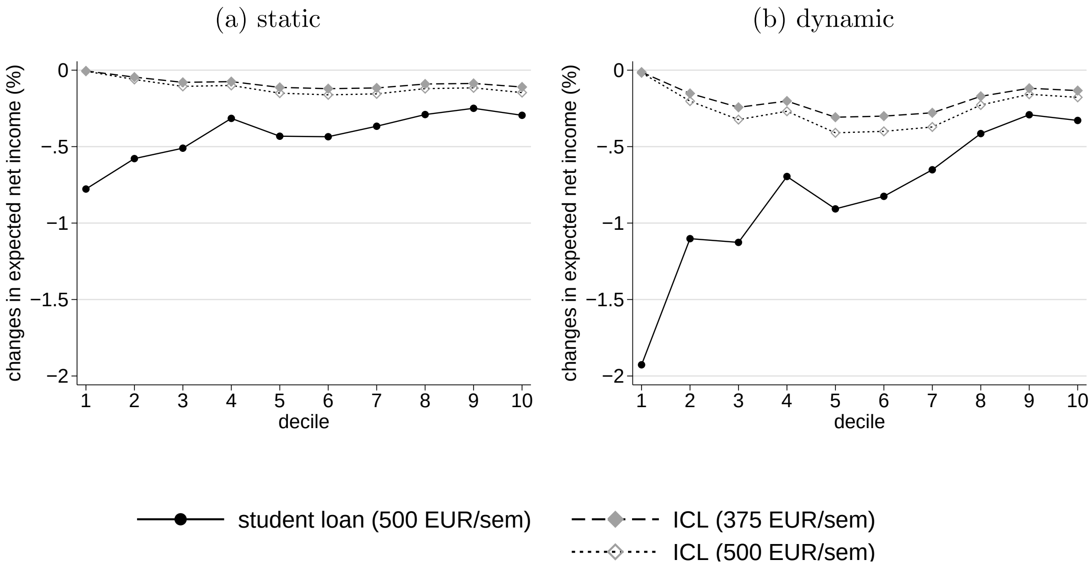
Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

lower.[8] For one, this is due to the fact that individual wage profiles are predicted at a time where individual characteristics differ only slightly, therefore the predicted wage profiles do not differ much, such that income is distributed more equally. Second, the sample includes only high school graduates, compared to the OECD measure where the underlying sample is the whole working age population. My sample is therefore, per construction, more homogeneous. Due to progressive taxation, the net income in the base scenario of no student fees is even more equally distributed, which is illustrated by a Gini coefficient of 0.173. In the different scenarios, the Gini coefficient increases by about 1.1%, it rises for the student loan scheme to 0.175, which indicates slightly higher inequality.

The ICL scheme exhibits smaller effects. Income decreases between 0.03 (D1) and 1.4% (D6,D7) when student fees amount to 375 EUR per semester, and between 0.04 (D1) and 1.9% (D6, D7) when student fees would be 500 EUR per semester. The decrease is strongest for intermediate income deciles and less at the higher and

[8]Note that the OECD Gini coefficient refers first to gross income and cannot be compared to the net Gini measures reported in table 4.4; second, a different population is analyzed.

Figure 4.1: Percentage changes in the expected net income over the life cycle - currently existing schemes



lower end of the distribution. Still, the effects are rather small which is also reflected by a Gini coefficient of 0.173 and thus indistinguishable from the estimate for the base scenario.

EXTENDING THE EXISTING SCHEMES - GRADUATE TAXES AND HIGHER TUITION FEES

In the current German higher education system, student fees amount to at most 500 EUR per semester. Compared to the future lifetime income, this amount is fairly small. After having discussed the effects from the currently existing schemes in the previous section, I now consider extensions in two dimensions. First I simulate the impact of higher fees in the existing schemes. The share of the costs a student has to take over is increased to 50% (from approximately 10%). Second, I introduce a new financing scheme, a graduate tax, and compare it to the existing ICL and mortgage type financing schemes. Table 4.5 shows the results of these simulations.

Similarly to table 4.2, the first row shows the baseline scenario of no student fees. Again, columns 2 and 5 show the percentage point changes in the enrollment probability for the scenarios compared to the base case. Columns 3 and 6 compare the simulated scheme to the alternative where all students have to take up a student loan to cover their fees.

Table 4.5: Simulations of alternative financing schemes with a subsidization rate of 50%

Scenario	Average (annual)			Cumulative (after 5 years)		
	Probability	Δ ppt. Base: no SF	Δ ppt. Base: SL,all	Probability	Δ ppt. Base: no SF)	Δ ppt. Base: SL,all
No Student Fees:	21.832**	-		50.941**	-	
	(7.040)	-		(11.243)	-	
Student Loan:						
all:	17.163**	−4.670**	-	42.451**	−8.491**	-
	(6.017)	(1.612)	-	(11.028)	(2.857)	-
only student aid eligible:	20.289**	−1.544*	3.126**	47.574**	−3.367**	5.123**
	(6.608)	(0.606)	(1.006)	(10.738)	(1.156)	(1.702)
Income Contingent Loan:						
General:	20.267**	−1.565**	3.105**	48.258**	−2.684**	5.807**
	(6.727)	(0.547)	(1.067)	(11.124)	(0.883)	(1.982)
General + interest:	19.935**	−1.897**	2.772**	47.653**	−3.288**	5.202**
	(6.658)	(0.663)	(0.950)	(11.085)	(1.077)	(1.788)
Graduate Tax:						
General	19.973**	−1.859**	2.810**	47.750**	−3.191**	5.300**
	(6.656)	(0.640)	(0.976)	(11.189)	(1.081)	(1.793)
General + Dropout	19.029**	−2.803**	1.866**	46.046**	−4.895**	3.595**
	(6.451)	(0.967)	(0.649)	(11.150)	(1.649)	(1.225)
Significance levels: † : 10%	∗ : 5%	∗∗ : 1%				

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

When increasing the costs in a student loan scheme, where all students have to take up a loan, the annual enrollment probability decreases in relative terms by 4.7 percentage points, which is a decrease of 21%. This effect slightly decreases when analyzing the cumulative enrollment probability after 5 years, here the decrease is 8.5 percentage points (17%).

Alternative financing schemes also have a negative impact on the enrollment probability, but not as strong as with the student loan scheme. A graduate tax applying only to university graduates decreases the annual enrollment probability by 1.9 percentage points, similar to the highest ICL decrease. When the graduate tax applies to all high school graduates who ever enroll at a university, the probability decrease by 2.8 percentage points. When simulating the ICL schemes, the annual enrollment probability decreases between 1.6 percentage points and 1.9 percentage points depending on the specific implementation. The decrease is lowest in the scheme without interest on the ICL and highest in a scheme where interest i is charged. The decrease in the enrollment probability is attenuated for the cumulative enrollment probability for both the ICL and the graduate tax schemes.

Table 4.6 shows the difference in the enrollment probabilities by parental income quartiles. As before, individuals with poor parents have a lower probability to take up higher education than high school graduates with rich parents. Increasing student

Table 4.6: Differences in the enrollment probabilities by parental income quartile

	Base	**Student Loan**	**Income Contingent Loan**		**Graduate Tax**	
Interest rate		4.28%	-	4.28%	-	
Scheme applies to:		All	All	All	Graduates	All
$P(Q1)$	12.545**	9.491*	11.783**	11.622**	11.449**	10.918**
	(4.667)	(3.758)	(4.434)	(4.386)	(4.334)	(4.169)
$\Delta PPT(Q1)$		−3.054*	−0.763*	−0.923*	−1.096*	−1.627*
		(1.193)	(0.306)	(0.370)	(0.435)	(0.645)
$P_{cum}(Q1)$	32.885**	25.849**	31.164**	30.796**	30.376**	29.080**
	(10.090)	(8.903)	(9.734)	(9.658)	(9.657)	(9.435)
$\Delta PPT_{cum}(Q1)$		−7.036**	−1.721**	−2.089**	−2.509**	−3.805**
		(2.536)	(0.668)	(0.809)	(0.929)	(1.402)
$P(Q4)$	29.730**	24.111**	27.800**	27.371**	27.494**	26.345**
	(8.360)	(7.589)	(8.140)	(8.085)	(8.083)	(7.925)
$\Delta PPT(Q4)$		−5.619**	−1.930**	−2.359**	−2.236**	−3.385**
		(1.798)	(0.654)	(0.798)	(0.728)	(1.104)
$P_{cum}(Q4)$	64.398**	55.666**	61.508**	60.809**	61.117**	59.336**
	(10.590)	(11.260)	(10.764)	(10.786)	(10.876)	(11.013)
$\Delta PPT_{cum}(Q4)$		−8.732**	−2.890**	−3.589**	−3.282**	−5.062**
		(2.842)	(0.951)	(1.174)	(1.094)	(1.673)
Differences between first and last quartile						
$P(Q1) - P(Q4)$	−17.185**	−14.619**	−16.018**	−15.749**	−16.045**	−15.427**
	(0.588)	(0.520)	(0.569)	(0.565)	(0.563)	(0.550)
$\Delta P(Q1) - \Delta P(Q4)$		2.565**	1.167**	1.435**	1.140**	1.758**
		(0.133)	(0.044)	(0.054)	(0.052)	(0.079)
$P_{cum}(Q1) - P_{cum}(Q4)$	−31.513**	−29.817**	−30.344**	−30.013**	−30.741**	−30.256**
	(0.899)	(0.882)	(0.892)	(0.889)	(0.893)	(0.891)
$\Delta P_{cum}(Q1) - \Delta P_{cum}(Q4)$		1.696**	1.169**	1.500**	0.773**	1.257**
		(0.234)	(0.071)	(0.088)	(0.088)	(0.134)

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%
All: Scheme applies to all who choose to enroll at a university, i.e. in case of graduation as well as dropping out

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

fees, however, attenuates this difference for the annual enrollment probability by one to two percentage points. In all scenarios the difference in the changes in the enrollment probabilities seem to be more distinct for high school graduates from high income families. The difference is also reflected in the changes in the cumulative enrollment probability, which is, with the exception of the ICL schemes, smaller than in the base scenario.

Table 4.7: Distributional Effects of alternative financing schemes - dynamic

	Base	**Student Loan**	**Income Contingent Loan**		**Graduate Tax**	
Interest rate		4.28%	-	4.28%	-	
Scheme applies to		All	All	All	Graduates	All
Income (in 1,000 EUR):						
Gross income						
Deciles	net	net	net	net	net	net
D1	207.542	184.126	207.309	207.284	200.282	197.989
D2	329.014	304.377	325.406	324.609	319.424	316.278
D3	383.112	354.097	376.638	375.013	370.206	365.846
D4	424.527	405.362	418.925	417.688	414.989	411.881
D5	452.711	424.580	441.570	438.357	437.966	433.267
D6	488.747	461.466	477.400	474.388	473.673	469.027
D7	544.183	520.346	531.607	528.390	530.020	525.798
D8	601.462	586.197	593.240	590.948	591.774	589.328
D9	634.590	619.422	625.630	623.038	624.261	621.697
D10	698.620	682.660	689.198	686.703	686.622	684.091
Total	475.975	453.773	468.225	466.176	464.448	461.046
Gini	0.173	0.188	0.174	0.174	0.177	0.179

All: Scheme applies to all who choose to enroll at a university, i.e. in case of graduation as well as dropping out

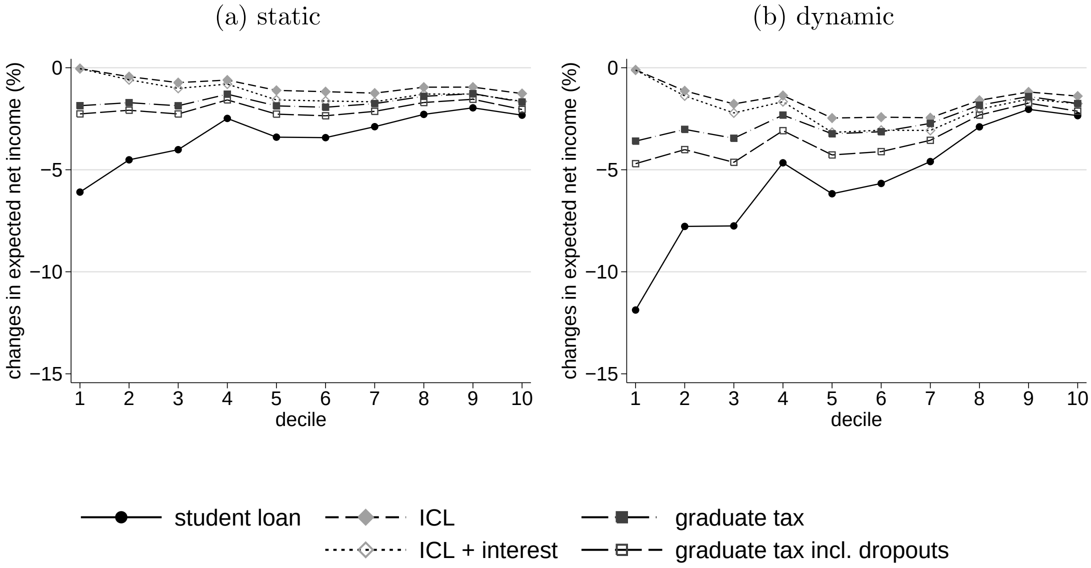
Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

Table 4.7 shows the distributional effects of the different simulations. The decreases in net future income across deciles are larger the higher the fees. The distributional pattern for the student loan scheme remains the same as in the currently prevailing scenario (table 4.4). As can be seen in figure 4.2, the lower income deciles are more strongly negatively affected than the higher deciles. For the income contingent loan schemes the picture is as before, the middle of the distribution exhibited the strongest decrease while the tails are less affected.

Graduate taxes have a similar effect, the decrease in net earnings is increasing (in absolute value) in the deciles and the ranges from 3.6 (D1) to 1.7% (D10). These patterns hold for the scenario without adjustments, as well as with adjustments in the enrollment probability.

The Gini coefficients reflect these patterns. With 0.19, the coefficient of the student loan scheme is markedly higher than in table 4.4, thus an increase in fees moderately increases the inequality of the expected distribution of net income. With ICLs, the coefficient slightly increases with respect to the previous schemes, thus

Figure 4.2: Percentage changes in the expected net income over the life cycle - Alternative schemes at subsidization rate=50%



higher fees mainly induce changes in the middle of the income distribution. Finally the simulated effects of the graduate tax lie in the range between the student loan and ICL schemes, with a Gini coefficient of 0.18. The decrease in inequality is mainly driven by less high school graduates enrolling at universities due to the less attractive alternative of university graduation. This decrease is centered around students with low expected future income which makes the distribution of income more disparate.

4.1.4 Conclusion and policy implications

In this chapter I analyze the effects of financing schemes for higher education on the probability to enroll at a university, as well as the effects on the expected income distribution. The structural model developed in chapter 3 has the main advantage to makes predictions on the effect of (hypothetical) policy changes feasible.

This allows me to evaluate the effects of different financing schemes for higher education, which is not captured by any microdata (yet). I focus on the following main questions: Has the university enrollment probability experienced changes due to the introduction or the increase of student fees? If so, has equal access to higher education changed due to the presence of student fees? Furthermore, what are the distributional effects of the introduction of student fees, and which financing alternative creates more/less equality in the distribution of expected lifetime income?

To analyze these questions, I focus on recently introduced changes in the financing schemes for Germany; first student fees of 500 EUR per semester which can be covered by a student loan; second an income contingent loan scheme where the student fees amount to 375 EUR per semester which are, at the latest, due after 10 semesters. Since these amounts are relatively small compared to the income over the life cycle, I introduce as a second step the hypothetical and more severe change in the financing schemes by assuming that a higher amount of student fees has to be paid. In addition to the currently prevailing schemes of student loan and income contingent loans, I also analyze the effects of a graduate tax.

The effect of student fees for the currently existing schemes in Germany on the enrollment probability is negative, but very moderate. The effect lies between 0.2 and 0.6 percentage points. When the fees are increased to 50% of the average costs as compared to approximately 10% in the currently existing schemes, the decrease in the enrollment probability more than doubles, the simulations show decreases of 1.5 to 4.7 percentage points in enrollment.

High school graduates with parents in the lowest income quartile are less likely to attend a university than students from parents in the highest income quartile. This difference decreases when high tuition fees are introduced but is nearly unaffected when considering the currently existing schemes. The attenuation is driven by a decrease in the enrollment probability of the high income group.

The expected income inequality, measured by the Gini coefficient, increases moderately in all scenarios where student fees are in place. For the case for student loans, the increase in the inequality is highest. These differences are mainly driven by changes in university enrollment.

Overall income contingent loans perform best, both in terms of equal access to higher education as well as with respect to distributional effects.

Policy implications are mixed; the results indicate that even strong increases in student fees would induce only a modest, not disproportionally high, decline in enrollment. No financing scheme exhibits strong properties to reduce the gap of university enrollment between high school graduates from poor and rich families. Quite the opposite is true if student loans are only necessary for student aid eligible students. Here the gap in university uptake is clearly increasing. Income contingent loans or a graduate tax are preferable to student loans in both the dimension of enrollment as well as expected income inequality. But the simulated effects are rather small so changing an existing financing scheme is not advisable.

Since student fees have only moderate effects on the enrollment probability, the funds generated could be used to increase the quality of education (as was the main argument for the introduction of student fees) with few repercussions on the demand. This however is only possible if the increase in income from student fees for the higher education institutions is not accompanied by a decrease in public spending. Although the average effect on the enrollment probability is moderate, high school graduates from low income families exhibit a low enrollment probability which is further decreased by the introduction of student fees. If policy aims on increasing or at least not decreasing the enrollment rate of students from disadvantaged backgrounds, they should be exempt from paying student fees. But a means test would not encourage the best graduates to take up higher education, so if the aim would be to allocate the best suited graduates to university, merit based scholarships would be the better alternative.

4.2 Taxation Policies

4.2.1 Introduction

As shown in the previous chapter, expectations about future net income influence the university enrollment decision. Therefore the estimated structural model can be applied to simulate the effects of tax policy scenarios on university enrollment. While taking up a loan and therefore deciding about later repayments is a choice students have to make, the environment itself and therefore a taxation system can not be changed by the individual directly. So when the government changes the tax rates for a selective income group, this might therefore have an impact on the enrollment decision of prospective students. The German income taxation system underwent some recent changes (see chapter 2) which were due to the tax reform in 2000. As an illustrative example, I evaluate the effect of the change in the progressive tax schedule from the tax reform on the university enrollment decision. Furthermore, I[9] analyze the effects of two revenue-neutral flat-rate tax scenarios.

[9] The simulation presented in this chapter is an extension of a joint study with Frank M. Fossen (Fossen and Glocker, 2009)

Eaton and Rosen (1980) extend the theoretical educational choice model under uncertainty of Levhari and Weiss (1974) by introducing taxation. They conclude that higher taxation on one side lowers after-tax returns and therefore lowers human capital investments. On the other side, income risk associated with human capital investments is reduced, which increases the investments in human capital. Which of the two effects dominates is ex-ante unclear. Trostel (1993) finds a significant negative effect of a proportional income taxation on human capital accumulation using a dynamic general equilibrium model. Wage uncertainty, however, is not captured in the model, thus possible positive insurance effects of taxation are disregarded which overestimate the negative effect. Heckman et al. (1998) empirically analyze the effect of different taxation policies on human capital accumulation in the United States but without considering wage risk. They find that switching from a progressive tax legislation to a flat tax system increases college attendance, an effect they ascribe to the lower marginal tax rate for higher income in a flat tax scenario compared with a progressive tax system. Recent theoretical literature on income taxation and education also notes the role of wage uncertainty. For example, Hogan and Walker (2003), Anderberg (2003), and Anderberg (2009) develop models of education and public policy, including tax policy, which as a key feature consider that education may change the wage risk. To the best of my knowledge though, the combination of taxation, wage risk, and education have not been empirically determined so far.

4.2.2 Simulations

In 1999, the Tax Reduction Act of March 24 defined tax reductions in income taxation which should be implemented in three steps in 1999, 2000 and 2002. In the framework of the following Tax Reduction Act 2000 (which comprises the Tax Reduction Act of October 23, and the Supplementary Tax Reduction Act of December 19, 2000), however, the last step was pushed forward by one year and thus started on January 1, 2001, and will therefore in the following be accounted to be part of the tax reform 2000. During the period between 2000 and 2005, the highest marginal tax rate was decreased from 51% to 42% (45% at the top tax bracket which applies to an income of above 250,000 EUR) where it remains until today. The amount of income at the end of the progression zone was adjusted accordingly, decreasing from 58,643 EUR to 52,152 EUR. Simultaneously the basic allowance was increased by 762 (for an unmarried individual), accompanied by a decrease in the lowest marginal tax rate from 22.9 to 15% in 2005. In the following simulation, I will analyze the changes in the university enrollment if the tax reform would not have occurred for the years 2005 onwards, thus if the government re-implemented the pre-reform taxation, by comparing this scenario ("tax 2000") with a simulation of the actual law of the respective years.

Furthermore, I analyze the effects that would result from an introduction of flat-rate taxes, since they have been widely discussed in Germany; Kirchhoff (2003), Mitschke (2004), and the Council of Economic Advisors to the Ministry of Finance (2004) all have presented proposals for tax policy reforms with (almost) flat-rate schedules.

In the strictest sense, a flat tax is a uniform tax rate on the total tax base. In practice, a flat income tax rate is usually combined with a basic tax allowance, which leads to an implicitly progressive tax schedule. Thus, if the tax base is left unchanged, a flat-rate tax policy can be defined by two parameters, the uniform tax rate and the basic allowance. Fuest et al. (2008) analyze the distributional and labor supply effects of two flat tax scenarios for Germany using a microsimulation model. The first policy is defined by a low tax rate and a low basic allowance (scenario "Low-Low"), whereas the second features higher values for the two parameters (scenario "High-High"). These authors balance the parameters of each scenario to establish revenue neutrality in their simulation for 2007, assuming that there are no behavioral responses such as labor supply reactions. In the scenario "Low-Low" (LL), the basic allowance remains unchanged at 7,664 EUR, and the tax rate that establishes revenue neutrality is 26.9%. In the scenario "High-High" (HH), a higher basic allowance of 10,700 EUR and a higher revenue-neutral flat tax rate of 31.9% are chosen.[10] Scenario HH is implicitly more progressive than scenario LL because of its higher basic allowance. Thus, it is more similar to Germany's current progressive tax schedule, whereas in scenario LL effective tax rates are significantly flatter.

The aim of this section is to estimate the effects of first, the re-implemention of the pre-reform tax law, and second the two flat tax policies defined by Fuest et al. (2008) on university enrollment. The baseline scenario is the actual German tax legislation of 2005 to 2007, thus the time after the full implementation of the tax reform 2000. Accordingly, I use the high school graduates observed in 2005 to 2007

[10]The distinctive feature of scenario HH is that it does not change the Gini index of inequality compared with a situation without the reform, according to the simulations of Fuest et al. (2008), again without behavioral responses. This is explained by the high basic allowance, which reduces taxes for low income people. The Council of Economic Advisors to the Ministry of Finance (2004) suggested a similar (but not revenue-neutral) flat tax with a basic allowance of 10,000 EUR and a tax rate of 30%.

to simulate the effects of the reforms. Using the microsimulation model, I calculate the first and second moment of net (after-tax) income in the baseline and the two alternative policy scenarios, based on my estimates of gross income, and then apply the estimated structural model of university enrollment to simulate the effects of the changes in the expectation and variance of net income.

4.2.3 Results

The results are presented in Table 4.8 along with the tax parameters that define the different scenarios. In the baseline scenario (first row), the average annual probability of university enrollment is estimated to be 23.6% for female and 27.6% for male high school graduates.[11] The model accounts for gender differences by employing gender-specific baseline hazards, and the other explanatory variables control for different endowments. To illustrate the simulation results, I use figure 4.3 to depict the development of the cumulative enrollment probabilities in the different tax scenarios during the first five years after high school graduation, separately for men and women with average observed characteristics.

I focus first on the re-implementation of the pre-reform tax schedule of the year 2000, where the basic allowance is 6,902 EUR and the marginal tax rate varies between 22.9 and 51%. This translates to a reduction of the after-tax income and simultaneously decreases the income risk compared to the actual baseline scenario of the tax schedule of the respective year. Overall, the reintroduction of the tax-schedule of 2000 would have a negative effect. The annual enrollment probability decreases for men by 0.6 and for women by 0.8 percentage points. While the negative effect becomes stronger for the cumulative enrollment probability for men, it is insignificant for women. This pre-reform scenario exhibits a negative income effect accompanied with a higher insurance effect resulting in a lower enrollment probability. Thus the incentive effect dominates the insurance effect in this scenario.

The flat tax scenario LL leaves the basic tax allowance unchanged. The results indicate that scenario LL makes university education more attractive for male high school graduates. The average yearly probability of enrollment for young men significantly increases from 27.6% to 28.2% (+0.6 percentage points). The cumulative probability of enrollment five years after high school graduation also increases significantly by 0.9 percentage points, which corresponds to a relative increase in the

[11] This estimate, which is based on the pooled sample of 2005 to 2007, is somewhat higher than the estimate based on 2000-2007, which is reported in section 4.1.3.

Table 4.8: Simulated changes in the probability of university enrollment

	Male High School Graduates		Female High School Graduates		Tax Parameters	
	Average Probability	Cumulative Probability	Average Probability	Cumulative Probability	Basic Allowance (EUR)	Marginal Tax Rate[1] (percent)
Baseline scenario					7,664	15−42
Enrollment probability	27.562**	50.947**	23.594**	61.752**		
	(8.184)	(11.045)	(7.684)	(11.551)		
Re-implemention of tax schedule 2000 (tax 2000)					6,902	22.9−51
Enrollment probability	27.016**	50.169**	22.795**	61.164**		
	(8.125)	(11.090)	(7.602)	(11.809)		
Differences in percentage points (effect of reform)	−0.546*	−0.778†	−0.799**	−0.588		
	(0.274)	(0.432)	(0.255)	(0.438)		
Low-Low					7,664	26.9
Enrollment probability	28.184**	51.851**	23.152**	61.738**		
	(8.252)	(11.025)	(7.683)	(11.763)		
Differences in percentage points (effect of reform)	0.622*	0.904*	−0.442*	−0.014		
	(0.294)	(0.446)	(0.218)	(0.402)		
High-High					10,700	31.9
Enrollment probability	27.285**	50.529**	23.477**	61.651**		
	(8.147)	(11.073)	(7.665)	(11.579)		
Differences in percentage points (effect of reform)	−0.277	−0.418	−0.116	−0.101		
	(0.202)	(0.314)	(0.141)	(0.242)		

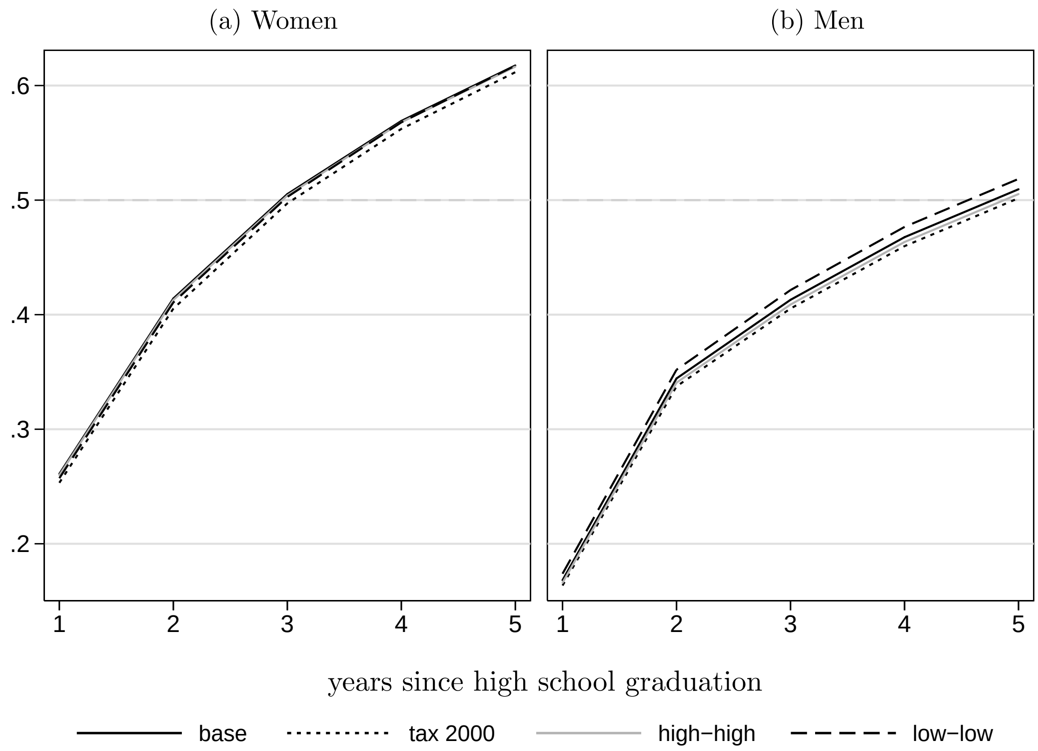
Significance levels: † : 10% ∗ : 5% ∗∗ : 1%
[1] plus solidarity surcharge in all scenarios
Average probability: annual; cumulative probability: after 5 years

cumulative enrollment probability by 1.7%. The change in the cumulative probability is directly relevant for policy, because it indicates how much the share of men who decide to study at all would increase (very few people enter university later than after five years after their high school graduation).

The simulated effect of scenario LL on young men contrasts with the effect on young women. The flat tax scenario significantly decreases women's average yearly probability of university enrollment by 0.4 percentage points. There is no significant effect on the female cumulative enrollment probability, however. Scenario LL may thus induce female high school graduates to enter university less quickly, but would not significantly decrease the number of female university students in the long run.

What explains the different effects of the flat tax scenario on male and female high school graduates? The revenue-neutral flat tax reform has two opposing effects. First, the tax burden decreases for higher and increases for lower incomes (above the allowance), so an academic career path becomes more attractive (incentive effect of taxation). Second, the variance of net income increases with a flat tax, which is especially relevant for academics, who face higher income risk. This effect discourages potential students from an academic career, as it becomes more risky (risk-sharing aspect of progressive taxation). The simulation results indicate that for men, the positive incentive effect of the flat tax outweighs the negative risk-sharing effect. For women, it is the other way round. This is explained by men's higher wages, especially in the academic career path. The spread between academic and non-academic average predicted gross wages is 6.57 EUR for men but only 4.47 EUR for women (see the bottom of Table B3.4). Because the flat tax reduces the tax rates for higher incomes, for men, incentives for an academic versus a non-academic career increase more than for women. In contrast, the spread between the log(variance) of gross wages in the alternative career paths is 0.55 for women and 0.54 for men (Table B3.5). The flat tax increases the variance of net wages, but this discouraging effect is only marginally stronger for women. So out of the two possible channels that would explain the difference for male and female high school graduates, the incentive effect through the mean wage difference dominates, the insurance effect has only a very small impact.

Figure 4.3: Cumulative university enrollment by gender



Scenario HH combines a flat tax rate with a basic tax allowance that is almost 40% higher than in the baseline scenario. It thus not only decreases the tax burden for high income people, but also for low income people who benefit from the higher allowance. As the reform scenario is revenue-neutral, people at intermediate income ranges pay more taxes than in the baseline scenario. The simulation results indicate that scenario HH has no significant effect on young men's university enrollment. The same holds for young women where enrollment decreases somewhat, but the decrease is statistically not significant. In this scenario, the disadvantage of the flat tax in terms of higher income risk offsets or even outweighs the incentive effect. The different results for the two flat tax scenarios highlight the importance of clear definitions when talking about a flat tax.

4.2.4 Conclusions

I apply the results of the estimated university enrollment model to simulate the effects of an actual tax reform, as well as two hypothetical revenue-neutral flat-rate tax scenarios on university enrollment in Germany. Revoking the Tax Reduction Act 2000 would significantly lower the average annual enrollment probability for men and women. Due to higher marginal tax rates at all income levels, the negative income effect outweighs the positive insurance effect. Furthermore, the simulation results indicate that a revenue-neutral, flat tax scenario with an unchanged basic tax allowance would significantly increase the cumulative probability of university enrollment for male high school graduates by 0.9 percentage points (five years after high school graduation), which corresponds to a relative increase of 1.7%. For men, the positive incentive effect of the flat tax reform thus outweighs the negative insurance effect. Because of women's lower expected wages though, the simulated flat tax scenario with an unchanged basic allowance would not have a significant effect on the cumulative enrollment probability of female high school graduates. The scenario with a higher basic allowance and accordingly a higher marginal tax rate does not exhibit any significant effects.

The policy debate about taxation and tertiary education focuses primarily on the effect of relative levels of net income on incentives for education. However, the findings from this chapter suggest that relative after-tax income risk associated with academic and non-academic career paths should not be neglected in the discussion.

4.3 Appendix

4.3.A Additional Tables

Table A4.1: Distributional effects of current financing schemes - static

	Base	**Student Loan**		**Income Contingent Loan**	
		German Scheme		Hamburg Scheme	
Amount/semester	0 EUR	500 EUR		375 EUR	500 EUR
Scheme applies to	All	All	BAfoeG eligible	All	All
Gross income Deciles	net	net	net	net	net
D1	207.542	205.979	206.652	207.530	207.526
D2	329.014	327.153	328.271	328.866	328.817
D3	383.112	381.145	382.326	382.813	382.714
D4	424.527	423.183	424.094	424.199	424.090
D5	452.711	450.698	452.002	452.195	452.024
D6	488.747	486.597	488.370	488.155	487.958
D7	544.183	542.195	543.569	543.563	543.356
D8	601.462	599.865	601.221	600.968	600.803
D9	634.590	632.869	634.394	633.986	633.785
D10	698.620	696.585	697.908	697.863	697.610
Total	475.975	474.151	475.404	475.539	475.393
Gini	0.173	0.175	0.174	0.173	0.173

All: Scheme applies to all who choose to enroll at a university, i.e. in case of graduation as well as dropping out. Income in 1,000 EUR.

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

Table A4.2: Distributional Effects of alternative financing schemes - static

	Base	**Student Loan**	**Income Contingent Loan**		**Graduate Tax**	
Interest rate		4.28%	-	4.28%	-	
Scheme applies to		All	All	All	Graduates	All
Gross income						
Deciles	net	net	net	net	net	net
D1	207.542	195.276	207.452	207.439	203.707	202.877
D2	329.014	314.491	327.595	327.100	323.496	322.303
D3	383.112	367.634	380.393	379.347	375.973	374.430
D4	424.527	413.940	421.958	421.132	419.052	417.868
D5	452.711	436.852	447.565	445.380	444.007	442.125
D6	488.747	471.820	483.107	480.923	479.230	477.172
D7	544.183	528.518	537.562	535.295	534.749	532.709
D8	601.462	588.876	596.301	594.462	593.815	592.162
D9	634.590	621.035	627.964	625.576	625.767	623.860
D10	698.620	682.592	689.905	687.259	687.019	684.511
Total	475.975	461.626	471.512	469.925	468.211	466.532
Gini	0.173	0.179	0.172	0.172	0.174	0.174

All: Scheme applies to all who choose to enroll at a university, i.e. in case of graduation as well as dropping out. Income in 1,000 EUR.

Source: SOEP 2000-2008 (2008 used to obtain retrospective income information for 2007 only), own calculations; weighted

Chapter 5

The Effect of Student Aid on the Duration of Study

5.1 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 chapter I evaluate the effect of student aid on the success of tertiary education in terms of time-to-degree and actual graduation rates.

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 or her time either on working to raise money for his or her education, on studying more intensively to reduce the time until graduation and therefore improving the return to his or her education, or thirdly on leisure. When deciding how to optimally allocate their time, students first have to consider how to cover their subsistence level expenditures (i.e. cost of living, tuition fees, insurance, etc.). Well-off students can cover these costs by drawing money from their own or their parents' wealth. Students from low income 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. This results in less time available for studying, thus

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

their time in tertiary education may prolong or they are even forced to drop out of university, see e.g. Ehrenberg and Sherman (1987) or Stinebrickner and Stinebrickner (2008). 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. (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 students. 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 students to finish in a certain time frame. If a student does not finish within this time frame, he or she 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 Germany, only recently the more time constrained bachelor and master programs have been introduced at the universities. The usual degree before this, i.e. in the "pre-Bologna[2]" 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.[3] 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. A study by Amann (2005) uses the advantage of this conceptual framework for Germany to analyze the effect of employment on the duration of study. He finds that full-time, as well as part-time employment lower the probability to graduate from university at any time of enrollment. Although he controls for possible unobserved heterogeneity and endogeneity, a students financial endowment, and thus the individuals need to work, is not explicitly modeled. This, however, might be of high interest for policy implications regarding the need for student aid in terms to prevent a possible discrimination in pursuing a university degree by social background.

The main source of student aid in Germany is 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.[4]

To determine the effect of student aid on the outcome of study I use the SOEP from the pre-Bologna period (1984-2007) 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 dropouts.

The results 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

[2]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)

[3]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.

[4]See chapter 2.1.1 for details

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% 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% of students who are receiving the same amount as private transfers.

5.2 Theoretical Motivation

In a simple model of a student's time allocation one might think of a student having three options to spend time on: he or she could work to raise money, study to reduce the time until graduation and thereby increase the return to his or her education[5] and thirdly he or she 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 their family exists. The receipt of 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 inter-temporal supply concerns are neglected), a shorter time-to-degree is expected.

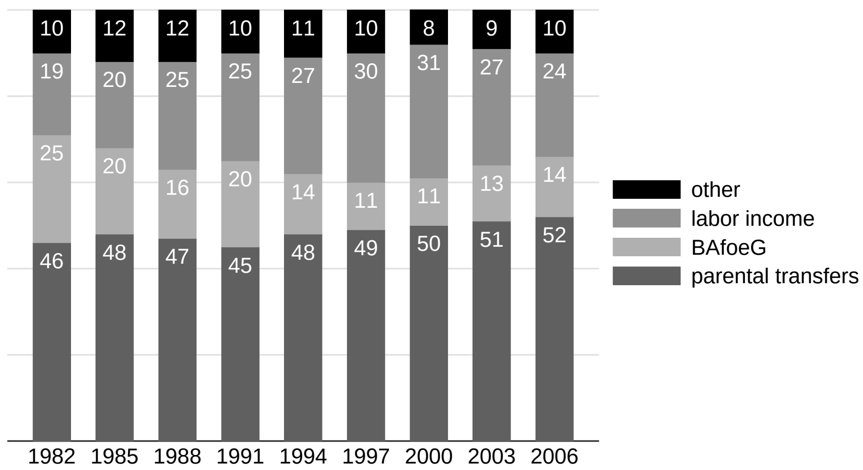
If a student needs to exert a certain fixed amount of effort to satisfactorily finish a study year, he might not be inclined to study more, even if the budget constraint is relaxed. This case can be considered a corner solution in the aforementioned model. The result of allocating student aid to such 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, student aid 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

[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.

the incentive to start working as soon as possible. Therefore the time-to-degree might even be prolonged by the receipt of financial aid.

Figure 5.1 shows the different income sources for students between the years 1982 and 2006. It can be seen, that the share of parental transfers remains fairly stable over time. The share of income from student aid however declined over the years from 25% of the students income in 1982 to only 11% in 2000. Contrary to this development, the share of labor income increased drastically from 19% to 30% during the same period. As a result of the BAfoeG reform in 2001, the share of income due to BAfoeG increased slightly in the following years (see section 2.1.1 for details). At the same time a decrease in the share of labor income is observable. These

Figure 5.1: Sources of monthly income of students between 1982-2006 (in percent)



Source: Bundesministerium für Bildung und Forschung (2007)

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.

5.3 Empirical Methodology

5.3.1 Model Specification

To determine the effect of student aid on the time-to-degree, I have to use 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 time until 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:

$$h_{ij}(t|\alpha_j(t), x_i(t), \epsilon_i^m) \quad = \quad Pr_j(T_i = t|T_i \geq t, \alpha_j(t), x_i(t), \epsilon_i^m) \tag{5.1}$$

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, $m = 1, 2, ...M$:

$$E(\epsilon_i^m) = \quad \textstyle\sum_{m=1}^{M} P(\epsilon_i^m)\epsilon_i^m = 0; \quad \sum_{m=1}^{M} P(\epsilon_i^m) = 1; \quad E(\epsilon_i^m x_i(t)) = 0, \qquad \forall m = 1, 2, \ldots, M \tag{5.2}$$

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.[6]

[6] For an extensive formal discussion of the competing risk model see e.g Prentice et al. (1978),

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

$$h_i(t|\alpha_j(t), x_i(t), \epsilon_i^m) = \sum_{j=1}^{2} h_{ij}(t|\alpha_j(t), x_i(t), \epsilon_i^m) \tag{5.3}$$

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:[7]

$$\begin{aligned} S_i(t|\alpha_j(t), x_i(t), \epsilon_i^m) &= Pr(T_i > t|\alpha_j(t), x_i(t), \epsilon_i^m) \\ &= \prod_{k=1}^{t} [1 - h_i(k|\alpha_j(k), x_i(k), \epsilon_i^m)] \, . \end{aligned} \tag{5.4}$$

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

$$\begin{aligned} Pr_j(T_i = t|\alpha_j(t), x_i(t), \epsilon_i^m) &= h_{ij}(t|\alpha_j(t), x_i(t), \epsilon_i^m) \prod_{k=1}^{t-1} (1 - h_i(k|\alpha_j(k), x_i(k), \epsilon_i^m)) \\ &\quad \text{for } j \in \{1, 2\}. \end{aligned} \tag{5.5}$$

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".

$$h_{ij}(t|\alpha_j(t), x_i(t), \epsilon_i^m) = \frac{\exp(\alpha_j(t) + \beta_j' x_i(t) + \epsilon_i^m)}{1 + \sum_{l=1}^{2} \exp(\alpha_l(t) + \beta_l' x_i(t) + \epsilon_i^m)} \tag{5.6}$$

In the empirical implementation 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 semesters whereas it is more likely to drop out in the first few semesters. To account for this difference between the alternatives and in order

Han and Hausman (1990) or Abbring and van Den Berg (2003).

[7]Used in this context "unconditional" means "not conditional on survival up to interval t". Of course all results are conditional on $\alpha_j(t)$, $x_i(t)$ and ϵ_i^m, as indicated.

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:

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

$$\text{where } \delta_{ij} = \begin{cases} 1 & \text{individual i makes transition to exit state j} \\ 0 & \text{otherwise} \end{cases} \quad (5.7)$$

with n being the number of individuals in the sample. Equation (5.7) 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 (5.2), using a standard numerical optimization procedure.[8]

5.3.2 DATA AND VARIABLES

The empirical analysis is based on data from the German Socio-Economic Panel Study (SOEP) for the years 1984 to 2007. The feature that is of main interest for this chapter, is the retrospective monthly calendar, which allows to identify whether a person studied during a certain semester.[9] 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 starting tertiary education in September; this student will count as having started in the winter term since many universities offer introductory/preparatory 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).

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

[9]There are two semesters each year and each lasts 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.[10]

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.

One complication in the data is the aggregation of student aid transfers according to BAfoeG and other financial aid, i.e. scholarships. I therefore simulate student aid eligibility for each student, which allows me to distinguish between BAfoeG recipients and students who hold scholarships. The simulation is based on the respective BAfoeG regulation for each year, where the calculation of BAfoeG eligibility is based strictly on the letter 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 form of BAfoeG.

Table 5.1 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.

About 28% 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.[11]

BAfoeG eligibility depends on financial resources of a student. Students eligible

[10]Until 1991 the sample contains only observations from West-Germany, afterward East-

Table 5.1: Descriptive statistics of main explanatory variables

	All	**BAfoeG**		**BAfoeG recipients** in periods of	
	students	non-recipients	recipients	non-receipt	receipt
BAfoeG[1]	0.25	0.00	0.90	0.00	1.30
	(0.56)	(0.00)	(0.73)	(0.00)	(0.74)
Scholarship[1]	0.13	0.11	0.17	0.47	0.01
	(0.34)	(0.33)	(0.35)	(0.67)	(0.06)
Private transfers[1]	0.36	0.39	0.26	0.33	0.23
	(0.73)	(0.8)	(0.53)	(0.63)	(0.53)
Labor income[1]	1.31	1.56	0.64	1.16	0.36
	(3.54)	(4.06)	(1.24)	(2.24)	(0.96)
Sum of all income[1]	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 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)
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 income[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 high school degree	(0.5)	(0.5)	(0.46)		
Right Censored	0.51	0.53	0.50		
	(0.50)	(0.50)	(0.50)		
Graduates	0.31	0.30	0.31		
	(0.46)	(0.46)	(0.46)		
Dropouts	0.18	0.17	0.20		
	(0.38)	(0.37)	(0.40)		
Time in semesters (a semester consists of 6 months, April-Sept or Oct - March)					
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 being right censored	6.55	6.09	7.83		
	(4.43)	(4.07)	(5.09)		
# of students	787	567	220	143	220

Note: Mean values with standard deviation in parentheses.
[1]In 1,000 EUR and in prices of 2000.

Source SOEP 1984-2007, own calculations for transfers under BAfoeG, receive with 260 EUR, only a third of the private transfers that non-recipients receive. 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 student aid recipients earn only half of that.

As the income for parents does not vary substantially for students fluctuating between receiving and not receiving BAfoeG, the main reason for losing the BAfoeG entitlement appears 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 work more when they are not financially supported, or that students lose BAfoeG eligibility because they earn too much and therefore exceed the personal fundamental allowance for labor income.

This can be identified by looking at the daily 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% compared to 40%), 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.

Almost two third of the students who are not right censored, have successfully finished their studies. This is independent of their funding source. 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 graduate.

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 semesters 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

Germans are considered as well given an individual started studying after 1991.

[11]Statistisches Bundesamt (2007b), Fachserie 11 Reihe 7; Calculation of the 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.

non-recipients for the average time until they drop out. While non-recipients drop out on average after seven semesters, students who received at least once student aid transfers according to BAfoeG drop out after eight semesters.

5.4 Estimation Results

To estimate the parameters I use a mixed multinomial logit model which allows me to control for unobserved heterogeneity (see section 5.3.1). Based on the Bayesian Information Criterion (BIC)[12], 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.[13] 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 the sample average of the marginal effects for each individual in table B5.1 in the appendix. 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 (increase) in the hazard rate which results in a higher (lower) average time-to-degree (or time-to-drop-out).

The baseline hazard for graduating increases with the time spent studying. The probability to graduate, conditional on survival up to the respective period, increases by 12% in semester seven and eight up to 46.6% in semester 15 and later relative to the base category.[14] 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% higher than for to the base category) and increases sharply thereafter. The pattern exhibited by the baseline hazard shows, that a transition to any of the exit states is more likely the longer a student has been studying, whereby the transition to graduate is more likely from the seventh semester onwards.

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

[13] The values of BIC for the specification with different mass-points can be found in table C5.3 in the appendix.

[14] Values calculated from table B5.1 in the appendix, i.e. the baseline hazard to graduate in semester 7 is calculated as $0.159 - 0.039 = 0.12$

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. Thus, 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 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 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 students receiving BAfoeG would therefore lead to a stronger decrease in the dropout 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 whether the parents are German born. The dummy capturing 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 reflects the case that a degree obtained in the same discipline usually takes longer to complete (even under perfect conditions) at a regular university. The higher dropout hazard might be explained by stricter requirements about the time in which a certain amount of courses have to be finished or the number of times exams can be retaken at universities of applied science.

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 5.2, 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).

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 endowment a student might have. In each scenario there is a base case calculated at the values reported in table A5.2 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 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 five, since labor income is the only financial source these students have. This also reduces the time spent on education (I set this to two 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

Table 5.2: 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 B5.1 in the appendix

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 5.2) the probability to have graduated by the 16th semester is 58%, thus a bit smaller than the average graduation rate from 2000-2006 with 67%[15]. 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% (Heine et al., 2008). Increasing BAfoeG by 600 EUR and 1,200 EUR, results in a sizable increase in the probability to graduate of 4 and 8 percentage

[15]own calculation; ratio of graduates to newly enrolled university students with German nationality for the years 2000 to 2006, see Statistisches Bundesamt (2008).

points, respectively. At the same time the probability to drop out decreases by 4 and 7 percentage points, respectively.

To get an intuition for the graduation and dropout probabilities of students with different sources of funding, the second to sixth block of table 5.2 shows the same increase in BAfoeG as described before, but for five different income situations.

In all 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 points (an increase of more than 50%). 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). For an average student, who is funded by high parental transfers only, the probability to have graduated by the 16th semester is only about half the probability of an average student who is 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 in addition, half of the BAfoeG amount received must be repaid. Private transfers on the other hand can be seen as a non repayable gift 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.

Scenario 1 and 2 describe the graduation and dropout rates for a student with an income situation that exemplifies low income families. A student receiving student aid (scenario 2) has a higher initial graduation rate than a student who is supported wholly by his or her 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% in the base scenario to 44%. However, even with this strong decline this group faces the highest dropout risk.

For the interpretation of my results in light of possible financial constraints, the last case is the most interesting. 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 financial constraints. A decrease in student aid seems to have only a minor effect on prolonging the time till graduation that is caused by the students need to take up work in order to compensate the financial loss. It seems to be of 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 C5.2 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 C5.3 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 C5.1 in the appendix) do not differ significantly from the specification including right censored observations (see table B5.1 in the appendix).

Lastly, I considered different specifications of the functional form of the baseline hazard. The results are reported in table C5.4 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.

5.5 Conclusion

In this chapter I analyze 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 Study 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 reduces the dropout 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 suggests 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 little financial endowment 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 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% compared to 45%).

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% of all students graduating that year, must only repay 25% of the BAfoeG if he or she finished within the funding time limit. This might be an incentive for a funded student to concentrate on his or her 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 (e.g., Ehrenberg and Mavros, 1995; Siegfried and Stock, 2001, 2006) but apply to a much wider range of students. Using data from the German Socio-Economic Panel Study 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 (see e.g. Heine et al., 2008). My results suggest that this can be attributed (at least in part) to the tighter schedule of the bachelor and master degrees. Less time than in the Diploma system can be spend on working in the market and financial constraints become more important accordingly. The role of student aid is therefore even more important for bachelor and master degrees than it was before and should become a focus of future research as well as policy considerations.

5.6 APPENDIX

5.6.A DEFINITIONS

Table A5.1: 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 EUR and prices of 2000

Table A5.2: 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 and prices of 2000

5.6.B Estimation Results

Table B5.1: Estimation results Multinomial Logit

	Coefficient Estimates		Marginal Effect, sample average	
Variable	**Graduation**	**Dropout**	**Graduation**	**Dropout**
Eligible for BAfoeG	-0.714†	0.290	-0.024†	0.016*
	(0.407)	(0.391)	(0.012)	(0.008)
Amounts received of				
BAfoeG	-0.668	-1.165**	-0.009	-0.026*
	(0.531)	(0.248)	(0.016)	(0.013)
Private transfers	-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)
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)
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**

Continued on next page...

... table B5.1 continued

Variable	Coefficient Estimates Graduation	Dropout	Marginal Effect, sample average Graduation	Dropout
	(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**
	(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

5.6.C Sensitivity Analysis

Table C5.1: Estimation without right-censored observations

	Coefficient Estimates		Marginal Effect, sample average	
Variable	**Graduation**	**Dropout**	**Graduation**	**Dropout**
Eligible for BAfoeG	-0.428	0.435	-0.024†	0.029
	(0.365)	(0.383)	(0.014)	(0.020)
Amounts received of				
BAfoeG	-1.487**	-1.507**	-0.031†	-0.043*
	(0.504)	(0.327)	(0.018)	(0.020)
Private transfers	-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)
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)
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**

Continued on next page...

... table C5.1 continued

Variable	Coefficient Estimates Graduation	Coefficient Estimates Dropout	Marginal Effect, sample average Graduation	Marginal Effect, sample average Dropout
	(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)
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 C5.2: 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: † : 10% $*$: 5% $**$: 1%

Standard errors in parentheses

Source: Estimations based on SOEP 1984-2007

Table C5.3: 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: † : 10% * : 5% ** : 1%
italic numbers are calculated values
Standard errors in parentheses
[1]Estimation with 5 masspoints is not feasible for both of the specifications

Source: Estimations based on SOEP 1984-2007

Table C5.4: Estimation with different functional baseline hazards

	Time specified as							
	Dummy Variables		Log. Function		linear Trend		linear and squared Trend	
	Grad.	Drop.	Grad.	Drop.	Grad.	Drop.	Grad.	Drop
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)	(.)						
9-10	6.962**	0.000						
	(0.670)	(.)						
11-12	9.171**	0.000						
	(0.890)	(.)						
13-14	10.610**	0.000						
	(0.942)	(.)						
≥15	11.146**	0.000						
	(1.035)	(.)						
Dropout in semester								
3-4	0.000	1.798**						
	(.)	(0.323)						
5-6	0.000	1.603**						
	(.)	(0.377)						
7-8	0.000	3.166**						
	(.)	(0.554)						
9-10	0.000	4.055**						
	(.)	(0.900)						
11-13	0.000	6.447**						
	(.)	(0.871)						
≥14	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)
AIC	2592.409		2601.802		2632.059		2571.929	
BIC	2941.327		2890.330		2920.587		2873.877	

Significance levels: † : 10% ∗ : 5% ∗∗ : 1%

Standard errors in parentheses; Akaike Information Criterion (AIC); Bayesian Information Criterion (BIC)

Source: Estimations based on SOEP 1984-2007

Chapter 6

Conclusion

6.1 Main Findings and Policy Implications

In this dissertation I evaluate the impact of funding and financing on enrollment and success in higher education. In particular I ask three questions:

- What are the enrollment effects of different tuition fee schemes?
- How does taxation of future earnings affect enrollment?
- What is the impact of student aid on the success of studies?

To answer the first two questions, I employ a structural microeconometric model of university enrollment (chapter 3). The model takes characteristics of potential students at the time they make the decision to take up tertiary education into account, as well as expectations about their future income and its uncertainty. I use the assumption that high school graduates compare the present value of the discounted utility from career paths with and without a university degree when deciding on taking up higher education. Utility in each future period depends not only on expected income but also on income risk (if students are not risk neutral).

For the empirical implementation, the value and the variance of wages in the two alternative career paths are estimated individually, allowing for non-random selection based on multiple correlated criteria. Taxes are accounted for and the predicted net earnings and variance are used in a duration model to estimate the impact on enrollment.

The results indicate that higher risk-adjusted expected wages as a university graduate, relative to the alternative, increase the probability of enrollment. Furthermore, high school graduates are risk averse, though to a low degree. Consequently, a higher variance of net wages for academics, ceteris paribus, discourages high school graduates from pursuing tertiary education.

The results show that expectations about future earnings matter. So if changes in policies affect future income as, e.g., is the recent introduction of student fees or simple changes in taxation, enrollment changes as well. I use the results of the structural model from chapter 3 as a base for policy simulations for both examples. First, I evaluate the enrollment changes from an introduction and different financing schemes for student fees (chapter 4.1) and second, the potential changes in enrollment from changes in the income taxation (chapter 4.2).

When students have to take up a loan in order to pay the imposed student fees, they transfer the incurred costs to the future. This involves a reduction of future income. The repayment conditions of the loan thus might be the key drivers with respect to taking up a loan, and thus being able to finance university studies. As future income is uncertain, especially risk averse persons might be deterred of taking up a loan as they fear not to be able to repay the debt. Based on the results derived by the structural enrollment model, I analyze three different loan schemes (mortgage type; income contingent loan; graduate tax) with respect to their effect on university enrollment. In an extension I also consider the impact of the loan schemes on the equality of the predicted future income distribution. The simulation results show that the introduction of tuition fees that cover less than 10% of the average costs leads to a small decline in university enrollment. The decrease in enrollment becomes more profound when the amount of student fees increases. A concern when introducing student fees is that prospective students from poor families are deterred from enrolling. I find no evidence that the effect on enrollment differs for high school graduates with low income parents compared to graduates with high income parents, when the tuition fees are moderate. At higher levels the existing gap between the two groups is reduced because the discouraging effect is stronger for students from families with high income.

The income inequality of the expected lifetime earnings, measured by the Gini coefficient, increases when taking up a mortgage type student loan is the only alternative in order to pay the tuition fees. With income contingent loans or a graduate tax, the Gini coefficient also increases, but only to a small extend. These differences are mainly driven by changes in university enrollment. Overall income contingent loans perform best, both in terms of equal access to higher education as well as distributional effects.

The empirical results show that the task of achieving certain university enrollment and graduation quotas as suggested by the science council is non trivial. Furthermore, the government has to clearly define their goals, and act accordingly. A concerted action of federal states and government is essential. If the primary goal is to increase the enrollment rates, student fees act, without further adjustments, in the opposite direction. To maintain the goal, the results suggest that alternative financing schemes other than student loans might be an option. Student fees were introduced with the aim to increase the quality of education. In order to attract the most skilled high school graduates, a merit based scholarship scheme would be advisable. This would not affect the expectations about future income, as well as the risk associated with it. Additionally, merit based funding might also help to attract high school graduates with high ability from disadvantaged financial backgrounds. Although in general a student aid scheme is in place, this is also bound to certain repayment obligations, which reduce future income. Increasing the quality of education with the revenues of student aid however requires that the spending by the German government, as well as the federal states, is not decreased by the amount of student fees received.

In contrast to the existing literature considering earnings risk, the university enrollment model I use assumes that after-tax income is relevant for the decision to acquire tertiary education. The structural university enrollment model takes taxation explicitly into account by applying a microsimulation model. This allows me to study the effect of changes in income taxation to answer my second question. Both the incentive effect of taxation—via its impact on the earnings differential between academic and non-academic career paths—and the risk-sharing effect—via its impact on earnings risk in the two alternatives—can be analyzed simultaneously. In chapter 4.2, I simulate the effect that would result when repealing the tax reform 2000, which would increase the progressiveness of the income tax schedule. Furthermore, I propose two hypothetical revenue-neutral flat-rate tax scenarios and determine the effect of their introduction on university enrollment in Germany.

Re-implementing the tax schedule of 2000 (pre-tax-reform) would lead to a major decrease in the expected after tax income which outweighs the positive insurance effect, resulting in lower university enrollment probabilities. I also find that a revenue-neutral flat tax with an unchanged basic tax allowance would significantly increase the cumulative probability of university enrollment for male high school graduates. For men, the positive incentive effect of the flat tax reform thus outweighs the negative insurance effect. For women I cannot find this effect, which can be attributed to women's comparatively lower expected wages. Increasing the basic allowance by about 40% and the tax rate by 18.5% offsets the positive incentive effect and no difference compared to the prevailing tax scheme can be found.

The policy debate about taxation and tertiary education focuses primarily on the effect of relative levels of net income on incentives for education. However, the findings from this study suggest that it may be just as important to consider the relative after-tax income risk associated with academic and non-academic career paths. Hence, policy makers face the challenge to provide wage incentives on one side, and an insurance against high wage loss on the other side. This task becomes even more complicated when alternative ways of higher education financings are considered, e.g. student fees. Student fees decrease the earnings differential between academic and non-academic career paths. If the tax schedule and thus the insurance effect remain unchanged, this negative incentive effect reduces the university enrollment rate. So the negative impact on enrollment due to student fees can be compensated by the "right" taxation. But leaving the incentives for potential students unchanged or even increasing taxes at the upper end might worsen the effect on university enrollment.

Finally turning to the third question, the factors that influence the successful graduation from university, as well as the time-to-degree (chapter 5). My focus is the importance of means-tested student aid. Estimating a discrete-time duration model with competing risks and discrete unobserved heterogeneity allows me to analyze jointly the effect of student aid on both the probability to graduate and the time-to-degree. The results indicate that aid eligible students have per se a lower hazard to graduate and a higher conditional probability to drop out. The amount of financial aid received however reduces the dropout hazard. When I investigate this average effect further by comparing different funding scenarios for students, I find that an increase in student aid 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 little financial endowment faces the highest dropout risk. With an increase in the amount of student aid 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 find that the type of financial aid matters. Comparing student aid eligible persons who are funded with the maximum amount of financial aid to students who receive the same amount in private transfers, more student aid recipients graduate by the 16th semester.

Although I base the model on data from the Pre-Bologna era, the results also have important implications for the recently introduced bachelors and master degrees. In contrast to the diploma and magister track, these new tracks are designed to be completed within a fixed time period. This leaves fewer opportunities for the students to freely design their schedule. As long as the financing of the students is ensured, no problems should arise. But if the financing is an issue, i.e. student aid is not sufficient to cover the living expenses, students face the challenge how to cover the emerging costs since the tight schedule leaves no opportunity for working alongside studying. Financial constraints become a severe problem. For bachelor and master degrees student aid might thus be even more important than it was for students in the diploma and magister track.

6.2 Future Research

I use a structural model to evaluate the impact of the recent introduction of tuition fees and also evaluate the effect of potential changes of funding policies. Since the changes are recent, data for nonstructural policy evaluation is rare or not available. The next step would be to do a policy evaluation as soon as data is available. This is interesting itself, but would also serve as a verification test for the results obtained in this thesis. Evaluation of the introduction of tuition fees could be done in a difference-in-differences framework or maybe with an instrumental variable strategy using the “color” of the federal states’ governments or the timing of elections as instruments (controlling for educational spending).

The financing schemes I analyzed assume that the persons do not change their working behavior at the intensive margin, i.e. how much they work (I control for selection at the extensive margin, i.e. whether they work at all). This might be a rather strong assumption which should be relaxed by accounting for wage and income elasticities. The behavioral adjustment might not be a problem for student loan schemes, but for income contingent loans the problem might be severe. Since repayment obligations are due only if yearly gross income exceeds a certain threshold, persons at the margin may choose to work a few hours less and save on the repayment. Especially (married) women, who already tend to work part-time more often than men, might react with a change in their labor supply. In light of my findings regarding variations in the marriage decision and the allocation of tax benefits (*Ehegattensplitting*) is another field that needs additional evaluation.

Since my results show that expectations about future income matter, analyzing the formation of expectations would be of interest. So far, I assume that the students predict their future wages rationally, but the empirical evidence suggests that behavior often deviates from this norm. The use of hyperbolic discounting or nonstandard preferences on loans might improve the enrollment decision model.

I take the presence of student fees as granted and the chosen amounts follow the policies implemented. A natural question for future analysis would be what the optimal amount that should be charged is. For this a proper cost-benefit analysis is necessary. My results capture part of the costs but it would be necessary to quantify the returns of higher education and the costs for both the individual as well as the society to do this properly.

The introduction of the bachelors and master degrees also leaves room for further analysis. Unlike the diploma track analyzed in this thesis, time-to-degree for bachelors will be less heterogeneous. Therefore other measures of success are needed, i.e. graduation or grades. As my results suggest, financial support can be assumed to be an important determinant in such a model. For both, student aid eligible and non-eligible persons, the rather new alternative to take up a student loan should be considered in such a model as well. Of further interest would be information of the subjects in which a student is enrolled, and also the motivation that lead to the choice of subject (interest, career options, expectations about job security and income). Finally academic success might not be the most interesting outcome but just means to an end. So evaluating the careers of academics and their income would be an interesting extension. But collecting data on this is big challenge. Here I focus on structural identification via a multilevel latent variable model for multivariate responses. An alternative strategy would be to find exogenous variation in student aid. One idea would be to use the local variation in real student aid, 300 EUR in Chemnitz is worth more than 300 EUR in Munich, but student aid is fixed at the national level and does not account for regional differences since 1999. The variation in real terms could be used to evaluate academic success, if selection into a specific university could be controlled for.

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List of abbreviations

BAFoeG BundesAusbildungFörderungsGesetz
EStG EinkommensSteuerGesetz
GT Graduate tax
HRG HochschulRahmenGesetz
ICL Income contingent loan
OECD Organisation for Economic Cooperation and Development
UBR Unemplayment benefit rate

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German summary

Bildung, insbesondere Hochschulbildung, rückt zunehmend ins Interesse von Politik und Forschung. Begründet ist dieses Interesse vornehmlich in der Schlüsselposition die Bildung in Bezug auf wirtschaftliche und soziale Stabilität einnimmt. Insbesondere in Industrieländern ist die demografische Entwicklung, d.h. die zunehmende Alterung der Gesellschaft ein Problem. Dies trifft auch auf Deutschland zu, welches als Fallbeispiel in der vorliegenden Dissertationsschrift behandelt wird.

Deutschland bietet einerseits mit dem Sozioökonomischen Panel eine repräsentative Datengrundlage, die es ermöglicht Individuen nach ihrem Erlangen der Fach- bzw. der Hochschulreife über die folgenden Jahre zu verfolgen. So können sowohl Übergänge ins Studium, als auch der Studienverlauf beobachtet werden. Des Weiteren gab es in den letzten Jahren einige Änderungen in der Bildungspolitik, die ein effizienteres Hochschulsystem bewirken sollen. Die deutsche Bildungspolitik versucht einerseits, die Einschreiberaten zu erhöhen, und andererseits die Studiendauer zu verkürzen. Begründen lässt sich diese neue Richtung mit der demografischen Entwicklung und einem daraus resultierenden Fachkräftemangel, insbesondere in den sog. MINT-Fächern (Mathematik, Informatik, Naturwissenschaft und Technik). Eine Verkürzung der Studiendauer würde zum einen die Kosten des Studiums reduzieren, und zum Anderen wird so "kurzfristig" das Angebot an Fachkräften erhöht. Auf lange Frist kann die Alterung der Gesellschaft zudem zu einer Verringerung der Bildungsausgaben führen. Da die Regierungsparteien ihre Programme auf ihre Wiederwahl ausrichten, ist davon auszugehen, dass Investitionen ins Hochschulsystem nur noch eine Nebenrolle spielen (Oberndorfer and Steiner, 2007). Die deutsche Regierung muss also versuchen die Zahl der Absolventen zu erhöhen, ohne die Ausgaben für die Hochschulbildung anzuheben. Einerseits kann dies durch eine Erhöhung der Immatrikulationsrate erreicht werden, andererseits durch eine Verringerung der Abbrecherquote.

Unter Berücksichtigung dieser politischen Herausforderung untersuche ich in dieser Arbeit zum einen die Einflussfaktoren, die die Entscheidung von (Fach-)

Abiturienten zur Aufnahme eines Studiums bedingen, und zum anderen, wie der erfolgreiche Abschluss des Studiums unterstützt werden kann. Im Speziellen greife ich in dieser Arbeit folgende Fragen auf:

- Wie wirken sich Studiengebühren, insbesondere verschiedene Finanzierungsformen von Studiengebühren, auf die Einschreiberate aus?
- Wie wirkt sich die Besteuerung des zukünftigen Einkommens auf die Aufnahme eines Studiums aus?
- Welchen Einfluss hat die Studienförderung in Form von BAFöG auf den erfolgreichen Abschluss des Studiums?

Bevor ich diese Fragen ausführlich behandeln werde, zeige ich im zweiten Kapitel die relevanten Entwicklungen des Hochschulsystems in Deutschland auf. Des Weiteren werden die wesentlichen institutionellen Verknüpfungen dargestellt. Ich vergleiche deskriptiv die Entwicklung von Einschreiberaten, Studierendenzahlen und die Finanzierung des Hochschulsystems. Daraus ergeben sich erste Hinweise auf die zu erwartenden Ergebnisse der empirischen Analyse.

Um die aufgelisteten Fragen beantworten zu können, entwickle ich im dritten Kapitel ein strukturelles Entscheidungsmodell, welches Erwartungen über zukünftiges Nettoeinkommen und dessen Varianz für Akademiker und Nicht-Akademiker explizit modelliert. Ein Abiturient entscheidet sich ein Studium aufzunehmen, wenn der erwartete Lebensnutzen aus dieser Alternative höher ist, als aus jeder anderen Wahlmöglichkeit. Ich schätze für jede Person ex-ante Lebenseinkommensprofile (netto) sowie deren Varianzen. Die Schätzung der Einkommensprofile geschieht unter der Annahme von nicht zufälliger Selektion sowohl in ein Studium als auch in die Erwerbstätigkeit. Für Selektion wird mittels eines multiplen Selektionsmodells, welches auch Korrelation zwischen den verschiedenen Selektionsstufen erlaubt, kontrolliert. Für das Nutzenmaximierungsproblem unterstelle ich eine Nutzenfunktion mit konstanter relativer Risikoaversion und berücksichtige zudem das Risiko eines Studienabbruchs und einer möglichen Arbeitslosigkeit. Basierend auf Daten von Abiturienten bis zu fünf Jahren nach dem Erwerb ihrer Hochschulreife schätze ich das strukturelle Entscheidungsmodell und evaluiere die Determinanten, die das Einschreiben an einer Universität begünstigen. Insbesondere erlaubt mir diese Methodik den Einfluss von erwartetem Einkommen und dessen assoziierter Varianz zu schätzen, wie auch den Arrow-Pratt Koeffizienten der Risikoaversion, wobei für individuelle

Charakteristika und familiären Hintergrund kontrolliert wird. Der Arrow-Pratt Koeffizient wird signifikant mit einem Wert von 0.05 geschätzt und deutet somit eine schwache Risikoaversion an. Der Koeffizient, der den Effekt des Unterschieds der Risikoangepassten Nutzen aus den Alternativen "Studium" und "Nicht-Studium" misst, ist signifikant und positiv. Wird mit einem Universitätsabschluss ein höheres Einkommen erwartet, so erhöht sich die Wahrscheinlichkeit einer Immatrikulation. Eine 10% Erhöhung der netto Einkünfte mit Universitätsabschluss erhöht ceteris paribus die Wahrscheinlichkeit zu studieren um 6.2 Prozentpunkte. Eine 10% Erhöhung der Varianz hingegen, reduziert die Wahrscheinlichkeit zu studieren um 0.05 Prozentpunkte.

Auf Basis der Ergebnisse des strukturellen Modells können nun verschiedene ex ante Politik-Simulationen durchgeführt, und so deren Auswirkungen modelliert werden. Solche Politik-Simulationen können alternative Finanzierungsmöglichkeiten und Veränderung in der Höhe der Gebühren sein. Derartige Simulationen sind Inhalt des vierten Kapitels. Im ersten Teil des Kapitels untersuche ich den Effekt von Studiengebühren, welche derzeit im Fokus der Bildungspolitik stehen. Da diese erst 2006 eingeführt wurden, existiert noch kein ausreichender Datensatz, um die Effekte anderweitig zu modellieren. Das strukturelle Modell erlaubt mir somit, eine erste Analyse durchzuführen. Für die Simulationen berücksichtige ich zwei Effekte der Studiengebühren. Zuerst beeinflussen sie das Vermögen zum Zeitpunkt des Studiums, aber auch das zukünftige Einkommen, da Rückzahlungen fällig werden. In meinen Simulationen modelliere ich verschiedene Alternativen, wann und wie viel Studenten bezahlen müssen.

Bevor ich rein hypothetische Finanzierungsmöglichkeiten untersuche, wende ich mich zunächst den aktuell vorhandenen Studiengebührensystemen zu. Ich gehe davon aus, dass Studenten aus verschiedenen finanziellen Schichten von Studiengebühren unterschiedlich beeinflusst werden können. Ich verwende drei verschiedene Finanzierungsformen: ein marktübliches Kreditsystem, ein einkommensabhängiges Kreditsystem und eine Akademikersteuer. Als Erweiterung untersuche ich zudem Verteilungsaspekte im erwarteten zukünftigen netto Lebenseinkommen. Die Ergebnisse zeigen, dass unabhängig vom Finanzierungssystem, Studiengebühren einen negativen Einfluss auf die Studierwahrscheinlichkeit haben. Dies betrifft sowohl Personen aus finanziell schwachen Haushalten, als auch aus finanziell gut gestellten Familien. Aber die Effekte sind je nach Finanzierungssystem unterschiedlich ausgeprägt: Sowohl einkommensabhängige Kredite als auch eine Akademikersteuer zeigen weniger starke Effekte als eine Finanzierung über einen Studienkredit. Auch bezüglich der zu erwartenden Verteilungseffekte unterscheiden sich die Finanzierungsformen. Für ein System mit Studienkrediten steigt die Ungleichheit (ein Gini Koeffizient von 0.188 im Vergleich zu 0.173 im Fall ohne Studiengebühren). Wenn Studiengebühren erhoben werden, erscheint eine einkommensabhängige Kreditfinanzierung am Vorteilhaftesten zu sein, sowohl bezüglich des Effektes auf die Immatrikulationswahrscheinlichkeit, als auch unter dem Aspekt der Verteilungsgleichheit. Bei Studiengebühren von 1,000 EUR im Jahr (derzeitige Regelung) würde die durchschnittliche jährliche Einschreibewahrscheinlichkeit um 0.3 Prozentpunkte sinken, im Vergleich zu 0.6 Prozentpunkten in einem System, in dem alle Studenten einen Studienkredit aufnehmen müssten.

Der zweite Teil des vierten Kapitels befasst sich mit der indirekten Wirkungsweise von Steuern auf die Wahrscheinlichkeit zu studieren. Durch Besteuerung des Einkommens werden zum einen die erwarteten netto Einkünfte verändert und zum anderen das Einkommensrisiko. Im Rahmen der Steuerreform von 2000 wurde im Zeitraum von 2000 bis 2005 erstens der Freibetrag angehoben, zweitens der Eingangsgrenzsteuersatz abgesenkt (von 22.9% auf 15%) und drittens der Höchstgrenzsteuersatz von 51% auf 42% abgesenkt. Ebenso wurde viertens das obere Ende der Progressionszone drastisch abgesenkt. Die Steuerreform führt also zu einer Verringerung der Progressivität und hat damit zwei für die Immatrikulationsentscheidung wichtige Implikationen: Erstens erhöht sich durch die Steuerreform das zu erwartende Nettoeinkommen; zweitens führt dies zu einer Verringerung des Versicherungseffektes. Ich evaluiere den Effekt für 2005 und die darauf folgenden Jahre, da ab diesem Zeitpunkt die Steuerreform 2000 abgeschlossen war, indem ich die Einschreibewahrscheinlichkeiten unter dem aktuellen Steuersystem mit dem Steuersystem vor der Reform (also dem Steuersystem in 2000) vergleiche. Die Ergebnisse zeigen, dass eine Wiedereinführung des Steuersystems von 2000 einen negativen und signifikanten Effekt hätte. Die durchschnittliche jährliche Einschreibewahrscheinlichkeit würde um 0.6 Prozentpunkte für Männer und um 0.8 Prozentpunkte für Frauen sinken.

Des Weiteren analysiere ich die Effekte einer möglichen Einheitssteuer. Einheitssteuern geraten immer wieder in den Fokus öffentlicher Debatten; Kirchhoff (2003), Mitschke (2004), und der Wissenschaftliche Beirat des Bundesministeriums für Finanzen (2004) schlagen alle Steuerreformen mit einem (fast) Einheitssteuersatz vor. Obwohl das Immatrikulationsverhalten mit diesem Vorschlägen nicht beeinflusst werden sollte, können diese doch indirekte und interessante Auswirkungen auf die Einschreibewahrscheinlichkeit haben. Ich untersuche zwei verschiedene aufkommensneutrale Einheitssteuersysteme, die von Fuest et al. (2008) vorgeschlagen wurden. Das eine lässt den Freibetrag unverändert, was zu einem aufkommensneutralen Steuersatz von 26.9% führt. Das zweite Szenario erhöht den Freibetrag und führt somit unter der Bedingung der Aufkommensneutralität zu einem Steuerersatz von 31.9%. Die Ergebnisse der jeweiligen Simulation ergeben, dass im ersten Szenario mit dem unveränderten Freibetrag die durchschnittliche jährliche (kumulative nach fünf Jahren) Wahrscheinlichkeit einer Studienaufnahme der Männer um 0.6 (0.9) Prozentpunkte steigt. Für Frauen ist der Effekt in diesem Fall negativ. Dieser ist jedoch nur für die durchschnittliche jährliche Wahrscheinlichkeit signifikant. Der negative Effekt für Frauen deutet darauf hin, dass Frauen sich in einem Bereich der Einkommensverteilung befinden, in dem der Grenzsteuersatz in diesem Szenario höher ist als in der Ausgangssituation. Die Simulation einer Einheitssteuer mit einem höheren Freibetrag und einem daraus resultierenden höheren Steuersatz führt weder für Männer, noch für Frauen, zu einer signifikanten Veränderung in der Einschreibewahrscheinlichkeit.

Die Immatrikulation an einer Universität ist die notwendige Voraussetzung für einen Universitätsabschluss, eine Anhebung der Zahl der Akademiker kann demnach durch eine Erhöhung der Einschreiberaten erzielt werden. Jedoch setzt dies Voraus, dass Studenten die ein Studium beginnen, dieses auch erfolgreich beenden. Im fünften Kapitel dieser Dissertation untersuche ich deshalb die Faktoren, die einen schnellen und erfolgreichen Studienabschluss beeinflussen. Die Studiendauer hängt nicht nur von dem gewählten Studiengang, sondern auch von der Finanzierung des Studenten während des Studiums ab. Bis vor Kurzem war in Deutschland das zeitunabhängige Diplom (Magister)-studium der Regelfall. Ein Studium wurde erfolgreich zum Abschluss geführt, wenn eine bestimmte Anzahl an Scheinen erreicht wurde. Dies ermöglichte es den Studenten, selbst zu entscheiden, wie viele Veranstaltungen und Prüfungsleistungen sie in einem Semester besuchen bzw. erbringen wollten. Sie konnten sich somit ihre Zeit dementsprechend einteilen. Wenn die Studenten mehr Zeit mit Arbeiten verbrachten, so führte dies im Allgemeinen zu einer längeren Studiendauer (siehe Amann, 2005). Die Gründe für die Aufnahme einer Nebentätigkeit können z.B. die Finanzierung der Lebenskosten sein, wenn der Student keine anderen finanziellen Rücklagen hat. Finanzielle Unterstützung zur Deckung der Lebenskosten könnte die Notwendigkeit einer Nebentätigkeit aufheben und so indirekt zu einem schnelleren Studienabschluss führen. Ob diese Sachverhalte sich empirisch nachweisen lassen, ist Gegenstand des fünften Kapitels. Ich untersuche den Effekt von finanzieller Unterstützung (BAföG) auf den erfolgreichen Abschluss eines Studiums. Ich konzentriere mich hierfür auf zwei Dimensionen, die Studiendauer und die Wahrscheinlichkeit das Studium mit einem Abschluss zu beenden. Ich schätze ein diskretes Verweildauermodell, in dem ich explizit für konkurrierende Risiken (erfolgreiches Abschließen und Studienabbruch) berücksichtige. Meine Ergebnisse zeigen, dass die Studiendauer mit der Quelle der Finanzierung variiert. Es gibt drei wesentliche Ergebnisse: Erstens, Studenten die finanzielle Unterstützung (BAföG) erhalten studieren schneller als Studenten, die den gleichen Betrag in Form von familiärer Unterstützung bekommen. Zweitens, obwohl eine höhere finanzielle Unterstützung (BAföG) im Durchschnitt nicht die Studiendauer beeinflusst, wird dieser Effekt (drittens) durch eine höhere Wahrscheinlichkeit des erfolgreichen Studienabschlusses dominiert.

Das sechste Kapitel fasst die wesentlichen Ergebnisse meiner Dissertation zusammen, gibt einen Überblick über daraus resultierende politische Empfehlungen und einen Ausblick auf mögliche weitere Forschungsvorhaben.