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The Effect of the Bologna Process on the Duration of Studies*

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Abstract

This paper evaluates the effect of replacing traditional German five-year degrees with three-year bachelor programs on the duration until graduation and dropping out of university. Using an extensive dataset containing detailed administrative data on more than 9000 students, competing risks models are estimated. The results reveal that the Bologna process reduced the duration until graduation in absolute and relative terms, indicating that one of the reform's main objectives was achieved. In addition, there is a favorable impact of being enrolled in a bachelor program on the probability of dropping out of university for students enrolled at the faculty of humanities. However, the results concerning university drop out are less conclusive for the other faculties.

Keywords: tertiary education, Bologna process, bachelor, survival analysis, competing risks
JEL classification: I21, I28, H75, J24

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1 Introduction

The Bologna declaration was signed by 29 European countries in 1999 with the aim of establishing a European Higher Education Area. It was, among other things, decided on a homogeneous two-tier university system in order to enhance mobility and to make academic degrees comparable. Therefore, the first degree, the bachelor's degree, is awarded after at least three years of study and should primarily be targeted to the labor market. After the completion of this first cycle, it is then possible to obtain a second, more academic, degree, the master's degree (European Ministers of Education, 1999).

For Germany, the introduction of bachelor and master programs implied a restructuring of part of the degree system. Since the traditional study programs were an example of a one-tier system with a degree awarded after approximately five years of study, the reform involved the implementation of two study cycles, and hence a revision of the existing curricula. Furthermore, examination regulations and conditions of study had to be rearranged. In line with this view, the reform was also seen as an opportunity to evaluate old structures and adapt them to present needs and requirements. In particular, the aim was to reduce the time German graduates need to obtain a degree as well as drop-out rates (Wissenschaftsrat, 2000).

Evaluating the effect of the Bologna process on student behavior and university outcomes is of interest, due to the major changes imposed on the German university system. This paper addresses this issue by estimating the impact of the reform on the duration until graduation and dropping out of university. The analysis reveals a positive impact of being enrolled in a bachelor program on the time until graduation, indicating that the aim of reducing study duration both in absolute and relative terms was achieved. With regard to university drop-out, however, the results are less conclusive. There is a clear favorable effect of the reform on the probability of dropping out for students at the faculty of humanities. For the other faculties the effect is insignificant or sensitive to different specifications.

The effect of restructuring study programs in the course of the Bologna process has been examined in studies on Germany, Portugal and Italy. Research topics are, among others, university participation and drop-out rates, student behavior and

performance as well as labor market implications.

Using administrative data on German students, Horstschräer and Sprietsma (2015) estimate a fixed effects panel model and find no significant impact of the Bologna process neither on enrollment rates nor on university drop-outs for most fields of study. By means of descriptive analysis, Heublein et al. (2009) show that the average duration until university drop out is lower for bachelor students than for students enrolled in one of the old degree systems. Concerning the duration until graduation, further descriptive analysis suggests that the Bologna process resulted in more students graduating within the standard time period (Autorengruppe Bildungsberichterstattung, 2012). Using survey data, Mühlenweg (2010) examines the impact of the reform on student satisfaction. She finds that students enrolled in bachelor programs are slightly more satisfied with their study conditions than their peers who aim at a traditional degree. The author also points out that the reform did not change the composition of the German student population with regard to socio-economic factors.

For Portugal, Cardoso et al. (2008) and Portela et al. (2009) find that demand increased for most study programs that were restructured in the course of the Bologna process. This result is consistent with findings for Italy: using survey data, Cappellari and Lucifora (2009) show that the restructuring of study programs had a positive impact on university participation. Additionally, they point out that it is mostly students with good high school performance but low socio-economic background who benefit. This is confirmed by Di Pietro (2012) who finds that university enrollment of Italian students from less advantageous backgrounds increased after the reform. Furthermore, Di Pietro and Cutillo (2008) show that, in contrast to the results obtained by Horstschräer and Sprietsma (2015) for Germany, the introduction of a two-tier system reduced drop-out rates at Italian universities.

Bratti et al. (2006, 2010) focus on the impact of the Bologna process on student behavior and performance at an Italian university. They show that students spent less time on courses that had a high workload before the reform. In addition, the probability of failing these courses decreased while the average grade stayed constant. For courses that were already easier in the old system, the authors find no changes in the students' workloads, but evidence of grade inflation (Bratti et al., 2006). When

only looking at the faculty of economics (Bratti et al., 2010) the results are similar: the average grades in first-year examinations improved and the number of attempts failed decreased while students reduced their workload.

Finally, Bosio and Leonardi (2011) study the reform's effect on the Italian labor market and find ambiguous results. Except for women living in the south of Italy, there is a positive impact of the Bologna process on the probability of being employed after graduation. However, the wage premium of university compared to high school education is reduced by the reform.

This paper contributes to the literature on the Bologna process by assessing the effect of replacing traditional German five-year degrees with three-year bachelor programs on the duration until graduation and dropping out of university. To the best of my knowledge, it is the first study that estimates competing risks models to evaluate in detail the time to the occurrence of one of these events and, in particular, the differences between the new and the old study system. Thereby, additional information on the reform's effects can be obtained, such as whether the aim of reducing study duration was achieved. Since most of the previous literature on Germany is based on descriptive analysis, this paper also provides more profound results on the effect of the Bologna process.

The remainder of the paper is structured as follows: Sections 2 and 3 give an overview of the institutional background and the dataset. Section 4 describes the empirical framework. Section 5 shows and interprets the results. Finally, Section 6 sums up the main findings and concludes.

2 Institutional Background

The traditional German degree programs were an example of a one-tier system. There were five different types of university degrees: examinations carried out by the state (*Staatsexamen*) and the church (*theologisches Examen*), the diploma (*Diplom*), an old master's (*Magister*) as well as an old teacher degree, each of them obtained after approximately five years of study. In the teacher program students can choose two to three different subjects that are part of the German high school curriculum. Furthermore, the degree contains pedagogical training that prepares the students for

their later teaching profession. In the *Magister* degree, two to three different subjects, mainly from the faculty of humanities, are combined into one course of study. The *Diplom*, on the other hand, is obtained when finishing one of the study programs offered by the faculties of biology, mathematics, physics, chemistry, agriculture, economic sciences, social sciences, geology/geography or forestry. Finally, the state and church examinations *Staatsexamen* and *theologisches Examen* are achieved in the fields of medicine, law and theology and are characterized by a centralized final examination that is organized by a state authority or the regional subdivision of the church.

Although the state and church examinations are still in existence, the *Diplom*, *Magister* and teacher degrees were gradually replaced by the new bachelor and master programs in the course of the Bologna process. Despite only 19 percent of the study programs at German universities and universities of applied sciences were bachelor and master programs in the summer term 2004, this number increased to 85.3 percent by the winter term 2011 (Hochschulrektorenkonferenz, 2011). At Göttingen University, the first bachelor programs were introduced in 2001. After the summer term 2006, only a small number of students still enrolled in one of the old degree programs.

The implementation of two study cycles resulted in a reduction of the amount of semesters a student needs to obtain her first university degree. At Göttingen University, the standard time period for bachelor programs is six semesters, while it is nine to ten semesters for the old degree programs.

Besides the outer structure, curricula, examination regulations and conditions of study were adopted in the course of the Bologna process. The old study programs were characterized by a high degree of freedom with regard to which courses to take and when to do the examinations, while the new system is more structured. Especially in the first semesters, there is little flexibility and some faculties introduced stricter rules concerning the time frame when parts of the study program need to be completed. For instance, students enrolled in a bachelor program in agriculture, mathematics or psychology need to successfully complete specific basic courses within the first four semesters of their studies. Furthermore, grades are awarded to nearly all of the courses taken and most of them also count towards the degree.

In contrast, the final grades of the teacher and *Magister* degrees were the result of decentralized final examinations organized by the university's institutes in charge of the respective field. The courses taken during one's studies just had to be passed and sometimes this did not even imply taking an examination. On the other hand, in the *Diplom* program, grades were awarded to all courses. However, only those achieved in the main study period counted towards the degree.

3 Data Description

For the analysis, administrative student data collected at Göttingen University, Germany is used. The data contains detailed, anonymized information on more than 9000 students who were enrolled in either a bachelor or a *Diplom*, *Magister* or teacher program and started university between the winter term 2003 and the summer term 2008. One part of the data is information the students have to provide at the beginning of their studies, for example their high school leaving grade, gender and type of health insurance. The other part covers the students' path at university: for every semester the student is enrolled in, the subjects studied and the target degree are registered. If the student obtained a degree at Göttingen University, the type and grade of the degree as well as the semester are observed.

The sample is restricted to students who started university studies at Göttingen University. The reason for this procedure is that for these students all relevant information from when they first enter the university system until they leave Göttingen University can be observed. Furthermore, I exclude students who change between the old and new system as well as students who are enrolled in more than one study program at the same time. More information on data processing is provided in the appendix.

The standard time period for completing a bachelor degree is six semesters while for the old degree programs it is nine to ten semesters. This means that using absolute semesters as time measure is not expedient when analyzing the effect of the Bologna process on the duration until graduation or drop-out. For instance, bachelor students are likely to finish their studies in their sixth semester while most old degree students will not graduate before their ninth semester. Thus, I use a

time measure that is relative to the standard time period in the respective field to make information on study duration comparable[1]: the time variable *study period* equals one for the first third of the standard time period (semester one and two for bachelor programs, semesters one to three for old degrees), it equals two for the second third of the standard time period, and so on. Hence, students who graduate in the last semester of the standard time period finish their studies in study period three irrespective of the degree program they are enrolled in. The scale continues in the same way so that study period four corresponds to one third above the standard time period, which is semester seven and eight for bachelor programs and semesters ten to twelve for old degrees. As a result, this methods allows to assess the duration of studies not only in absolute, but also in relative terms. This is especially interesting for the duration until graduation since bachelor students by definition spend less time at university until they obtain their first degree. However, this does not necessarily imply that the reform reduced the relative time spend at university.

Failure Events.[2] Each individual has two different possibilities of terminating her studies: graduation and dropping-out of university. Furthermore, students can be censored, which means that it cannot be observed whether they graduate or drop out of university. This is the case for students who either change university or are still studying by the end of the time frame under analysis which is the winter term 2011.

Graduation is registered for all students who achieve a degree at Göttingen University within the observed time frame. Students who neither obtain a degree nor are censored are registered as drop-outs. This includes students who definitely fail their studies as well as students who decide to leave university for whatever reason. In fact, only a small number of students who drop out lose the entitlement to take examinations and are therefore expelled from university.

Independent Variables. The treatment variable *bachelor* is an indicator variable that equals one if the student is enrolled in a bachelor program and zero if

[1]For all old degree programs a homogeneous standard time period of nine semesters is assumed.

[2]In the context of survival analysis, the expression *failure* describes an individual's transition into a different state, e.g. graduation or dropping out of university. This should not be confused with failing in the sense of dropping out of university. Therefore, the term "drop out" is used for students who leave university without a degree.

she aims at a *Diplom*, *Magister* or old teacher degree. The student's high school leaving grade is used to control for pre-university ability. Additionally, it may be a reasonable measure of general motivation as students with a good high school leaving certificate are probably not only smart but also willing to put a lot of effort into studying. The high school leaving grades are converted into the U. S. grading scheme with 4 being the best and 1 the worst grade still allowing to pass.[3]

In the analysis, the student's socio-economic background is measured by two variables: the purchasing power index related to the zip-code area the student's parents live in and her health insurance status. The purchasing power index is provided by *GfK*, a market research firm. It quantifies the purchasing power within a zip-code area relative to the German average.[4] Since zip-code areas in Germany are fairly small, the variable seems to be a reasonable measure of family income.

Additionally, the health insurance status can be used to control for the student's socio-economic background. This is possible due to the German health care system distinguishing between private and public health insurance. In particular, it is only possible to select a private health insurance if one fulfills certain criteria with regard to income or employment status. Therefore, compared to the whole German population, a disproportionately high number of people who are privately insured hold a certificate allowing them to enroll at a university or a university of applied sciences or obtained a degree or even a Ph.D. at a university or a university of applied sciences.[5] Bearing in mind that students normally are insured through their parents, their health insurance status provides information on their family background. Moreover, I control for the student's gender.

The analysis also takes into account that students who move further away for studying may be different to their peers who decide to study at a place close to

[3]Grades were converted into the U. S. grading scheme by subtracting the high school grade from five.

[4]*GfK* collects information on people's lifestyle and consumption behavior. The purchasing power index used in the analysis is based on data provided by the German tax offices as well as other relevant statistics, such as pensions and unemployment benefits.

[5]In 2008, 56.7% of the privately insured held a high school leaving certificate allowing them to register at a university or a university of applied sciences, 38.0% finished university or university of applied sciences with a degree or a Ph.D. The corresponding numbers for the overall German population are 24.4% and 13.0% respectively (Finkenstädt and Keßler, 2012; Statistisches Bundesamt, 2009).

their home town. It is conceivable that these students are more independent and put more effort in finding the university that best fits their preferences. This may in turn also influence university outcomes. Therefore, I control for the logarithm of the linear distance between the student's home town and Göttingen.[6]

At Göttingen University the faculties are to a large extent responsible for the study and examination regulations and thereby have a direct impact on the study duration. Moreover, there may be differences in the study and learning culture: at some faculties it may for example be more common to take longer until obtaining a degree. With regard to graduation, Danilowicz-Gösele et al. (2014) show that it is more difficult to obtain a degree at some faculties than at others. For these reasons, the university's different faculties are controlled for in the analysis.

Furthermore, I control for the student's cohort in order to take changes in study conditions into account. For instance, this includes the introduction of general tuition fees in the winter term 2006. This topic is further discussed in Section 5.3.

Summary Statistics. The summary statistics in Table 1 show that 54 percent of the students in the sample are enrolled in a bachelor program. Furthermore it can be seen that 25 percent of the students are censored, meaning that they were still studying at Göttingen University by the end of the observed time frame which is the winter term 2011. Nearly half of the students in the sample graduated and 26 percent dropped out of university. Looking at bachelor students and students within one of the old degree programs separately, small differences in these numbers can be observed: graduation rates are higher for bachelor students, while a smaller share drops out of university.

The Kaplan-Meier failure functions for the different events presented in Figure 1 give further information. They are defined as one minus the Kaplan-Meier estimate, which is the running product of the conditional probability of surviving beyond a certain point in time (Kaplan and Meier, 1958). Consequently, the functions presented in Figure 1 show the unconditional probability of graduating or dropping out of university within a certain study period. The first figure reveals that the probability of graduating is very low in the first two time periods for all degrees

[6]The linear distance is obtained by using geographic coordinates provided by *geonames.org*. Further information on the calculation is provided in Appendix II.

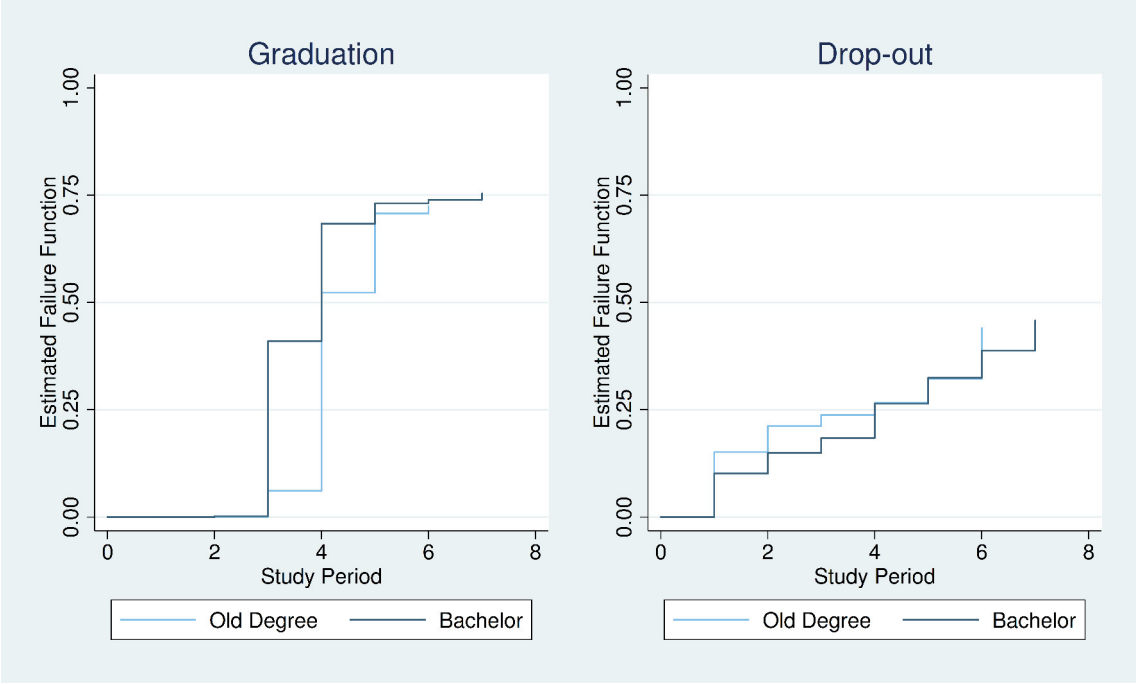
Table 1: Summary Statistics

	Total		Bachelor		Old Degree	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Censored	0.25	0.43	0.23	0.42	0.28	0.45
Graduation	0.49	0.50	0.54	0.50	0.44	0.50
Drop-out	0.26	0.44	0.24	0.42	0.28	0.45
Bachelor	0.54	0.50	1.00	0.00	0.00	0.00
High school GPA	2.46	0.62	2.46	0.62	2.47	0.61
Female	0.53	0.50	0.52	0.50	0.55	0.50
Private health insurance	0.19	0.39	0.17	0.38	0.21	0.41
Purchasing power index	97.60	11.49	97.63	11.41	97.57	11.59
Log distance	4.30	1.35	4.39	1.27	4.18	1.43
Theology	0.00	0.06	0.00	0.05	0.01	0.07
Law	0.00	0.04	0.00	0.05	0.00	0.02
Medicine	0.01	0.08	0.01	0.11	0.00	0.00
Humanities	0.25	0.43	0.22	0.41	0.29	0.46
Mathematics	0.04	0.19	0.04	0.20	0.03	0.17
Physics	0.04	0.20	0.03	0.18	0.05	0.23
Chemistry	0.05	0.22	0.04	0.21	0.05	0.23
Geology/geography	0.03	0.18	0.03	0.17	0.04	0.19
Biology	0.11	0.31	0.10	0.30	0.12	0.32
Forest science	0.04	0.20	0.08	0.27	0.00	0.00
Agriculture	0.09	0.29	0.17	0.37	0.00	0.00
Economic sciences	0.18	0.39	0.20	0.40	0.16	0.36
Social sciences	0.15	0.35	0.06	0.24	0.25	0.43
Cohort 1	0.23	0.42	0.06	0.24	0.43	0.49
Cohort 2	0.19	0.40	0.06	0.24	0.35	0.48
Cohort 3	0.18	0.39	0.15	0.36	0.22	0.41
Cohort 4	0.17	0.37	0.31	0.46	0.00	0.02
Cohort 5	0.23	0.42	0.42	0.49	0.00	0.02
Observations	9167		4984		4183	

Grades transformed to 1-4 Scale, with 4 being the best and 1 being the worst grade still to pass. Faculty is the last faculty the student is enrolled at.

and converges towards 0.75 by study period six, which represents semester 11 and 12 for bachelor students and semester 16 to 18 for students within the old degree programs. This means that the probability of finishing one's studies before twice the time of the prescribed study duration is nearly 75 percent for the students in the sample. In addition, it can be noted that the probability of graduating within the standard time of study or one third above is higher for bachelor students than for students aiming at one of the old degrees.

Figure 1: Kaplan-Meier Failure Functions



In the case of dropping out of university, the Kaplan-Meier failure function shows that the probability of failure in study period one is around 0.15 for students aiming at one of the old degrees and 0.1 for bachelor students. Afterwards, it increases steadily to around 0.45 for both the treatment and the control group but is lower for bachelor students until study period four.

Summary statistics for the additional control variables (Table 1) reveal that

the mean high school leaving grade is nearly the same for bachelor and old degree students in the sample. Moreover, the share of female students enrolled in one of the old degree programs is 55 percent and consequently three percentage points higher than within bachelor programs. The purchasing power index is slightly higher for bachelor students, while a lower share of students holds a private health insurance. Concerning the distance to university, the summary statistics show that the average bachelor student's home town is further away than the home town of the average student enrolled in one of the old degree programs.

Looking at the indicator variables for the university's faculties, differences between the share of bachelor and old degree students within the respective fields can be observed. For instance, even if 29 percent of the students who aim at one of the old degrees is enrolled at the faculty of humanities the share for bachelor students at this faculty is only 22 percent. On the other hand, for the faculty of economic sciences, the share of bachelor students is higher than the share of students within the old degrees.

Finally, the summary statistics for the different cohorts reflect the introduction of the bachelor programs: only 6 percent of the bachelor students enrolled in the winter term 2003 and summer term 2004 (*cohort 1*), while 42 percent started studying in the winter term 2007 and summer term 2008 (*cohort 5*). In comparison, almost all students aiming at one of the old degrees enrolled at university between the winter term 2003 and the summer term 2006 (*cohorts 1-3*).

4 Empirical Framework

Duration models are generally used to analyze the time until an event occurs, such as the duration until graduating from university. Compared to ordinary least squares regressions, they have the advantage that they do not assume a normal distribution of the residuals. This is important since the assumption implies that, conditional on the covariates, time to an event is normally distributed. However, this assumption does not prove to be realistic for many events (Cleves et al., 2010). For instance, for the event of graduation, one might expect that its rate is close to zero within the

first semesters but rises steeply towards the end of the standard time period.[7]

In the context of this paper, there are two different events, so called failure events, that could cause a student to stop studying: graduation and dropping out of university. Since only one of these events can occur for every student, they represent competing risks. This means that the occurrence of one event prevents the individual from failing due to a different cause of failure: graduation prevents students from dropping out of university and vice versa. Therefore, the likelihood of failing due to one cause, the so called cumulative incidence function, may also depend on the probability of failing from a competing risk (Cleves et al., 2010). More precisely, for a given set of covariates, the probability of graduating before a certain point in time also depends on the likelihood of dropping-out of university.

As a result of this correlation between failure events, competing risks need to be treated differently than censoring where a failure is expected to happen at an unobserved point in time. The concept of subhazards proposed by Fine and Gray (1999) is used to take this into account. Thereby, the subhazard for failure event 1, λ_1, is defined as follows (Fine and Gray, 1999):

$$\lambda_1(t;\mathbf{Z}) = \lim_{\Delta t \to 0} \frac{1}{\Delta t} Pr\{t \leq T \leq t + \Delta t, \varepsilon = 1 \mid T \geq t \cup (T \leq t \cap \varepsilon \neq 1), \mathbf{Z}\}$$

where t denotes time and $\mathbf{Z}$ is a vector of covariates. Furthermore, T is the specific failure time and ε the cause of failure. Consequently, the subhazard function gives the likelihood of failing from cause 1 at time T given that either no failure or failure from a different cause has occurred.

The model is a counterpart to the traditional Cox regressions. It is semiparametric which means that the effect of the independent variables are assumed to be proportional to an unspecified baseline subhazard $\lambda_{10}(t)$. Thereby, the baseline subhazard is the subhazard for all covariates set to zero (Fine and Gray, 1999):

$$\lambda_1(t;\mathbf{Z}) = \lambda_{10}(t) exp\{\mathbf{Z}^T \beta_0\}$$

The exponantiated coefficients, $exp\{\mathbf{Z}^T \beta_0\}$, are called subhazard ratios. A positive

[7]For a detailed description of survival analysis see also Cleves et al. (2010).

(negative) coefficient implies a subhazard ratio that is bigger (smaller) than one. Consequently, an increase of the covariate by one unit increases (decreases) the subhazard by the factor of the subhazard ratio. For the binary treatment variable of being in a bachelor program, the subhazard ratio gives the factor by which the likelihood of graduating or dropping out of university differs between the treatment and the control group.

The main characteristic of the subhazard model introduced by Fine and Gray (1999) is that it does not remove subjects who experience competing risks from the sample, but treats them as not having any chance of failing. Therefore, students who drop out of university are not excluded from the risk set, but reduce the probability of graduating. Thereby, they are weighted by the likelihood of being otherwise censored, meaning that neither graduation nor drop out is observed. The higher the likelihood of being censored at a given point in time, the lower the weight given to these subjects (Cleves et al., 2010; StataCorp LP, 2013).

Moreover, the model allows the subhazard ratios to vary with duration by interacting the covariates with time. As a result, it is possible to assess whether the impact of the reform changes with duration. In the analysis, I follow this approach and assume linearity in time.

5 Results

The changes in examination regulations and conditions of study that were implemented in the course of the Bologna process may influence student behavior and performance in different ways. On the one hand, it is likely that the clearer structure of the new study programs helps students to find their way at university and focus on what is relevant for their studies. This may reduce the duration until graduation as well as drop out rates. However, it may also lead to students with low academic ability getting pulled along for some time and dropping out of university at a rather late point of their studies. On the other hand, the stricter examination regulations and the larger number of examinations increase the pressure to perform, especially for students with low academic ability. This may result in higher drop out rates and more drop out at an early stage of one's studies.

To assess the effects of the Bologna process on the duration until graduation and university drop-out, the following analysis estimates competing risks models for the two different possibilities of terminating one's studies. Besides the treatment, I control for the high school leaving grade, the student's socio-economic background, gender, the logarithm of the linear distance between the student's home town and Göttingen, the university's faculties and the student's cohort. The respective tables present the estimated coefficients (columns (1), (3) and (5)) and corresponding sub-hazard ratios (columns (2), (4) and (6)). The first two columns of Table 2 and Table 3 show the model without time-varying coefficients. In the second model, covariates are interacted with the study period to allow the coefficients to vary with duration. In all regressions, standard errors are clustered by county.

5.1 Graduation

The results for the competing risks analysis for the event of graduation are shown in Table 2. The subhazard ratio for the treatment variable in the model without time-varying coefficients, in column (2), is 1.689. Hence, the model suggests that the subhazard, the probability of graduating at time T given that subjects are not censored or dropped out of university, is 68.9 percent higher for bachelor students than for students within one of the old degree programs in every study period. The model with time-varying coefficients, in columns (3) and (4), confirms the positive impact of being enrolled in a bachelor program on the duration until graduation. However, the negative coefficient of the interaction term in column (3) shows that the size of the effect decreases with study duration. In study period three, the conditional probability of graduating is approximately 250[8] higher for bachelor students than for their peers who are enrolled in one of the old programs. This means that bachelor students are more than three times as likely to graduate in the last third of the standard time period as students aiming at one of the old degrees. In study period four (semesters seven and eight for bachelor and semesters 10 to 12 for old

[8] $e^{\beta_{bachelor}+\beta_{bachelor}\cdot t} = e^{\beta_{bachelor}} \cdot e^{\beta_{bachelor}\cdot t} = e^{3.017} \cdot e^{(-0.591)\cdot t} = 20.432 \cdot 0.554^3 = 3.47$ percent. This means that in study period three, students within the treatment group have a conditional probability of graduating that is 3.47 times, and hence 247 percent, higher than the probability of graduating for students in the control group.

degree students), the effect is smaller, but still positive: depending on still studying, bachelor students are 92 percent more likely to graduate one third above the standard time period than students within one of the old degrees.

The findings show that the introduction of the bachelor programs in the course of the Bologna process had a positive impact on the duration until graduation. Consequently, one of the reform's main objectives was achieved. A possible reason for the result is the restructuring of examination regulations and study conditions which often implied a lower degree of flexibility and stricter rules for the time frame when examinations have to be taken. By giving the study process in itself a clearer structure, the reform helps students to focus on what is relevant for their studies and prevents them from delaying courses. In fact, the German Council of Science and Humanities considered the high degree of freedom within the old study programs to be one of the main causes for the excessive length of studies that was observed before the reform (Wissenschaftsrat, 2000).

However, the negative interaction term in column (3) implies that the effect is decreasing the longer students stay at university. In study period six (semesters 11 and 12 for bachelor and semesters 16 to 18 for students within the old degree programs), bachelor students have even a lower conditional probability of obtaining a degree than their peers within the old degree system. An explanation for this finding lies again in the rearrangement of study regulations. The lower degree of flexibility helps students in focusing on their studies, whereas the stricter examination regulations and time restrictions that were introduced in the course of the Bologna process make it more and more difficult to achieve a degree the longer a student stays at university. In contrast, the high degree of freedom within the old study programs results in longer periods spent at university for most students. Nevertheless, it is more likely to graduate at a very late point in time.

5.2 Dropping Out of University

Table 3 presents the results for the duration until dropping out of university. When not controlling for time-varying coefficients, as shown in columns (1) and (2), the analysis suggests that bachelor students are 14.5 percent less likely to drop out of

Table 2: Graduation

Failure: Graduation				
	(1)	(2)	(3)	(4)
Main				
Bachelor	0.524***	1.689***	3.017***	20.432***
	(0.050)	(0.084)	(0.294)	(6.003)
High school GPA	0.578***	1.782***	1.062***	2.892***
	(0.028)	(0.049)	(0.126)	(0.363)
Female	0.084***	1.087***	0.156	1.169
	(0.023)	(0.025)	(0.152)	(0.178)
Private health insurance	0.036	1.036	-0.445*	0.641*
	(0.028)	(0.029)	(0.198)	(0.127)
Purchasing power index	0.002	1.002	-0.000	1.000
	(0.001)	(0.001)	(0.005)	(0.005)
Log distance	0.094***	1.099***	0.097	1.102
	(0.013)	(0.015)	(0.056)	(0.062)
Cohorts included	yes	yes	yes	yes
Faculties included	yes	yes	yes	yes
Time-varying coefficients				
Bachelor			-0.591***	0.554***
			(0.076)	(0.042)
High school GPA			-0.136***	0.873***
			(0.031)	(0.027)
Female			-0.019	0.981
			(0.040)	(0.040)
Private health insurance			0.127*	1.136*
			(0.053)	(0.060)
Purchasing power index			0.001	1.001
			(0.001)	(0.001)
Log distance			-0.001	0.999
			(0.013)	(0.013)
Cohorts included	yes	yes	yes	yes
Faculties included	yes	yes	yes	yes
Observations	30063	30063	30063	30063
No. of subjects	9167	9167	9167	9167
No. failed	4522	4522	4522	4522
No. competing	2338	2338	2338	2338
No. censored	2307	2307	2307	2307
Log pseudolikelihood	-39081.369	-39081.369	-38384.377	-38384.377

Columns (1) and (3): coefficients, columns (2) and (4) subhazard ratios; standard errors in parentheses; clustered by counties; TVC interacted with t; faculty is the last faculty the student is enrolled at $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

university in every study period. However, the positive interaction term in column (3) shows that the effect is varying with duration. Conditional on still studying, the probability of dropping out of university is 32 percent lower for bachelor students in study period one and 18 percent lower in study period two. From study period four onward, however, the conditional likelihood of dropping out of university is higher for students within a bachelor program and the size of the effect increases over time.

The results suggest that old degree students are more likely to drop out of university at the beginning of their studies while bachelor students have a higher probability of failing at a later point in time. However, further analysis shows that the main effect is driven by the faculty of humanities and the faculty of social sciences. When excluding students who are enrolled at these faculties from the sample, the main coefficient and the interaction term turn insignificant (as shown in Table 4, columns (1) and (2)). This result not only holds true for the joint sample, but also when looking at the faculties separately. Besides for the faculty of economic sciences, this could, however, also be due to low numbers of observations. Nevertheless, it indicates that there is no difference between bachelor and old degree students concerning university drop out in most fields of study.

Reducing the sample to students from the faculty of humanities only (represented in Table 4, columns (3) and (4)), reveals a negative coefficient of the treatment variable. The interaction term is positive but not significant. Therefore, the results imply that bachelor students who are enrolled at the faculty of humanities are less likely to drop out of university in every study period. Looking at the faculty of social sciences only, reveals a negative main effect and a positive interaction term for students enrolled at this faculty (as shown in Table 4, columns (5) and (6)). Both coefficients are significant. Consequently, bachelor students at the faculty of social sciences are less likely to drop out of university in study periods one and two. Afterwards, however, the effect changes.

A possible explanation for the special role of the faculty of humanities is the share of students enrolled in the old *Magister* and teacher programs. Close to all of the old degree students at the faculty of humanities aim at a *Magister* or teacher degree while the respective shares are between zero and 50 percent at the other faculties.

Table 3: Dropping Out of University

Failure: Drop-out				
	(1)	(2)	(3)	(4)
Main				
Bachelor	-0.157*	0.855*	-0.590***	0.554***
	(0.074)	(0.063)	(0.141)	(0.078)
High school GPA	-0.733***	0.480***	-0.611***	0.543***
	(0.037)	(0.018)	(0.060)	(0.033)
Female	0.004	1.004	0.368***	1.445***
	(0.042)	(0.042)	(0.067)	(0.096)
Private health insurance	-0.008	0.992	0.155	1.168
	(0.052)	(0.052)	(0.088)	(0.103)
Purchasing power index	-0.005*	0.995*	0.002	1.002
	(0.002)	(0.002)	(0.004)	(0.004)
Log distance	-0.139***	0.870***	-0.144***	0.866***
	(0.013)	(0.011)	(0.019)	(0.016)
Cohorts included	yes	yes	yes	yes
Faculties included	yes	yes	yes	yes
Time-varying Coefficients				
Bachelor			0.198***	1.219***
			(0.051)	(0.063)
High school GPA			-0.056*	0.945*
			(0.022)	(0.021)
Female			-0.170***	0.843***
			(0.029)	(0.025)
Private health insurance			-0.078*	0.925*
			(0.036)	(0.033)
Purchasing power index			-0.003*	0.997*
			(0.001)	(0.001)
Log distance			0.002	1.002
			(0.007)	(0.007)
Cohorts included	yes	yes	yes	yes
Faculties included	yes	yes	yes	yes
Observations	30063	30063	30063	30063
No. of subjects	9167	9167	9167	9167
No. failed	2338	2338	2338	2338
No. competing	4522	4522	4522	4522
No. censored	2307	2307	2307	2307
Log pseudolikelihood	-20604.079	-20604.079	-20562.232	-20562.232

Columns (1) and (3): coefficients, columns (2) and (4) subhazard ratios; standard errors in parentheses; clustered by counties; TVC interacted with t; faculty is the last faculty the student is enrolled at; $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 4: Reduced Sample

Drop-out	Without Humanities and Social Sciences		Humanities		Social Sciences	
	(1)	(2)	(3)	(4)	(5)	(6)
Main						
Bachelor	-0.013	0.987	-0.773***	0.462***	-0.715**	0.489**
	(0.150)	(0.148)	(0.147)	(0.068)	(0.231)	(0.113)
High school GPA	-0.721***	0.486***	-0.467***	0.627***	-0.383*	0.682*
	(0.072)	(0.035)	(0.113)	(0.071)	(0.163)	(0.111)
Female	0.520***	1.682***	0.107	1.113	0.371*	1.449*
	(0.094)	(0.158)	(0.142)	(0.158)	(0.152)	(0.220)
Private health insurance	0.216	1.241	0.002	1.002	0.153	1.165
	(0.129)	(0.160)	(0.146)	(0.146)	(0.193)	(0.225)
Purchasing power index	0.006	1.006	-0.001	0.999	-0.002	0.998
	(0.005)	(0.005)	(0.007)	(0.007)	(0.008)	(0.008)
Log distance	-0.091***	0.913***	-0.217***	0.805***	-0.112**	0.894**
	(0.020)	(0.018)	(0.030)	(0.024)	(0.041)	(0.037)
Faculties included	yes	yes	no	no	no	no
Cohorts included	yes	yes	no	no	no	no
Time-varying Coefficients						
Bachelor	0.069	1.072	0.081	1.085	0.287***	1.333***
	(0.068)	(0.072)	(0.052)	(0.056)	(0.075)	(0.100)
High school GPA	-0.058	0.944	-0.089*	0.915*	-0.010	0.990
	(0.031)	(0.029)	(0.041)	(0.038)	(0.061)	(0.060)
Female	-0.186***	0.830***	-0.119*	0.888*	-0.200**	0.819**
	(0.040)	(0.034)	(0.057)	(0.050)	(0.072)	(0.059)
Private health insurance	-0.118*	0.889*	-0.054	0.947	0.013	1.013
	(0.056)	(0.049)	(0.060)	(0.057)	(0.082)	(0.083)
Purchasing power index	-0.004*	0.996*	-0.005	0.995	-0.002	0.998
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Log distance	-0.022*	0.978*	0.041**	1.042**	-0.013	0.987
	(0.010)	(0.009)	(0.013)	(0.014)	(0.017)	(0.016)
Faculties included	yes	yes	no	no	no	no
Cohorts included	yes	yes	no	no	no	no
Observations	17907	17907	7481	7481	4675	4675
No. of Subjects	5517	5517	2305	2305	1345	1345
No. Failed	1303	1303	669	669	366	366
No. Competing	3099	3099	858	858	565	565
No. Censored	1115	1115	778	778	414	414
Log Pseudolikelihood	-10790.484	-10790.484	-4919.8897	-4919.8897	-2533.2508	-2533.2508

Columns (1), (3) and (5): coefficients, columns (2), (4) and (6): subhazard ratios; standard errors in parentheses; clustered by counties; TVC interacted with t; faculty is the last faculty the student is enrolled at; $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Compared to the *Diplom*, the differences between the *Magister* and old teacher degree and the new bachelor programs are more substantial. Both programs are characterized by a particularly high level of freedom with regard to which courses to take and when to do the examinations. Sometimes only regular attendance is required to successfully complete a class and most of the grades achieved during one's course of study do not count towards the final degree. Instead, the graduation grade is the result of decentralized final examinations carried out by the university's institutes. The new bachelor programs, on the other hand, have a clear structure and low degree of flexibility. Furthermore, grades are awarded to most of the courses taken and the vast majority also counts towards the degree. These changes in study conditions induce a more scholastic learning environment that helps students in finding their way at university. In addition, the frequent examinations lead to students regularly reflecting their performance and focusing on what is relevant for their studies. Finally, the faculty of humanities did not introduce time restrictions into its examination regulations, which may also explain the special role with regard to university drop out. In particular, it may be a reason for the fact that bachelor students do not have a higher conditional probability of dropping out of university at a rather late point of their studies than students enrolled in one of the old degree programs.

Also at the faculty of social sciences, the share of students enrolled in a *Magister* or old teacher degree is comparatively high. More than half of the old degree students at this faculty aims at one of the two mentioned degrees. In line with the argumentation for the faculty of humanities, the substantial differences to the new bachelor programs may explain the lower conditional probability of dropping out of university for bachelor students in study period one and two. However, from study period three onward, bachelor students at the faculty of social sciences are more likely to drop out of university than their peers within the old degree system. On the one hand, this finding could be the result of differing effects for students enrolled in *Magister* programs and the diploma. On the other hand, it may also indicate that students who are at the risk of dropping out get pulled along for some time and leave university without a degree at a rather late point of their studies. Although the faculty of social sciences did not introduce time restrictions in the course of the

Bologna process, the frequent examinations cause students to regularly reflect their performance. This may not only help them to focus on their studies, but also lead to students with low academic ability getting discouraged the longer they stay at university. Unfortunately, it is not possible to identify the channels which drive the found effects with the data at hand.

5.3 Robustness Tests

The robustness of the results is tested in three ways. Firstly, the time-varying coefficients are interacted with the logarithm of time, instead of assuming a linear relationship. This implies that the impact of being in a bachelor program is non-linear with a decreasing marginal effect. Secondly, a possible impact of the introduction of general tuition fees on the results is taken into account by reducing the sample to students who enrolled after the state government of Lower Saxony decided to introduce these fees. Thirdly, instead of the relative time measure different definitions of *study period* are used.

5.3.1 Interaction with ln(t)

So far, the analysis assumed that there is a linear relationship between the effect of the covariates and time. However, it is also conceivable that the marginal impact of being enrolled in a bachelor program is decreasing with duration. Therefore, Table A.1 shows the results when the covariates are interacted with the logarithm of time instead. The coefficients in column (1) imply that the conditional probability of graduating is approximately 293 percent higher for bachelor students in study period three and 84 percent higher in study period four. In study period six, however, bachelor students are less likely to graduate given that they are still studying. These results are very similar to the findings in section 5.1 where linearity in time is assumed.

Also for the event of dropping out of university, the results are similar to the findings in section 5.2. When looking at all faculties, in column (2), bachelor students are less likely to drop out of university in study period one and two. From study period three onward, however, the effect changes. Furthermore, the faculties

of humanities and social sciences still play a special role. When looking at students enrolled at the faculty of humanities only, represented in column (4), bachelor students are less likely to drop out of university in all study periods. Also for the faculty of social sciences, interacting the covariates with the logarithm of time, as shown in column (5), leads to similar results than assuming a linear relationship: bachelor students are less likely to drop out of university in study period one. From study period three onward the effect changes.

However, when interacting the covariates with the logarithm of time, the effect for the faculty of economic sciences also turns significant, as shown in column (6). The positive and significant interaction term implies that bachelor students at this faculty have a higher conditional probability of dropping out of university in every study period and the effect is increasing with duration.

Furthermore. excluding students enrolled at the faculty of humanities, the faculty of social sciences and the faculty of economic sciences from the sample, in column (3), leads to insignificant effects for being enrolled in a bachelor program. This is in line with the results in section 5.2 which also show insignificant effects for most fields of study.

5.3.2 Tuition Fees

In July 2005 the state government of Lower Saxony decided to introduce general tuition fees. Students who enrolled at Göttingen University in the winter term 2006 were the first ones who had to pay 500 Euro in addition to the regular administrative fees, all in all resulting in a payment of approximately 700 Euro per semester. From the summer term 2007 onward, every student at Göttingen university had to pay tuition fees, irrespective of when they enrolled at university.

Since most old degree students enrolled at university before the introduction of tuition fees and most bachelor students afterwards, one may argue that the results are affected by this reform. So far, the analysis controls for the student's cohort, which also captures if a student enrolled before or after the introduction of general tuition fees. Nevertheless, the sample is reduced to students who enrolled at Göttingen University from the winter term 2005 onward and hence after the state

government's decision, cohorts three to five, as a robustness test.

The results for the reduced sample are shown in Table A.2. For the event of graduation, in column (1), the main effect of being enrolled in a bachelor program is still positive and significant while the interaction term turned insignificant. Consequently, when reducing the sample to students who enrolled after the introduction of tuition fees, bachelor students are approximately 246 percent more likely to graduate. In contrast to the results for the full sample, the effect is not changing with duration.

For the event of dropping out of university the results are similar to those found for the full sample, Section 5.2. When looking at students from all faculties, in column (2), bachelor students are less likely to drop out of university in study periods one to three. Afterwards, the effect changes. Furthermore and in line with the findings for the full sample, the effect for being enrolled in a bachelor program turns insignificant when excluding the faculty of humanities and the faculty of social sciences, as shown in column (3). Looking at the faculty of humanities only, in column (4), reveals that bachelor students are still less likely to drop out of university in all study periods. In contrast to the results in Section 5.2, however, the size of the effect is decreasing over time. Finally, the results in column (5) show that bachelor students at the faculty of social sciences are less likely to drop out of university in study period one and two. From study period three onward, the conditional probability of dropping out of university is higher for bachelor students than for students enrolled in one of the old degree programs. Similarly, for the faculty of physics and the faculty of mathematics the effect of being enrolled in a bachelor program turns significant. However, these findings have to be dealt with caution due to a low number of observations and are therefore not reported.

The robustness test shows that the results do not change substantially when restricting the sample to students who enrolled after the state government's decision to introduce tuition fees. Therefore, controlling for the student's cohort is an adequate way to take this reform into account.

5.3.3 Study Period

So far, the time measure used is relative to the standard time period in the respective field in order to make duration between old and new degree programs comparable. The following analysis uses different classifications to test whether the definition of the *study period* has an impact on the results. The new classification of the time variable for the events of graduation and university drop-out are shown in Table 5.

Table 5: New Classification *Study Period*

Graduation			**Dropout**		
Study period	Semester Bachelor	Semester Old Degree	Study period	Semester Bachelor	Semester Old Degree
1	1-4	1-7	1	1	1
2	5	8	2	2	2
3	6	9	3	3	3
4	7	10	4	4	4
5	8	11	5	5	5
6	9	12	6	6	6
7	10-12	13-15	7	7-9	7-9
8	≥ 13	≥ 16	8	≥ 10	≥ 10

For the event of graduation the new classification gives a more detailed picture of the time between one semester before and three semesters above the standard time period. The results are shown in Table A.3. The coefficients in column (1) imply that until one third above the standard time period (semester nine for bachelor and semester 12 for old degree students) bachelor students have a higher conditional probability of graduating. Afterwards the effect changes. This is consistent with the findings in Section 5.1.

When analyzing the time until dropping out of university it is not only interesting to use a relative time measure, but also to look at the actual semester in which the students leave university. Furthermore, most of the students who drop out of university do so at the beginning of their studies. 75 percent of the bachelor students in the sample who left university without a degree did so between semester one and six, 20 percent dropped out of university between semester seven and nine. The shares for old degree students is 74 percent and 8 percent respectively. Taking these considerations into account, the new time classification compares time in absolute

terms and is more detailed for the first semesters.

The results in Table A.3 reveal an insignificant effect both for the main coefficient and the interaction term for the full sample, as shown in column (2). For the faculty of humanities, in column (3), the main effect is negative and highly significant. This implies again that bachelor students at this faculty are less likely to drop out of university than their peers enrolled in one of the old study programs. In contrast to the results in Section 5.2, the treatment coefficients for the faculty of social sciences, in column (4), turn insignificant when using the new time classification. Furthermore, the results indicate that bachelor students at the faculty of economic sciences have a higher conditional probability of dropping out of university than students who are enrolled in one of the old degree programs, as shown in column (5). Also for the faculty of physics the effect of being enrolled in a bachelor program turns significant. However, this finding should be dealt with caution due to a low number of observations and is therefore not reported.

In a nutshell, the results for the event of graduation are robust to the presented different classifications of the time variable. Concerning the event of dropping out of university, the same holds true for the faculty of humanities. Furthermore, the insignificant effects for the full sample underlines that the reform did not influence university drop-out in most fields of study. The results for the faculty of social sciences and the faculty of economic sciences, however, seem to be sensitive to different time definitions.

6 Discussion and Conclusion

For Germany, the introduction of bachelor programs in the course of the Bologna process implied a restructuring of part of the degree system. This involved a reduction of the standard time period needed to obtain the first university degree as well as a rearrangement of the existing examination regulations and study conditions. Since the reform may influence students' behavior and performance, this paper evaluates its effect on the duration until graduation and dropping out of university. An extensive dataset containing detailed administrative data on more than 9000 students allows the application of competing risks models for the two possibilities of

terminating one's studies. As the standard time period differs between the old and new study system, this paper uses a relative time measure to make information on study duration comparable.

The analysis shows that the Bologna process had a positive impact on the duration until graduation. This effect is robust to a variety of different specifications. Consequently, one of the reform's main objectives was achieved, namely to reduce the time German graduates need to obtain their first university degree not only in absolute but also in relative terms. In line with this view, the finding also confirms descriptive evidence by the Authoring Group Educational Reporting (Autorengruppe Bildungsberichterstattung, 2012). A possible explanation for the result is the clear structure and low degree of flexibility within the new bachelor programs. Both help students to find their way at university and to focus on what is relevant for their studies.

For the event of dropping out of university, the result is less conclusive. There is no significant effect of the reform on university drop-out for most fields of study. However, the analysis reveals a clear favorable impact of being enrolled in a bachelor program for students at the faculty of humanities. This effect is robust to a variety of different specifications. Furthermore, both results are in line with the study by Horstschräer and Sprietsma (2015) who find, among others, insignificant effects for most fields of study but lower drop-out rates for bachelor students in English and German literature departments.

Furthermore, the analysis shows significant effects on university drop-out for students at the faculty of social sciences and the faculty of economic sciences in some specifications. Thereby, the results suggest, that bachelor students at the faculty of social sciences are less likely to drop out of university in the beginning of their studies, but have a higher conditional probability of leaving university without a degree from study period three onward. At the faculty of economic sciences, bachelor students are, if at all, more likely to drop out of university in all study periods.

These findings differ from the results by Horstschräer and Sprietsma (2015) who find that the reform decreased drop-out rates for students studying business administration. Moreover, they show that drop-out rates increase at biology departments.

A possible reason for the differing results is that Horstschräer and Sprietsma (2015) are not able do distinguish between students who drop out of university and students who change subject or change to a different institution of higher education. This distinction is made in the present analysis, though. In addition, they look at business administration and economic departments separately while the faculty of economic sciences in this study includes both subjects.

With regard to the timing of university drop-out, the present study does not confirm the descriptive evidence by Heublein et al. (2009). While comparing the average amount of semesters until university drop-out suggests that bachelor students leave university without a degree at an earlier stage of their studies than students aiming at one of the old degrees (Heublein et al., 2009), using survival analysis draws a different picture. Besides the different methodological approach, this may also be due to Heublein et al. (2009) taking into account students from both universities and universities of applied sciences. Furthermore, the group of old degree students also includes students who aim at a state examination in medicine or law. These study programs are, however, special with regard to study and examination regulations.

To sum up, the analysis showed that the restructuring of examination and study regulations in the course of the Bologna process reduced the duration until graduation both in absolute and relative terms. In addition, it had a favorable impact on the probability of dropping out of university for students enrolled at the faculty of humanities. For most of the other faculties the effect of the reform on university drop-out is insignificant. Although being a case study, the assessment of administrative student data allows a broad insight into the timing of graduation and university drop-out. Thereby, the present study obtains additional information and more profound results than the mainly descriptive evidence that so far is available for Germany. However, similar analysis for other German universities are needed in order to assess whether the achieved results can be transferred to a more general level.

Appendix I: Tables

Table A.1: Interaction with ln(t)

	Graduation	**Drop-out**				
	All	All	Without Humanities, Social Sciences, Economic Sciences	Humanities	Social Sciences	Economic Sciences
	(1)	(2)	(3)	(4)	(5)	(6)
Main						
Bachelor	4.258***	-0.407***	-0.126	-0.734***	-0.472*	0.272
	(0.385)	(0.110)	(0.135)	(0.115)	(0.189)	(0.177)
High school GPA	1.182***	-0.647***	-0.700***	-0.522***	-0.389**	-0.984***
	(0.158)	(0.049)	(0.075)	(0.086)	(0.120)	(0.154)
Female	0.108	0.228***	0.442***	0.013	0.201	0.141
	(0.202)	(0.047)	(0.074)	(0.102)	(0.111)	(0.131)
Private health insurance	-0.602*	0.082	0.112	-0.029	0.173	0.020
	(0.267)	(0.063)	(0.097)	(0.100)	(0.148)	(0.183)
Purchasing power index	-0.001	-0.000	0.006	-0.003	-0.003	-0.006
	(0.007)	(0.003)	(0.004)	(0.005)	(0.005)	(0.009)
Log distance	0.097	-0.137***	-0.134***	-0.174***	-0.124***	-0.043
	(0.069)	(0.014)	(0.019)	(0.024)	(0.029)	(0.029)
Faculties included	yes	yes	yes	no	no	no
Cohorts included	yes	yes	yes	no	no	no
Time-varying Coefficients						
Bachelor	-2.630***	0.436***	0.193	0.240	0.664***	0.365*
	(0.289)	(0.122)	(0.178)	(0.125)	(0.189)	(0.176)
High school GPA	-0.484***	-0.151**	-0.240**	-0.250**	-0.027	0.156
	(0.115)	(0.051)	(0.085)	(0.095)	(0.141)	(0.168)
Female	-0.018	-0.397***	-0.496***	-0.296*	-0.460**	-0.224
	(0.154)	(0.067)	(0.109)	(0.129)	(0.171)	(0.163)
Private health insurance	0.486*	-0.169*	-0.229	-0.160	0.015	-0.181
	(0.205)	(0.079)	(0.140)	(0.129)	(0.198)	(0.232)
Purchasing power index	0.002	-0.009*	-0.007	-0.014*	-0.006	-0.008
	(0.006)	(0.003)	(0.005)	(0.006)	(0.008)	(0.012)
Log distance	-0.004	-0.003	-0.025	0.078**	-0.030	-0.110*
	(0.047)	(0.018)	(0.024)	(0.029)	(0.038)	(0.043)
Faculties included	yes	yes	yes	no	no	no
Cohorts included	yes	yes	yes	no	no	no
Observations	30063	30063	12327	7481	4675	5580
No. of subjects	9167	9167	3848	2305	1345	1669
No. failed	4522	2338	907	669	366	396
No. competing	2338	4522	2093	858	565	1006
No. censored	2307	2307	848	778	414	267
Log Pseudolikelihood	-38386.079	-20557.084	-7173.7246	-4917.8188	-2528.8023	-2807.3914

Coefficients; standard errors in parentheses; clustered by counties; TVC interacted with ln(t); faculty is the last faculty the student is enrolled at; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table A.2: Cohorts 3–5

	Graduation	**Drop-out**			
	All	All	Without Humanities and Social Sciences	Humanities	Social Sciences
	(1)	(2)	(3)	(4)	(5)
Main					
Bachelor	1.241**	-0.923***	0.256	-1.160***	-1.367***
	(0.464)	(0.198)	(0.242)	(0.162)	(0.366)
High school GPA	1.137***	-0.735***	-0.840***	-0.474*	-0.698*
	(0.172)	(0.086)	(0.110)	(0.185)	(0.299)
Female	-0.290	0.281**	0.480***	0.010	-0.072
	(0.258)	(0.102)	(0.115)	(0.199)	(0.231)
Private health insurance	-0.529	0.234	0.390*	0.134	-0.362
	(0.294)	(0.152)	(0.188)	(0.236)	(0.370)
Purchasing power index	0.001	-0.003	-0.003	-0.004	-0.004
	(0.008)	(0.005)	(0.006)	(0.011)	(0.012)
Log distance	0.038	-0.139***	-0.100***	-0.172***	-0.216**
	(0.063)	(0.026)	(0.028)	(0.046)	(0.070)
Faculties included	yes	yes	yes	no	no
Cohorts included	no	no	no	no	no
Time-varying Coefficients					
Bachelor	-0.057	0.251***	-0.204	0.183*	0.638***
	(0.126)	(0.075)	(0.106)	(0.078)	(0.172)
High school GPA	-0.161***	-0.005	0.003	-0.059	0.051
	(0.048)	(0.029)	(0.037)	(0.062)	(0.116)
Female	0.111	-0.168***	-0.188***	-0.131	-0.132
	(0.073)	(0.043)	(0.048)	(0.080)	(0.102)
Private health insurance	0.155	-0.099	-0.179*	-0.112	0.252
	(0.084)	(0.063)	(0.090)	(0.090)	(0.148)
Purchasing power index	0.001	-0.001	-0.000	-0.004	-0.002
	(0.002)	(0.002)	(0.002)	(0.004)	(0.005)
Log distance	0.018	0.003	-0.018	0.040	0.015
	(0.016)	(0.011)	(0.011)	(0.022)	(0.029)
Faculties included	yes	yes	yes	no	no
Cohorts included	no	no	no	no	no
Observations	17091	17091	10642	4494	1955
No. of subjects	5296	5296	3354	1362	580
No. failed	2505	1306	814	341	151
No. competing	1306	2505	1752	555	198
No. censored	1485	1485	788	466	231
Log Pseudolikelihood	-20153.735	-10771.417	-6333.0364	-2335.5462	-900.91857

Includes students who enrolled at Göttingen University between the winter term 2005 and the summer term 2008. Coefficients; standard errors in parentheses; clustered by counties; TVC interacted with t; faculty is the last faculty the student is enrolled at; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table A.3: New Definition *Study Period*

	Graduation		**Drop-out**		
	All	All	Humanities	Social Sciences	Economic Sciences
	(1)	(2)	(3)	(4)	(5)
Main					
Bachelor	2.463***	-0.228	-0.645***	-0.337	0.673***
	(0.177)	(0.167)	(0.164)	(0.253)	(0.198)
High school GPA	0.832***	-0.632***	-0.421***	-0.370*	-1.055***
	(0.080)	(0.067)	(0.113)	(0.163)	(0.216)
Female	0.112	0.390***	0.060	0.418**	0.251
	(0.084)	(0.070)	(0.137)	(0.152)	(0.198)
Private health insurance	-0.273*	0.190	0.075	0.221	0.073
	(0.107)	(0.098)	(0.153)	(0.209)	(0.267)
Purchasing power index	0.001	0.002	0.002	0.001	-0.005
	(0.003)	(0.003)	(0.007)	(0.008)	(0.012)
Log distance	0.079*	-0.153***	-0.238***	-0.116**	-0.002
	(0.036)	(0.020)	(0.031)	(0.040)	(0.041)
Faculties included	yes	yes	no	no	no
Cohorts included	yes	yes	no	no	no
Time-varying Coefficients					
Bachelor	-0.361***	0.031	0.032	0.089	-0.028
	(0.041)	(0.033)	(0.032)	(0.048)	(0.041)
High school GPA	-0.054***	-0.031*	-0.066**	-0.008	0.040
	(0.016)	(0.014)	(0.023)	(0.031)	(0.045)
Female	-0.002	-0.100***	-0.055	-0.113**	-0.043
	(0.019)	(0.017)	(0.029)	(0.037)	(0.060)
Private health insurance	0.070**	-0.053*	-0.050	-0.008	-0.002
	(0.025)	(0.021)	(0.032)	(0.044)	(0.003)
Purchasing power index	0.000	-0.002*	-0.003*	-0.002	-0.063
	(0.001)	(0.001)	(0.002)	(0.002)	(0.046)
Log distance	0.004	0.002	0.026***	-0.007	-0.029**
	(0.006)	(0.004)	(0.007)	(0.008)	(0.011)
Faculties included	yes	yes	no	no	no
Cohorts included	yes	yes	no	no	no
Observations	34214	53323	12846	8257	10104
No. of subjects	9167	9167	2305	1345	1669
No. failed	4522	2388	669	366	396
No. competing	2338	4522	858	565	1006
No. censored	2307	2307	778	414	267
Log Pseudolikelihood	-37746.136	-20482.377	-4885.1514	-2527.5104	-2798.5972

Coefficients; standard errors in parentheses; clustered by counties; TVC interacted with t; faculty is the last faculty the student is enrolled at; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Appendix II: Data Processing[9]

The sample contains students who obtained a German high school leaving certificate only. Furthermore, students with the worst possible high school grade 4.0 are excluded, as it is often used as a placehoder when the grade is not important for the admission process. Students who died are removed from the sample. Moreover, I leave out students with missing data or for whom I observe pure data errors, such as a high school leaving grade that is not within the possible interval.

In the analysis, the purchasing power of the parental zip-code area is used to control for the students' socio-economic background. This is possible as students have to provide information about their home and semester address when enrolling at university. Thereby, the home address usually corresponds to the parents' address and the semester address to the place the students live by themselves. Since most students move to Göttingen when starting university, the two zip-codes should differ. However, for some students in the sample, the zip-codes of the home and the semester address are identical. If the zip-codes are identical and from a place outside of Göttingen, it is very likely that the student is still living with her parents. However, if the zip-codes are identical and from Göttingen, it may be that the stated home address does not correspond to the parents' address. Therefore, I take the administrative district the student went to school in into account. When she obtained her high school leaving certificate at a school outside of Göttingen, it is likely that the provided home address does not correspond to the parental address. These students are excluded from the sample.

Moreover, the analysis controls for the linear distance between the student's home town and Göttingen. The distance is obtained by using geographic coordinates for the different zip codes that are provided by *geonames.org*. The distance is calculated by first converting the coordinates from grades to radians (multiplication with $\frac{\pi}{180}$). Afterwards the following formula is used to calculate the linear distance: $\arccos(\sin(latitude\_home) * \sin(latitude\_Goe) + \cos(latitude\_home) * \cos(latitude\_Goe) * \cos(longitude\_Goe - longitude\_home)) * 6367.4445$. In the

[9]Due to overlap in the data processing procedure, part of this appendix borrows heavily from the appendix in Danilowicz-Gösele et al. (2014).

case where different towns or villages have the same zip code, the mean distance is used in the analysis. To calculate the logarithm *one* is added to the distance so that the distance for a student coming from Göttingen is zero.

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