



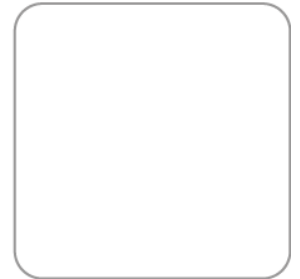
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Leaky Pipeline

Gender Counts?!

Analysis of Student Dropout at Vienna University of Technology
Elisabeth Günther & Sabine T. Köszegi





Leaky Pipeline

The Vienna University of Technology (VUT) experiences both high horizontal and vertical gender segregation as well as high drop-out rates of female students and scientists along the career path. Within the traditional engineering schools like Electrical & Mechanical Engineering the rate of female students is low from the very beginning (only 8.4% of all students of Electrical Engineering are female) and becomes invisible along the academic career path (no single female professor or associate professor serves in Electrical Engineering School). Contrarily, in the School for Architecture we observe more than 50% of female beginners, but then the steady attrition of females along the scientific career path leads to a proportion of only 17% of females among full professors, a phenomenon called the “Leaky Pipeline”. Efforts to attract more female students and to achieve higher gender diversity along the career path have not yet delivered the desired results. It is suggested that the lack of gender awareness on the part of decision makers as well as gendered organizational processes and decision-making result in a resistance to change toward effective diversity management. In a comprehensive case study we analyze overt and subtle barriers for women at the VUT in order to explain both forms of gender segregation. By using a triangulation research approach, we tie loose ends between the following aspects: (1) We analyze student registration data to estimate drop-out chances of female and male students. (2) We examine entrance barriers for females by looking at hiring practices of the institution. (3) To explore the work context of female scientists, we analyze survey-data on organizational culture and climate as well as workplace aggression. (4) Finally, we conduct biographic interviews with female students and scientists in order to gain deeper insight into entire female careers in science and technology.

Results prove that female students have a 30% higher chance to drop out, all other variables controlled. Furthermore, decision makers at VUT suffer from (unconscious) gender biases in recruiting decisions: there is evidence of positive discrimination of certain male applicants in hiring practices. However, quantitative analyses reveal that male and female employees do not differ in their perception of organizational culture and climate and women do not experience higher rates of workplace aggression. Nevertheless, the narratives of female researchers deliver evidence that females are exposed to overt and hidden discrimination, but apply a typical token behaviour by trivializing conflicts and assimilating to cultural norms. Moreover successful female tokens at VUT report to have strongly benefitted from a male sponsor, who acts as a mentor, lends his network and promotes her (informally). However those women who do not assimilate and who lack of or lose a sponsor due to a conflict also lose all career perspectives at VUT.

In all four studies, the minority status of women reveals different realities and coping strategies for female scientists. Thus the overall study clearly shows the multiple and far reaching faces of gender discrimination at VUT. Actions against discrimination require a profound change of culture which implies integrative measures of diversity management instead of assimilation mechanisms.

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Analysis of Student Dropout at Vienna University of Technology

ELISABETH GÜNTHER & SABINE T. KOESZEGI

Abstract

Vienna University of Technology (VUT) has an extremely high student dropout rate of more than 50 percent in its curricula. This study analyses whether and to what extent socio-demographic factors increase the dropout risk at VUT. In particular, the study analyses whether academic integration, measured by several performance indicators, decreases dropout for male and female students in the same way when other factors such as the field of study, age and nationality are controlled. The analysis is based on data from active students enrolled between 1998 and 2010 in thirteen science and technology disciplines. Logistic Regression models estimating the dropout risk for the entire student population show that women face a substantially higher dropout risk than male students. Logistic Regression models for male and female subsamples further show, that academic integration does not reduce the dropout risk for female students to the same extent than it does for male students. Policy makers are well advised to consider diversity aspects in designing curricula and principles of teaching. In order to attract and retain high potential candidates it is necessary to support their social integration at VUT.



1 Introduction

Earning a university degree is one necessary step over the threshold into science, engineering and technology (SET) and opens attractive career opportunities in academia and practice. Hence equal chances for men and women of different nationalities and age within SET is not just an issue of social and individual costs but also of socio-political importance.

Despite the fact that women have been allowed to enrol at VUT since 1919 (Mikoletzky 1997), gender segregation is still observable, both vertically and horizontally. Thus, even if social closure mechanisms do not directly lead to a collective exclusion, there is evidence that they still proceed in a more subtle way (e.g.: Wetterer 1993; Wolfram 2003). An ongoing research project analyzing the leaky pipeline at VUT reports substantial gender discrimination for faculty and students (Koeszegi et al. 2010). Dropout rates within SET are quite high in Austria, e.g. at VUT less than 50 percent of the students graduate (BMWF 2008: 212).

Most students drop out within their first year of study (Kolland 2002; Ratzer et al. 2006), some without taking an exam at all. Recent studies have shown that first-year students could have used more information on fields of study prior to enrolling. Unfulfilled expectations is one of the most stated explanations by dropout students in Austria (Horwath et al. 2007; Unger et al. 2009). Institutional adjustments could prevent a higher dropout. For instance, in an Austrian survey on early dropout, 17.3 % of the respondents state that they have a problem with the university system, as it is perceived very bureaucratic and confusing (Unger et al. 2009). In particular beginners feel overstrained and shocked by the abundance of new terms, content of teaching and the necessity of self-organised learning (Horwath et al. 2007; Unger et al. 2009; Wolfram et al. 2009). Other studies assume that structural changes like the implementation of the Bologna Study Architecture, which is associated with rationalisation and modularisation, may have led towards a more masculine form of organization (Parker and Jary 1995) and increased dropout rates.

Tinto (1975) identifies academic and social integration as important factors influencing students' decisions to dropout. Grade performance and intellectual development have an impact on the degree of academic integration while peer group and faculty interactions influence the degree of social integration. Tinto (1975) argues that higher academic and social integration directly correlate to higher goals and institutional commitment from students and lower risk for student dropout. Several empirical studies support this model (Unger et al. 2009; Wolfram et al. 2009; Derboven and Winker 2010). Particularly in the field of engineering, social integration has proven to be crucial since working and studying in learning groups are essential to students' success (Horwath et al. 2007). With regard to academic integration, perceived poor grades, competitive exams, and heavy workloads are seen as major factors leading to dropout (WOMENG 2005; Wolfram et al. 2009; Wächter 2010).

This study aims to test whether the proposition that accomplished academic integration reduces dropout risk is true for both female and male students to the same extent. Unless we find a similar dropout rate for female and male students with comparable academic achievements, VUT endangers losing high potential female students. On an aggregated level, we estimate with Logistic Regression models the effects of performance indicators on the dropout rate for male and female student populations (Backhaus et al. 2008; Fromm 2010). The analysis is based on enrolment data for students at VUT between 1998 and 2010. We use performance indicators included in the data set as proxies for academic integration. These indicators as well as control variables of logistic regression models on student dropout risk are discussed in more detail in the next section. The last section of the paper presents results and a discussion of findings.



2 Theoretical Background

Referring to Tinto's model, we evaluate whether similar academic achievement and integration has the same effects on the odds to drop out for male and female students. Since our data set does not include direct indicators of academic achievements such as passed courses and grades, we use the following variables as indicators for academic integration: (1) pre-university education, (2) initial study decisions, (3) participation in the Erasmus programme, and (4) switch from diploma¹ to bachelor programme (see also Figure 1).

Previous research indicates that dropout risk in SET is reduced for students with domain specific pre-university education (Ratzer et al. 2006; Horwath et al. 2007; Unger et al. 2009). Graduates of a college for engineering (and to some extent also graduates of a *Realgymnasium*² already have domain specific knowledge and therefore are more familiar with teaching content and domain specific terms contributing to academic integration. Hence, we include pre-university education in the model as an indicator of favourable/unfavourable preconditions for academic integration, with different types of qualifications as a set of dummy variables³.

The study of Unger et al. (2009) as well as the work of Dell'Mour et al. (2002) show that students who start studying right after graduation from secondary school usually have a lower dropout risk compared to others. These students seem to be more confident in their study choice and more focussed. Enrolment data from VUT comprises both information about the term students enrolled for the first time, as well as type of programme(s) (curricula) chosen. These two variables of initial study decisions indicate whether or not a student chose his/her field of study straight after graduation. We hypothesize that such a confident and determined behaviour contributes positively to academic integration and constitutes a favourable precondition for academic integration.

¹ The former diploma programme basically combined a bachelor and master programme, thus a diploma degree is more or less equivalent to a master degree. Nevertheless diploma students count as undergraduates. In order to distinguish the former diploma programme from the master programme according to Bologna Study Architecture, we utilize this term.

² Secondary Academic School with emphasis on mathematics and science

³ *Realgymnasium* serves as reference category

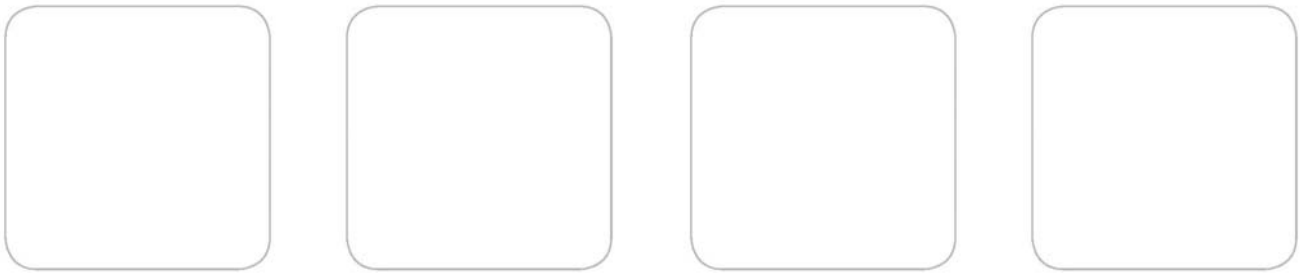
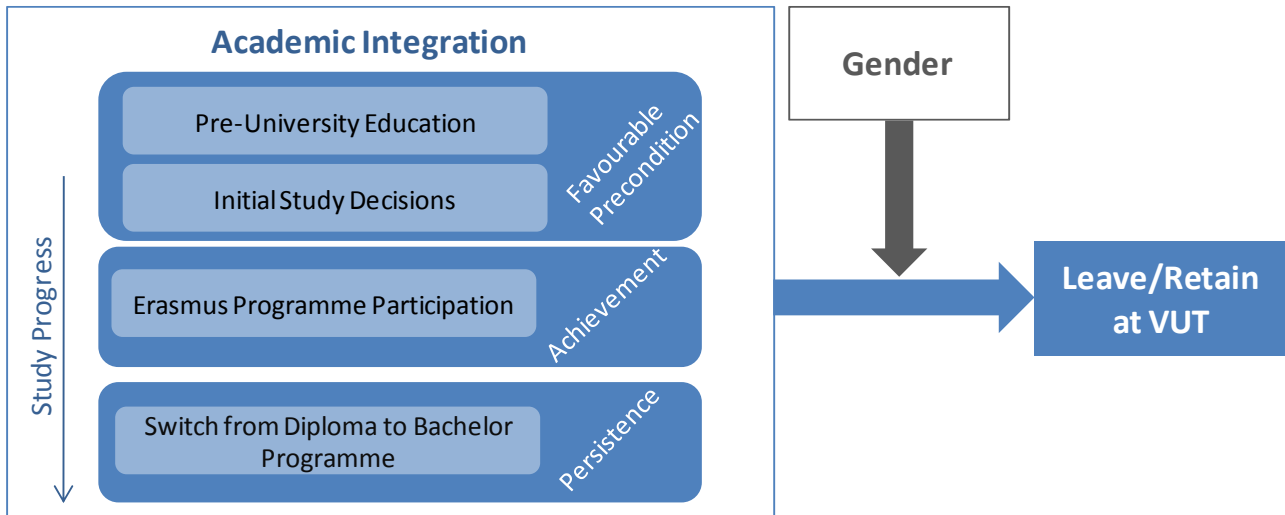


Figure 1: Academic Integration and Student Dropout Rate



One decisive performance indicator is a student’s participation in an international student exchange. Only advanced students with academic achievements and good grades are accepted for these programmes. Enrolment data of VUT includes a variable about a student’s participation in the Erasmus Programme, and this serves as a predictor for academic integration in the estimated models.

Along with the implementation of the Bologna Study Architecture, diploma students were encouraged to change to new bachelor programmes. Qualitative research about students’ social integration shows that female students find it hard to accommodate especially in the beginning of their studies at VUT (c.f. Koeszegi et al., 2010). As a switch from diploma to bachelor programmes requires bureaucratic effort, it can be assumed that only interested students switch. This variable is therefore included as an indicator for persistence in the models estimated for bachelor programmes.

Finally, successful academic integration is demonstrated when bachelor graduates decide to enrol in a master programme. However, a recent student survey unveiled that fewer female bachelor graduates continue in a master programme compared to male students (Unger et al. 2010). Unger and Angel et al. (2010) assume, inter alia, that low expectations about the labour market and future income lead to early opt out of women (c.f. Bargel et al. 2007). Therefore, we additionally estimate a logistic regression model to calculate the odds that males and females will continue a master programme directly after graduation.



3 Data

Hypotheses are tested with data from all active students enrolled between 1998 and 2010 at VUT⁴. Raw data comprises 104,596 data sets. The data was aggregated by student registration number. Each case (i.e. student) comprises information about all programmes in which the student was enrolled at VUT, first and last term of enrolment, demographic variables, pre-university education, Erasmus Programme participation, and graduation. Aggregated data was cleaned for all students who (1) enrolled in more than one programme at the same time, (2) never attended an exam, and (3) who have a foreign university entrance qualification. The cleaned data set comprises 36,317 students. For the dependent variable, students are counted as a dropout when undergraduates neither graduated by June 1, 2010 nor enrolled in 2009/10.

At VUT the Bologna Study Architecture was implemented at a different pace by the schools. The School of Informatics started in 2001/02 with the first bachelor programmes, and the last schools within the VUT implemented the Bologna Study Architecture by 2006/07. This study accounts for these institutional changes by estimating different dropout models in all 13 fields of studies for diploma programmes, bachelor programmes, and a model for bachelor graduates continuing on to a master programme. In more detail, the study considers diploma students who enrolled in 1998/99, 1999/00, and 2000/01 as well as bachelor students who enrolled in 2006/07, 2007/08, and 2008/09 and all bachelor graduates since 2001.

4 Results

4.1 DIPLOMA PROGRAMME

The following models estimate the odds of male and female students, to either have graduated by June 2010 (coded 0) or dropped out (coded 1). All students who did not finish their studies but changed to the new bachelor or master programmes and all students of Computer Science and Business Informatics who also enrolled at University of Vienna were excluded⁵. Overall, 66% of the remaining 4126 diploma programme students did not graduate. The odds to rather drop out than graduates are 1.303 times higher for female students as for male students.

Table 1 displays parameter estimates for the whole student population, as well as separate models for male and female student populations:

⁴ ADV TUW (2010): Studierendendaten der TU Wien 1998-2010.

⁵ VUT and University of Vienna ran a joint study programme in Business Informatics and Computer Sciences. Students could choose to graduate either at VUT or University of Vienna. As we only have graduation data from VUT, it is not possible to estimate seriously dropout in these joint programmes and students of these programmes were excluded.



Table 1: Regression Model 1 a-c: Dropout Risk Diploma Programme 1998-2001⁶

	Total (a) Exp(B)	Male (b) Exp(B)	Female (c) Exp(B)
Gender (female = 1 / male = 0)	1.303**		
Age at first Registration	1.114***	1.134***	1.079*
Citizenship (0 = Austria / 1 = other)	1.802*	2.147**	(1.172)
Austrian university entrance qualification			
Reference Category: Secondary Academic School emphasizing Mathematics and Science (<i>Realgymnasium</i>)			
<i>Classical Secondary Academic School (Gymnasium y = 1 / n = 0)</i>	(0.844)	(0.903)	(0.771)
College for Engineering (HTL y = 1 / n = 0)	0.798*	0.767*	(0.935)
<i>Other Types (y = 1/n = 0)</i>	(1.238)	(1.132)	(1.500)
<i>Regularly enrolled in winter term (winter term = 1 / summer term = 0)</i>	(1.208)	(1.087)	(1.695)
Registered in the same year as enrolled at VUT (yes = 1 / no = 0)	0.653***	0.634***	(0.790)
Erasmus (yes = 1 / no = 0)	0.072***	0.082***	0.045***
Constant	-1.636***	-1.875***	(-1.147)
N	4126	3114	1012
Nagelkerke R ²	0.266	0.276	0.270

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; (statistically not significant on a common level)

In Table 1, parameters relevant to academic integration are marked with blue colour. As expected, domain specific pre-university education (i.e. HTL) significantly reduces – compared to a *Realgymnasium* – the odds to drop out by about 23 %. This reduction, however, is only observable in the male student population. If female beginners bring in domain specific knowledge, their dropout risk is not decreased. Similarly, initial study decisions (a student' confident and determined choice of his/her field of study straight after graduation) decreases the odds to rather drop out than graduate only for male students by about 37 %, and it does not have a significant effect in the female student population.

The performance indicator Erasmus Programme participation clearly demonstrates that academic achievements are a strong and decisive indicator for retention. Almost all students who participated in an Erasmus Programme graduated. For male students with Erasmus Programme the odds to rather drop out than graduate are reduced by a factor of 12, for female students by a factor of 22 (see odds ratios in Table 1). Hence, compared to males, the increase in commitment to the study is almost twice as high for female students with academic achievements.

4.2 BACHELOR PROGRAMME

In these models the odds are estimated for students who started their bachelor programme in 2006/07, 2007/08 and 2008/09. As there was hardly enough time for students to already have graduated by June 2010, we calculate the odds of whether a student was still studying respectively graduated (coded 0) or dropped out (coded 1). About one fourth (25.6 %) have already dropped out from VUT within the first three years of observation. As indicated in Table 2, the explained variance in this model is relatively low compared to the model for diploma students. We assume that it will increase in the future when we have a longer time period of observation and data comprising significantly more graduates.

In addition to the models for diploma students, we again control for those students who switched from a diploma to a bachelor programme. Once more, women are much more likely to drop out as men. As can be

⁶ The field of study was controlled in the model with 12 dummies and Civil Engineering as reference category. In some programmes we observe significantly higher or lower dropouts compared to the reference category. Due to lack of space we do not display the parameter estimates in the table. They can be requested from authors.



seen in Table 2, the odds to rather drop out than continue studying are increased by 50 % for female bachelor students compared to male colleagues when taking previous education, citizenship, age, field of study and performance into account.

Table 2: Regression Model 2 a-c: Dropout Risk Bachelor Programme 2006-2009⁷

	Total (a) Exp.(B)	Male (b) Exp.(B)	Female (c) Exp.(B)
Gender (female =1 / male =0)	1.500***		
Age at first Registration	(1.008)	(1.013)	(0.987)
Citizenship (0= Austria / 1 = other)	(1.163)	(1.040)	(1.414)
Austrian university entrance qualification			
Reference category: Secondary Academic School emphasizing Mathematics and Science (<i>Realgymnasium</i>)			
Classical Secondary Academic School (Gymnasium $\gamma=1$ / $n=0$)	(0.989)	(0.894)	(1.135)
College for Engineering (HTL $\gamma=1$ / $n=0$)	0.647***	0.588***	(0.919)
Other Types ($\gamma=1/n=0$)	1.395***	1.399**	1.468**
Regularly enrolled in winter term (winter term = 1 / summer term = 0)	1.256*	1.454***	(0.874)
Registered in the same year as enrolled at VUT (yes = 1 / no =0)	0.760***	0.720***	(0.811)
Erasmus (yes = 1 / no = 0)	0.385**	0.119**	(0.740)
Enrolled in diploma programme (yes = 1 / no = 0)	0.419***	0.370***	0.547**
Constant	-0.782***	-0.833***	(-0.015)
N	7563	5482	2081
Nagelkerke R ²	0.059	0.055	0.032

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$; (statistically not significant on a common level)

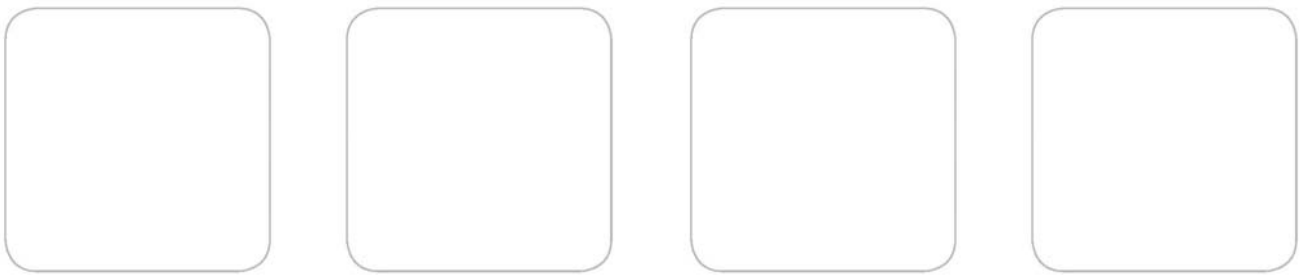
Once again, there are significant disparities in the odds for female and male students. Domain specific pre-university education (HTL) significantly reduces the odds to drop out only for male students (0.588 times), with *Realgymnasium* as a reference category. Students with other types of pre-university education, i.e. vocational colleges or second-chance education, face a significantly higher dropout risk compared to students with a *Realgymnasium* degree.

Contrary to the prediction of Unger et al. (2009) entrance in winter term increases the odds to rather drop out than continue studying by 45 % for male students. This variable shows no statistically significant effect for female students. It can be assumed that this positive effect of lateral study entrance in the summer term is associated with military service requirements. Male students who do their military service right after secondary school can manage to enrol in the following summer term. Again, these students demonstrate a confident and determined behaviour with regard to study entrance. Furthermore, students' registration in a particular study programme, i.e. students' initial study choice again decreases dropout risk significantly. However, this reduction of about 30 % is again only observed for the odds of male students but not for female students.

The performance indicator Erasmus Programme participation also impacts dropout risk differently for female and male students: While for male participants in the Erasmus programme the odds to rather drop out than continue are reduced by almost 90 % compared to those who did not take part in this programme, this achievement has no statistically significant effect for female students.

With regard to the persistence indicator we find, as predicted, that students who switch from diploma to bachelor programmes face significantly lower dropout risk: Compared to students who directly enrolled in a

⁷ The field of study was controlled in the model with 12 dummies and Civil Engineering as reference category. In some programmes we observe significantly higher or lower dropouts compared to the reference category. Due to lack of space we do not display the parameter estimates in the table. They can be requested from authors.



bachelor program, the odds for male students are reduced by a factor of 0.370, and the odds for female students by a factor of 0.547.

4.3 GRADUATES

In order to measure academic integration in the form of persistence, we estimated a model considering factors that might increase or decrease chances of graduates to continue with a master programme. The data shows that 4 out of 5 males with bachelor degrees (78.9 %) and 2 out of 3 females with bachelor degrees (68.8 %) also enrolled in a master programme at VUT. In analysing the odds for continuing a master programme at VUT (coded 0) or leaving VUT (coded 1), we find an increase of almost 80 % for female graduates compared to male graduates. These are the highest odds estimated for females compared to the previous models. With the introduction of Bologna Study Architecture emerged obviously a serious leak in the pipeline particularly for female SET students (Table 3).

Table 3: Logistic Regression Model 3 a-c: Consecutive Master Programme

	Total (a) Exp(B)	Male (b) Exp(B)	Female (c) Exp(B)
Gender (female = 1 / male = 0)	1.769***		
Age at Registration (Bachelor Programme)	1.142***	1.139***	1.163***
Austrian citizen (yes = 0 / no = 1)	1.779*	(1.681)	(2.041)
Austrian university entrance qualification			
Reference Category: Secondary Academic School emphasizing Mathematics and Science (<i>Realgymnasium</i>)			
Secondary Academic School (<i>Gymnasium</i> yes = 1 / no = 0)	(0.869)	(0.767)	(1.025)
College for Engineering (<i>HTL</i> yes = 1 / no = 0)	0.633***	0.666**	0.426**
Other Type (yes = 1 / no = 0)	(0.751)	(0.847)	(0.563)
Erasmus (yes = 1 / no = 0)	0.463***	0.456***	(0.467)
Also Enrolled in a Diploma Programme (yes = 1 / no = 0)	0.618***	0.717**	0.339***
Constant	- 4.117***	- 4.128***	- 3.695***
N	2880	2383	497
Nagelkerke R ²	0.130	0.122	0.153

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; (statistically not significant on a common level)

Not surprisingly, the model shows that the indicators of academic integration identified in earlier models also contribute significantly to persistence of bachelor graduates. Domain specific pre-university education significantly increases the odds to continue with a master programme: Compared to graduates from a *Realgymnasium*, the odds to leave VUT for female bachelor alumni with a HTL-degree are almost 60 % lower while the odds of male graduates with a HTL-degree are only reduced by 33 %.

Similar to the bachelor model, Erasmus Programme participation significantly increases the odds to continue with a master programme only for male students. Former diploma students who switched into the bachelor programme are also more likely to continue with a master programme at VUT than students who directly enrolled in bachelor programmes. This indicator is more than twice as strong for female graduates (0.339) than for male graduates (0.717).



5 Discussion

Theoretical models suggest that academic and social integration are important factors influencing dropout decisions of students. Tinto (1975) argues that higher academic and social integration directly correlate to higher goals and institutional commitment from students and lower the risk for student drop out. The aim was to test whether Tinto's proposition that accomplished academic integration reduces drop out risk is true for both female and male students to the same extent. In the case that there are distinct odds for female and male students with comparable academic achievements, alternative factors such as social integration must account for the higher dropout risk. This could mean that VUT chances losing high potential female students. Pre-university education, initial study decisions, participation in Erasmus programme, and switch from a diploma to bachelor programme served as indicators for academic integration in logistic regression models on dropout rates. Models for the whole student population as well as for female and male subpopulations were estimated and allowed the comparison of parameter estimates (odds ratios) between populations. The following Table 4 summarises the findings.

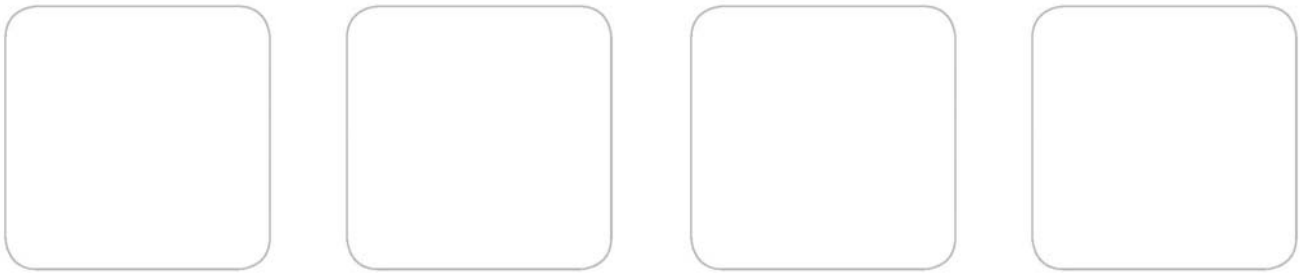
Table 4: Schematic Summary of Results

		male	female	
Diploma Programme <i>(Models 1 a-c)</i>	Domain Specific Pre-University Education	↓	-	
	Initial Study Decision	↓	-	
	Dropout: 66 %	Erasmus Programme Participation	↓	↓
Bachelor Programme <i>(Models 2 a-c)</i>	Domain Specific Pre-University Education	↓	-	
	Initial Study Decision	↓	-	
	Dropout: 25 %	Erasmus Programme Participation	↓	-
	Switch from Diploma to Bachelor Programme	↓	↓	
Continuing Graduates <i>(Models 3 a-c)</i>	Domain Specific Pre-University Education	↓	↓	
	Participation Erasmus Programme	↓	-	
	Opt out: 20%	Switch from Diploma to Bachelor Programme	↓	↓

↓ reduces dropout risk ↑ increases dropout risk - no significant effect on dropout risk

The analyses of this study clearly show that female students at VUT face a significantly higher dropout risk than their male colleagues in all estimated models.

The chosen indicators for academic integration along the study process, i.e. from favourable preconditions over achievement to persistence in academia, significantly reduce dropout risk. However, the effect of predictors on dropout risk is not the same for male and female students. The estimated parameters clearly show that favourable preconditions for academic integration, such as domain specific, pre-university education and confident and determined initial study choices only reduce dropout risk for male students but not for female students in both, bachelor and diploma programmes. At the same time, other forms of pre-university education, like second chance education or other vocational colleges, raise dropout risk for female bachelor students more than for male students. Given the fact that most students drop out within their first year of study (Kolland 2002; Ratzer et al. 2006), this finding has strong implications. The results deliver a stark indication that for female students other factors are influencing drop out decisions. Especially poor social and institutional integration seem to overshadow the positive effects of favourable preconditions. Consequently, social integration measures will be crucial for retaining women in the future.



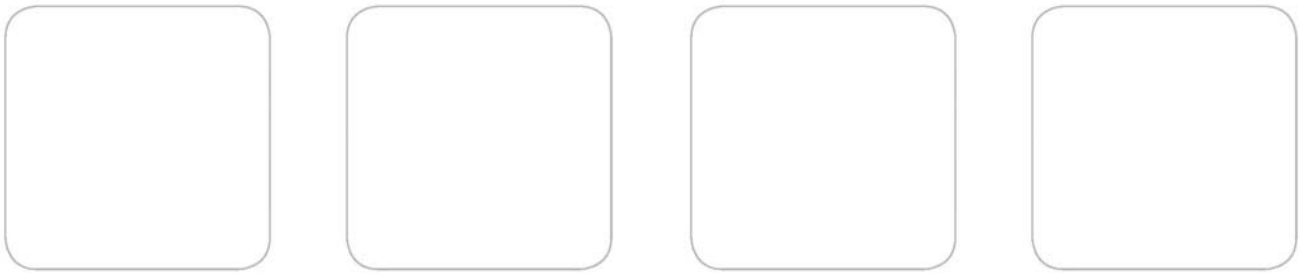
More challenging is the interpretation of the performance indicator participation in the Erasmus Programme: As expected, this indicator reduces dropout risk for male and female students, but again not to the same extent. In the diploma programme, the odds to rather drop out than graduate are almost twice as much reduced for female students as in the male sample. In the bachelor programme, participation in the Erasmus Programme does not reduce the odds significantly for females, while it does for males. The latter observation could be due to the short time period after and different pace of implementation of the Bologna Study Architecture by the schools at VUT. Some of the schools with a high quota of male students implemented the new bachelor programmes much earlier than other schools, and the numbers of female Erasmus students are still quite low. The diploma models 1 a-c therefore seem to be more reliable in this respect. Overall, the data shows that given students' advancement in their studies and high-level academic achievements (by being accepted into the Erasmus Programme) it is very unlikely that they do not graduate. If these students are women, the odds to rather drop out than graduate are reduced by a factor of 22. It is important to note here that female students face a substantially higher dropout risk than male students. Academic achievement needs to outweigh unfavourable preconditions or poor social integration. To say that more drastically: females have to compensate for factors that increase their dropout risk by attaining higher academic achievements.

As argued before, switching from a diploma to a bachelor programme is an indicator for interest in a chosen subject, hence a kind of commitment. Qualitative research about female students and scientists at VUT indicates that female students have difficulties with social integration and find it hard to accommodate (Koeszegi et al. 2010). Therefore, changing from a diploma to a bachelor programme can be seen as a reinforcement of their commitment in a subject, which is also supported by our data. However, previous studies have also suggested that the implementation of the Bologna Study Architecture which is associated with rationalisation and modularisation, may increase dropout (Parker and Jary 1995).

The models 3 a-c estimate the odds of bachelor graduates to continue with a master programme, and the data registers an extremely high dropout risk for female students. Again, all suggested parameters for academic integration significantly decrease dropout risk for both male and female students at this rather late state of study progress (except for participation in the Erasmus Programme, which is only significant for male students). However, this achievement does not outweigh alternative factors influencing the dropout decision of female students. At this critical decision point, the odds for females to drop out are 1.8 times higher than for men. Hence, with the introduction of Bologna Study Architecture emerged obviously a serious leak in the pipeline particularly for female SET students. Further qualitative studies have to clarify whether these female graduates leave VUT as "job outs" or decide to continue with a master programme elsewhere. In any case, VUT loses female talent at this point.

The models also contain additional noteworthy findings not yet discussed. There are differences in dropout risk for the socio-demographic variables age and nationality: Every year a beginner is older, he/she is more likely to leave VUT without graduation. As older students are more likely to be employed, this effect, which is stronger for male students, indicates that more effort must be given to improvement of compatibility of study and work. The higher odds to drop out for older students may also be a sign of problems in social integration. The latter is also true for non-Austrian nationals. Considering that all students of the sample included in the models have an Austrian university entrance qualification (i.e. Matura), the findings that dropout risk is significantly higher for non-Austrians are again strong indicator for poor social integration of students with diverse backgrounds.

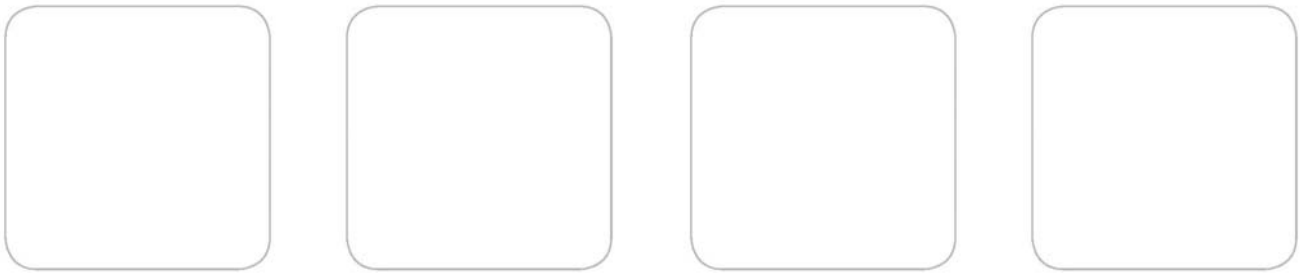
A young, male Austrian student with a HTL pre-university education, who started studying right after graduation from secondary school, has the best odds of achieving an academic degree at VUT – and this without having passed any exam at this stage of analysis. As our performance indicator analysis has demonstrated, this does not necessarily mean that this student belongs to the best. Social integration seems to be harder for females, for students with a non-domain specific, pre-university background and non-Austrians. Academic achievement for these students currently has to counterbalance poor social integration in order



to increase their chances of receiving a VUT degree. Policy makers are well advised to consider diversity aspects in designing curricula and principles of teaching. In order to attract and retain high potential candidates (with diverse backgrounds) it is necessary to support their social integration at VUT, not least by implementing affirmative action and anti-discriminatory measures.

6 References

- Backhaus, Klaus, Bernd Erichson, Wulff Plinke, and Rolf Weiber (2008): *Multivariate Analysemethoden. Eine anwendungsorientierte Einführung*. Berlin [u.a.], Springer
- Bargel, Tino , Frank Multrus, and Norbert Schreiber (2007): Studienqualität und Attraktivität der Ingenieurwissenschaften. Eine Fachmonographie aus studentischer Sicht. http://www.bmbf.de/pub/qualitaet_attraktivitaet_ingenieurwissenschaften.pdf access on 06.03.2011.
- BMWF, Bundesministerium für Wissenschaft und Forschung (2008): Universitätsbericht 2008. http://bmbwf.gv.at/uploads/tx_contentbox/Universitaetsbericht_2008.pdf access on 06.03.2011.
- Dell'Mour, René, Frank Landler, and René dell Mour (2002): *Akademische Grade zwischen Traum und Wirklichkeit : Einflussfaktoren auf den Studienerfolg*, Wien : Inst. für Demographie d. Österr. Akad. d. Wiss.
- Derboven, Wibke, and Gabriele Winker (2010): *Ingenieurwissenschaftliche Studiengänge attraktiver gestalten*. Berlin Heidelberg, Springer
- Fromm, Sabine (2010): *Datenanalyse mit SPSS für Fortgeschrittene. 2. Multivariate Verfahren für Querschnittsdaten*
- Horwath, Ilona, Nicole Kronberger, and Irmgard Wörthl (2007): *TEquality - Technik.Gender.Equality das Technikstudium aus der Sicht von Frauen und Männern*. Linz, Johannes Kepler Univ., Inst. für Frauen- und Geschlechterforschung
- Koeszegi, Sabine T., Marita Haas, Christina Keinert, Eva Zedlacher, and Elisabeth Günther (2010): To Boldly Go Where No Women has Gone Before: Understanding Resistance to Change in Segregated Organizations - A Case Study at Vienna University of Technology. *M/O/T Conference*. Vienna
- Kolland, Franz (2002): *Studienabbruch: Zwischen Kontinuität und Krise : eine empirische Untersuchung an Österreichs Universitäten*. Wien, Braumüller
- Mikoletzky, Juliane (1997): Von den Anfängen bis zur Zulassung von Frauen zum ordentlichen Studium an österreichischen Technischen Hochschulen 1919. "Dem Zuge der Zeit entsprechend ..." : zur Geschichte des Frauenstudiums in Österreich am Beispiel der Technischen Universität Wien. *Schriftenreihe des Universitätsarchivs der Technischen Universität Wien ; 1*. Mikoletzky, Juliane, Ute Georgeacopol-Winischhofer, and Margit Pohl. Wien, WUV-Univ.-Verl.: 17 - 108
- Parker, Martin, and David Jary (1995): "The McUniversity: Organization, Management and Academic Subjectivity." *Organization* 2(2): 319-338
- Ratzer, Brigitte , Sonja Hnilica, Bente Knoll, and Elke Szalai (2006): Erster Zwischenbericht Gender in die Lehre (GiL). http://www.tuwien.ac.at/typo3conf/ext/user_tuwien_links/download.php?cuid =1336



9&file=fileadmin%2Ft%2Fgender%2Fprojekte%2FGiL%2FGiL_Zwischenbericht1.pdf, access on 06.03.2011.

- Tinto, Vincent (1975): "Dropout from Higher Education: A Theoretical Synthesis of Recent Research." *Review of Educational Research* **45**(1): 89-125
- Unger, Martin, Stefan Angel, and Lukas Dünser (2010): Umstieg vom Bachelor- auf das Masterstudium. Studierende im konsekutiven Masterstudium. Zusatzbericht der Studierenden-Sozialerhebung 2009. http://ww2.sozialerhebung.at/Ergebnisse/PDF/sozialerhebung_2009_uebergang_bachelor_masterstudium.pdf access on 06.03.2011.
- Unger, Martin, Angela Wroblewski, Rossalina Latcheva et al. (2009): Frühe Studienabbrüche an Universitäten in Österreich. http://bmwf.gv.at/uploads/tx_contentbox/Frueher_Studienabbruch_an_Universitaeten_in_OEsterreich.pdf access on 06.03.2011.
- Wächter, Christine (2010): Nachhaltige Ingenieurausbildung. *Geschlecht und Innovation. Gender Mainstreaming im Techno-Wissenschaftsbetrieb*. Ernst, Waltraud, LIT Verlag: 105 - 115
- Wetterer, Angelika (1993): *Professionalisierung und Geschlechterhierarchie vom kollektiven Frauenausschluss zur Integration mit beschränkten Möglichkeiten*. Kassel, Jenior & PreSSler
- Wolffram, Andrea (2003): *Frauen im Technikstudium. Belastungen und Bewältigung in sozialen Situationen*. Münster, Waxmann
- Wolffram, Andrea, Wibke Derboven, and Gabriele Winker (2009): "Women withdrawers in engineering studies: Identity formation and learning culture as gendered barriers for persistence?" *Equal Opportunities International* **28**(1): 36 - 49
- WOMENG (2005): Creating Cultures of Success for Women Engineers. Synthesis Report. http://www.womeng.net/overview/Synthesis_Report.pdf access on 10.02.2011.

Appendix

Appendix 1: Descriptive Statistics Diploma Students 1998-2001

	Dropout		Graduates	
	male	female	male	female
Dropout	2087	667		
Graduate			1027	345
Austrian Citizen	2018	645	1010	337
other Nationalities	69	22	17	8
Enrolled in Winter Term	1614	567	928	307
Enrolled in Summer Term	473	100	99	38
Registered in the same year as enrolled at VUT yes	968	276	805	261
Registered in the same year as enrolled at VUT no	1119	391	222	84
Participation Erasmus Programme yes	33	9	209	94
Participation Erasmus Programme no	2054	658	818	251
Secondary Academic School emphasizing Mathematics and Science (Realgymnasium)	823	324	406	180
Classical Secondary Academic School (Gymnasium)	276	141	147	93
College for Engineering (HTL)	761	81	419	44
Other Forms	227	121	55	28
Age at first Registration				
~ Mean	23,129	21,727	20,780	20,077
~ Median	21,254	19,959	20,121	18,960
~ Maximum	61	45	55	41
~ Minimum	17	17	17	17



Appendix 2: Descriptive Statistics Bachelor students 2006-09

	Dropout		Studying/Graduates	
	male	female	male	female
Dropout	1225	717		
Studying/Graduates			4257	1364
Austrian Citizen	1182	679	4123	1313
other Nationalities	43	38	134	51
Enrolled in Winter Term	1024	621	3433	1201
Enrolled in Summer Term	201	96	824	163
Registered in the same year as enrolled at VUT yes	744	458	2643	901
Registered in the same year as enrolled at VUT no	481	259	1614	463
Enrolled in Diploma Programme yes	1157	686	3772	1260
Enrolled in Diploma Programme no	68	31	485	104
Participation Erasmus Programme yes	1223	708	4182	1336
Participation Erasmus Programme no	2	9	75	28
Secondary Academic School emphasizing Mathematics and Science (Real-gymnasium)	408	244	1170	514
Classical Secondary Academic School (Gymnasium)	188	208	591	382
College for Engineering (HTL)	436	94	2130	221
Other Types of pre-university Education	193	171	366	247
Age at first Registration				
~ Mean	22,363	20,845	22,173	20,923
~ Median	20,862	19,702	20,553	19,610
~ Maximum	55	43	63	61
~ Minimum	17	17	17	17

Appendix 3: Descriptive Figures Bachelor Graduates VUT

	left		Continued	
	male	female	male	female
Graduates, who left				
Graduates, who continued master programme	441	132	1942	365
Austrian citizens	421	126	1883	355
non-Austrian citizens	20	6	59	10
Also enrolled in a Diploma Programme yes	129	33	558	120
Also enrolled in a Diploma Programme no	312	99	1384	245
Participation in the Erasmus programme yes	20	8	230	50
Participation in the Erasmus programme no	421	124	1712	315
Secondary Academic School emphasizing Maths and Science (Real-gymnasium)	160	54	598	122
Secondary Academic School (Gymnasium)	55	38	264	84
College for Engineering (HTL)	179	17	925	80
Other Types of pre-university Education	47	23	155	79
Age at first Registration				
~ Mean	25,188	23,467	21,865	21,051
~ Median	21,974	20,022	20,715	19,921
~ Maximum	59	47	58	37
~ Minimum	18	17	15	17