

Admission Test for the First Year: Empirical Evidence from a European Business School

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1. INTRODUCTION

The selection of the best (those with the best grades or test scores) for admission to limited places is a central factor of increasing productivity in society (Lamont, Kaufman & Moody, 2000; Müller-Benedict, 2010). This selection of students is configured in various different ways, depending on the university system, and it follows traditions of the tertiary education sector that are specific to different countries.¹ A variety of criteria and instruments are used in student selection. For admission to a Bachelor's program, Swiss universities require students to possess a federally recognized *Matura* (secondary school leaving certificate) or equivalent foreign document. The universities decide on their own which foreign documents they will accept. All Swiss nationals earn open admission to 12 universities with their *Matura*.²

The University of St.Gallen is the only university in Switzerland that requires all foreign students to pass an admission test. University statutes stipulate that a maximum of 25 percent of the student population across the whole university may come from outside of Switzerland.

Scholastic aptitude tests are test procedures designed to measure those intellectual abilities that are considered to be important for academic success (Zimmerhofer & Trost, 2008, p.34). *General scholastic aptitude tests* assess cognitive abilities and skills that are generally considered relevant to studying. They are regular components of the selection process, especially in Sweden – with the Swedish Scholastic Assessment Test (SweSAT) (Wikström & Wikström, 2014) – and in the United States – with the SAT (Haase, 2008, p.29). *Specific scholastic aptitude tests* – for example in Germany, France, Spain and the United States (Haase, 2008, p.29) – measure cognitive abilities considered particularly important for a particular course of study such as medicine or business administration and economics (Hell, Trapmann & Schuler, 2007, p.252; Zimmerhofer & Trost, 2008, pp.34-35).

The admission test at the University of St. Gallen was conceived as a specific scholastic aptitude test to assess cognitive abilities and skills considered relevant for taking up studies in business administration and economics.³

Given their high levels of validity, scholastic aptitude tests are among the most valid individual predictors of academic success (Hell, Trapmann & Schuler, 2007, p.263; Hell, Trapmann & Schuler, 2008; Formazin, Schroeders, Köller, Wilhelm & Westmeyer, 2011). While the topic of the relationship between results on the admission test and future academic success is well researched, relatively few studies have focused specifically on the aspect of gender (Dlugosch, 2005; Mau & Lynn, 2001; Nankervis, 2011; Schult, Hell, Päßler & Schuler, 2013; Ragan, Li & Matos-Díaz, 2011). These confirm that men perform better on the quantitative elements of the tests (Mau & Lynn, 2001, pp.135-136; Trost et al., 1998; Hänsgen & Spicher, 2000; Hänsgen & Spicher, 2013; Spiel, Schober & Litzenberger, 2008; Wikström & Wikström, 2014; Bleske-Rechek & Browne, 2014, pp.27ff.). There is evidence that test fairness is not a given and that the future academic performance of women is underestimated (Kraft, Lamina, Kluckner, Wild & Prodingler, 2013; Kuncel & Hezlett, 2007; Young & Kobrin, 2001; Mattern & Patterson, 2013; Nankervis, 2011; Wiliam, 2000, p.662).

The aim of this study is to analyze the admission test at the University of St.Gallen over the years 2009-2013 with a particular focus on the variables of test participants' age and gender.

¹ For an international comparison of student selection, see Haase (2008, pp.21-31); in Germany, see Zimmerhofer & Trost (2008, pp.32-42).

² Exceptions include medicine (human, dentistry, veterinary medicine) and chiropractic, movement and sports sciences (CRUS, 2014).

³ It was developed by ITB Consulting GmbH in Bonn and designed in accordance with the tests for medical programs in Germany. Parts of the test are also found in Swiss qualification tests for medical programs as well as at other universities in Germany. See Section 2.1 ff.

2. ADMISSION TEST AT THE UNIVERSITY OF ST.GALLEN

The admission test at the University of St.Gallen was developed in 2001 and 2002 as part of conceptualizing the first year of studies, referred to as the Assessment Year. It is composed of different sections: *Text analysis*, *Solving quantitative problems*, *Diagrams* and *Linguistic systems*. *Recognising patterns* was added in 2010. The individual components are explained below in greater detail and in terms of the subsequent analysis.

2.1 Measuring Competence

2.1.1 Text Analysis

Texts of 10 to 15 lines in length describing a situation are presented in order to be analyzed. Each text is followed by two statements that must be examined to see whether they can be deduced from the information in the text. This tests reading comprehension, deductive reasoning in the verbal realm and the ability to separate the important from the unimportant. It is also about judgment, the confident assessment of what conclusions are valid and which are not.

This type of exercise is also found in national testing programs such as the Swiss aptitude test for medical studies (Eignungstest für das Medizinstudium, EMS) and the equivalent German test for medical studies (Test für medizinische Studiengänge, TMS), as well as in the Test for Academic Studies (Test für Ausländische Studierende, TestAS) given to foreign applicants to German universities in two languages worldwide.

2.1.2 Solving Quantitative Problems

This group of exercises is composed of simple quantitative problems in which events from economic and everyday life must be depicted mathematically. Tested are the ability to reason in the numerical realm and confidence in dealing with the basic rules of arithmetic and algebra. The focus is on finding the right approach to solving the problem, so extensive calculations are not required.

This module is also used in the EMS, TMS and TestAS. It was also for many years a component of the selection test at the WHU – Otto Beisheim School of Management.

2.1.3 Recognising Patterns

This section involves recognising, in a series of graphic elements that change in a systematic way, the rules under which the changes take place. Tested is the ability to infer rules in the figural realm – i.e., inductive reasoning.

This type of exercise is a component of a large number of intelligence tests – some with a high degree of difficulty – as well as TestAS and the selection test of the German National Academic Foundation (Studienstiftung des deutschen Volkes).

2.1.4 Linguistic Systems

In these exercises, expressions are presented in invented languages. The task is to figure out the meaning of individual words and the grammatical rules of the language. This group of exercises examines inductive thinking, in particular the consequent ability to deduce the rules of parts of language. Structures must be identified and applied to new situations. Also required is a high level of abstract thinking and hypothesis formation and testing.

This module was used for some time in the WHU test and remains a component of the TestAS and the selection test at Leuphana University Lüneburg.

2.1.5 Diagrams

Here, information from the economic and social spheres is presented in the form of diagrams, tables and charts. The task is to correctly interpret the relationships depicted. Tested is the ability to concretize abstract information, identify relationships and determine interdependencies. To do this, it is necessary to be flexible in switching between verbally described situations and graphical forms of presentation. It is about being able to extrapolate existing rules.

This type of exercise is a component of all scholastic aptitude tests in the German-speaking area as well as the university admissions process in the United States.

3. DATA-COLLECTION METHODS

The data set comprises the years 2009-2013. Collected from all students who sat the admission test during this period was data on gender, native language (foreign language Yes / No), age (birthday) and nationality. With regard to the results of the admission test, students can be classified into four groups: not admitted before the interview, admitted before the interview, not admitted after the interview or admitted after the interview.

Until 2013, all applicants could take the Graduate Management Admission Test (GMAT) or Graduate Record Examinations (GRE) as an alternative test for admission to the Assessment Year. However, as of 2013, admission with the GMAT/GRE is only possible for foreign applicants with residence outside of Europe. Students admitted to the Assessment Year with the GMAT/GRE are evaluated separately from the following statistical analyses.

Assessment Year	2009	2010	2011	2012	2013
Sample	781	666	751	460	545
Gender					
Men	533	458	538	307	397
Women	248	208	213	153	148
Foreign language (fewer points needed) / 2013: English test					
Yes	27	8	22	15	98
No	754	658	729	445	447
Normal admission test / 2013: German test					
Yes	754	658	729	445	447
No	27	8	22	15	98
Admission					
Admitted before interview	154	108	95	108	108
Admitted after interview	34	33	34	23	22
Not admitted after interview	10	12	9	5	5
Not admitted before interview	583	513	613	324	410
Result					
Admitted	188	141	129	131	130
Not admitted	593	525	622	329	415

Table 1: Overview of Participants Taking the Admission Test for the Assessment Year (2009-2013)

4. DATA ANALYSIS

To begin with, descriptive statistics are used to describe the data. Correlation analyses and t-tests were performed. To verify the findings obtained through additional methods of analysis, regression analysis and probit estimates were conducted in a second step.

4.1 Descriptive Statistics

4.1.1 Gender Distribution

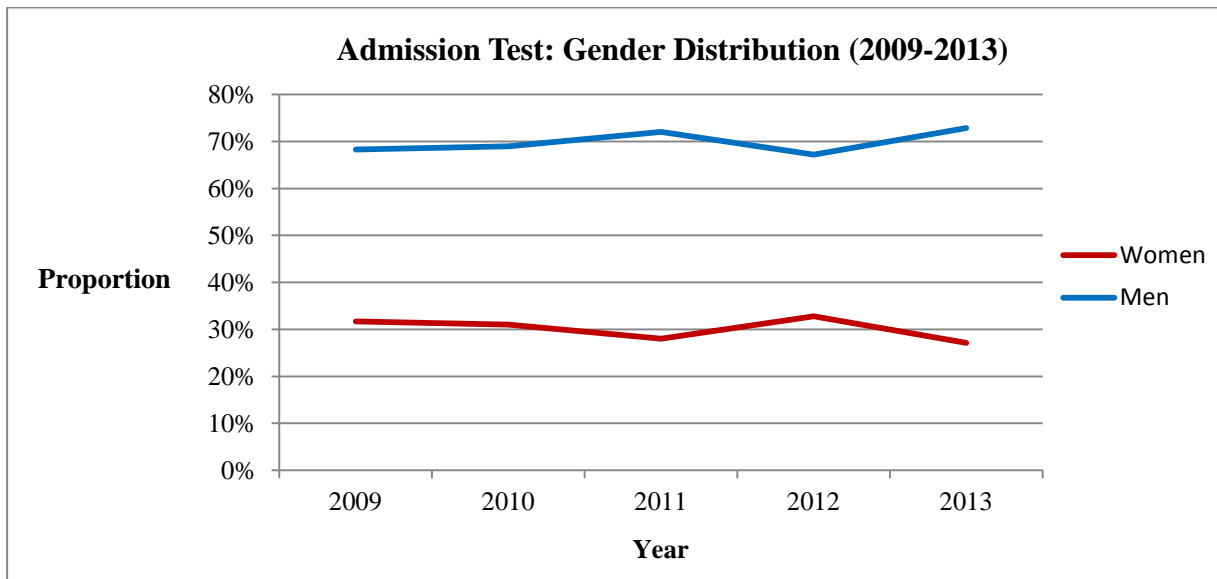


Figure 1: Gender Distribution of Participants Taking the Admission Test for the Assessment Year (2009-2013)

In the years 2009-2013, fewer women than men took the admission test at the University of St.Gallen. The ratio of women to men was approximately 1:2 in the years 2009, 2010 and 2012. In 2011 and 2013, more than 70% of those who took the test were men.

4.1.2 Nationality/Age

Assessment Year	Test year				
	2009	2010	2011	2012	2013
Nationality					
German	663	569	654	352	412
Austrian	68	70	69	73	71
Italian	13		2	6	4
French	6	3	3	3	6
Other	31	24	23	26	52

Table 2: Nationality of Participants Taking the Admission Test for the Assessment Year (2009-2013)

Assessment Year	Test year				
Age	2009	2010	2011	2012	2013
17 and younger	24	20	27	38	54
18	140	95	154	153	195
19	318	295	337	171	178
20	212	184	144	67	77
21	59	49	62	18	26
22	15	13	16	8	7
23 and older	13	10	11	5	8

Table 3: Age of Participants Taking the Admission Test for the Assessment Year (2009-2013)

4.1.3 Overall Score

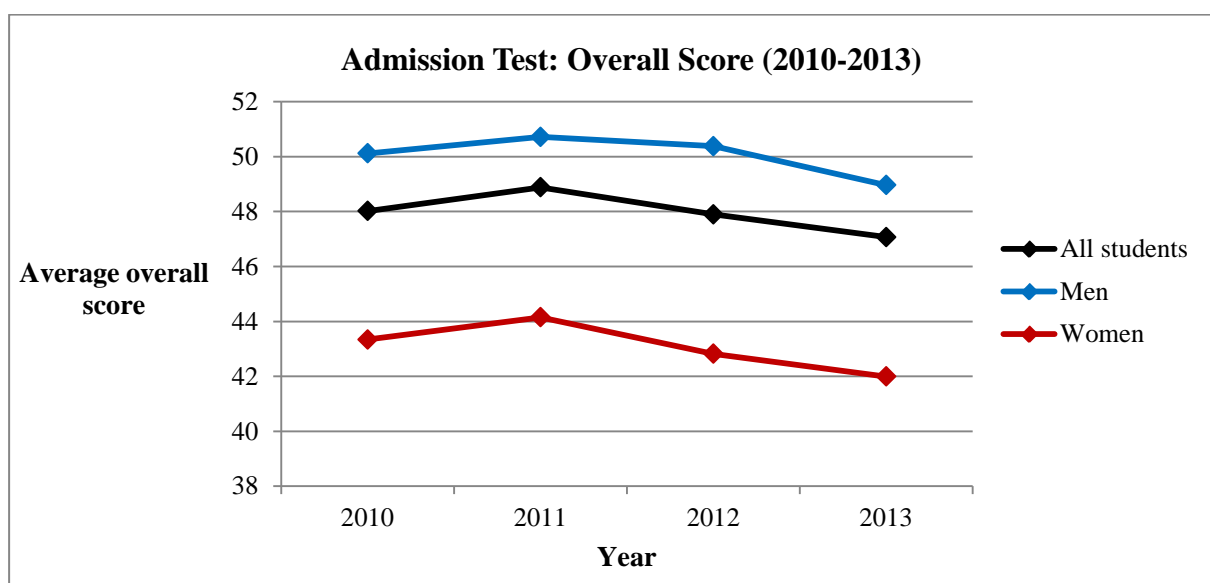


Figure 2: Overall Score on the Admission Test for the Assessment Year (2009-2013)

In terms of the performance of women compared to men, the descriptive statistics present a clear picture. Throughout the observation period, women fared on average much worse than men. These differences in performance in terms of average overall score are reflected in the probability of successfully passing the admission test, where significant differences are seen for women and men.

Year	Men	Women	Δ
2009	29.32%	12.13%	17.19 percentage points
2010	25.33%	12.25%	13.08 percentage points
2011	20.38%	8.82%	11.56 percentage points
2012	34.45%	15.75%	18.70 percentage points
2013	27.96%	12.84%	15.12 percentage points

Table 4: Probability of Men/Women Passing the Admission Test for the Assessment Year (2009-2013)

The probability of passing the admission test was at least 11 percentage points higher for men than for women.

4.1.4 Scores on Individual Test Sections

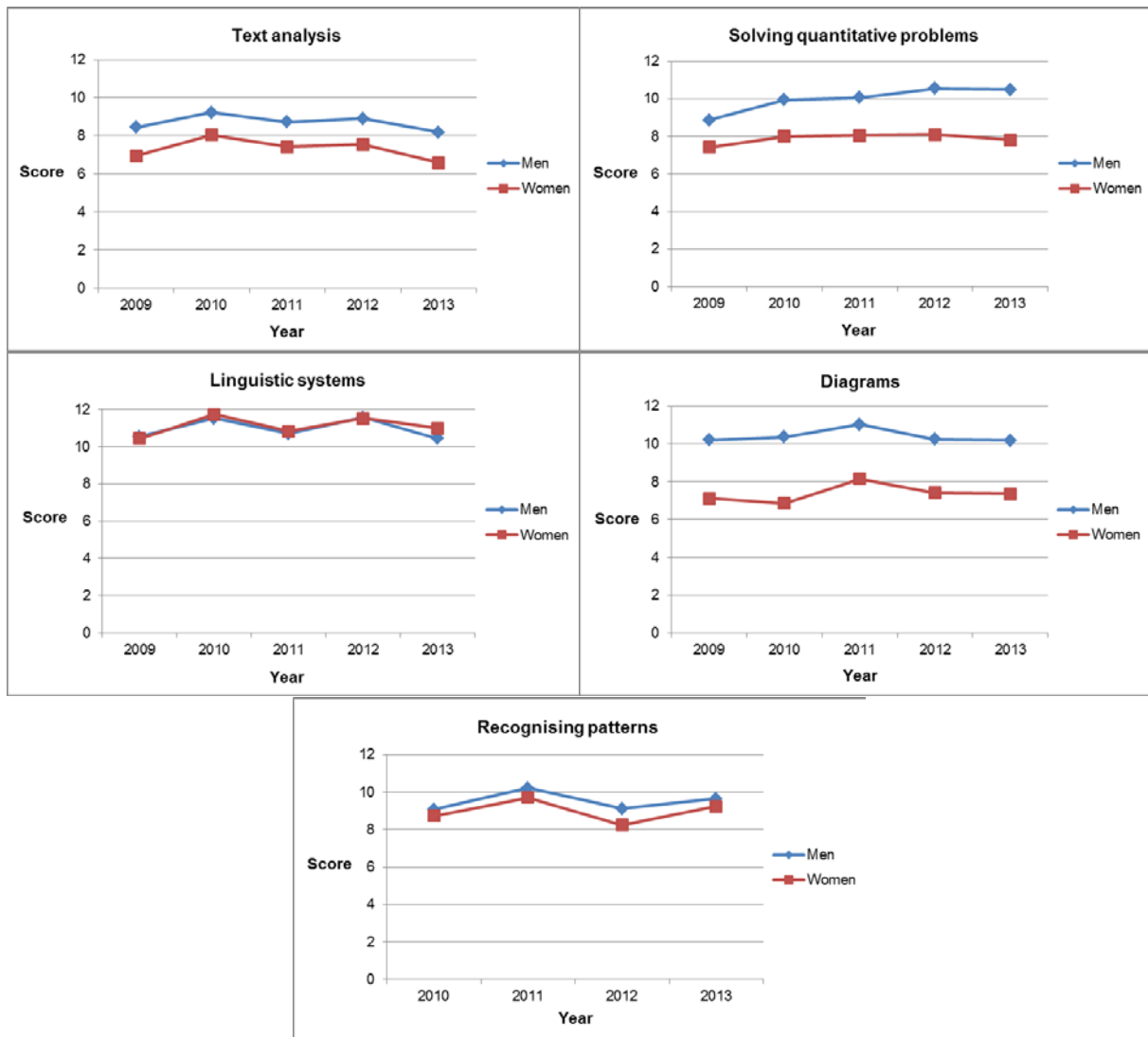


Figure 3: Scores on the Individual Sections of the Admission Test for the Assessment Year (2009-2013)

Men taking the admission test achieved a higher average score than women in all years on the test sections “Text analysis”, “Solving quantitative problems”, “Diagrams” and “Recognising patterns”. The difference between the sexes is particularly evident in the sections “Diagrams” and “Solving quantitative problems”. Female test participants generally performed better on the “Linguistic systems” section but not by enough to overcome the deficit on other sections.

4.2 Statistical Analyses

The remarks above on the performance of women and men on the admission test illustrate significant differences between the sexes (descriptive statistics). To statistically verify the relationship between the overall scores/scores on the individual sections and the gender of the test participants, several supplementary analyses were performed for the years 2009-2013.

4.2.1 Means Comparisons of Women/Men: T-tests

Variable	2009		2010		2011		2012		2013	
	P1 Value	P2 Value	P1 Value	P2 Value	P1 Value	P2 Value	P1 Value	P2 Value	P1 Value	P2 Value
Text analysis	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Solving quantitative problems	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Linguistic systems	0.695	0.550	0.552	0.536	0.715	0.563	0.909	0.944	0.122	0.129
Diagrams	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Recognising patterns			0.242	0.313	0.082	0.114	0.031	0.031	0.264	0.392
Overall score	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Age	0.000	0.000	0.000	0.000	0.004	0.000	0.003	0.003	0.076	0.003

Table 5: Means Comparisons of Women/Men (T-tests) on the Admission Test for the Assessment Year (2009-2013)

The means comparisons are based on data from those participants who completed the admission test for the Assessment Year. Foreign-language test participants are not included in the analysis.

P1 Value: Two independent samples t-test (unequal variances)

P2 Value: Wilcoxon-Mann-Whitney test (non-parametric)

With regard to the test sections “Text analysis”, “Solving quantitative problems” and “Diagrams”, as well as in terms of the overall score, significant differences in means can be distinguished for men and women on all admission tests from 2009 to 2013 (at the 5% level of significance). Men have consistently achieved significantly higher scores in these areas. Additionally, it can be observed that men who took the admission test were significantly older than women who took the admission test in the years 2009-2012.

4.2.2 Correlations (Pearson Correlation Coefficients)

Correlations (Assessment Year)	2009 Overall score	2010 Overall score	2011 Overall score	2012 Overall score	2013 Overall score
Women	-0.255 (0.000)	-0.248 (0.000)	-0.208 (0.000)	-0.245 (0.000)	-0.216 (0.000)
Age	-0.106 (0.003)	-0.065 (0.094)	-0.094 (0.010)	-0.135 (0.004)	-0.135 (0.002)
Foreign language/ Eng. admission test	-0.081 (0.024)	-0.106 (0.006)	-0.110 (0.003)	-0.062 (0.187)	-0.201 (0.000)
German-speaking foreign countries	0.150 (0.000)	0.136 (0.000)	0.146 (0.000)	0.156 (0.001)	0.269 (0.000)

Significance level in parentheses

Table 6: Correlations (Pearson) of Overall Score on the Admission Test for the Assessment Year (2009-2013)

The variable “*Women*” is negatively correlated with the overall score in all years. This result has a very high probability in terms of the analysed test participants in the years 2009-2013. The same applies to the variable “*German-speaking foreign countries*”. Indeed, in this case, the signs of correlation coefficients are positive. These results indicate that students with German or Austrian nationality perform significantly better on the admission test. It can further be observed that, with regard to a majority of the analysed years, there is a negative correlation between overall score and the variable “*Foreign language*”.

4.2.3 Ordinary Least Squares (OLS) Estimates

To statistically verify the relationship between the overall score achieved and the selected characteristics of the test participants, OLS estimates are performed in this section for the years 2009-2013. The OLS estimates are used to determine relationships between one dependent and one or more independent variables. In this case, the influence of gender, age, foreign language and nationality (German-speaking foreign countries) is investigated in terms of the overall score achieved on the admission test for the Assessment Year. The overall score achieved thus represents the dependent variable in each case.

OLS (Assessment Year)	2009 Overall score	2010 Overall score	2011 Overall score	2012 Overall score	2013 Overall score
Women	-6.77*** (0.82)	-7.60*** (1.08)	-6.75*** (1.11)	-8.01*** (1.41)	-6.38*** (1.31)
Age	-1.44*** (0.30)	-1.55*** (0.44)	-1.40*** (0.40)	-1.28*** (0.35)	-1.44** (0.45)
Foreign language / Eng. admission test	-3.51 (2.21)	-9.07 (4.70)	-5.02 (3.26)	-0.34 (3.92)	-3.81* (1.64)
German-speaking foreign countries	6.79*** (1.63)	8.68*** (2.61)	8.47** (2.89)	7.78** (2.67)	8.88*** (2.00)
Constant	59.66*** (6.03)	72.07*** (8.67)	69.48*** (8.35)	67.40*** (7.23)	68.68*** (8.85)
Observations	781	666	751	460	545
R-squared	0.12	0.10	0.08	0.11	0.13

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05

Table 7: OLS Regressions of Overall Score on the Admission Test for Assessment Year (2009-2013)

The coefficients of the regression analyses indicate a significant correlation between the overall score on the admission test and the gender of test participants. During the years 2009-2013, the coefficients for the variable “*Women*” are consistently negative. Furthermore, the coefficients are significant for each at the 0.01% level. The age of the test participants also has a negative effect on overall score. At the same time, it can be seen that test participants from German-speaking countries (Germany and Austria) perform significantly better than participants from other nationalities.

4.2.4 Probit Estimates of the Probability of Passing the Admission Test

In addition to the OLS estimates, several probit estimates were also performed on the probability of passing the admission test. Using the probit model allows the probability of occurrence of a binary target variable, in this case passing the admission test, to be modelled. In the scope of our analysis, the probit estimates thus provide clues about the extent to which the probability of passing the admission test is affected by certain characteristics of the test participants.

The results for the years 2009-2013 show that gender has a significant influence on the probability of success. The negative sign of the respective coefficient indicates that women have a substantially lower probability of success in all years studied. The other coefficients are also significantly negative for student age in four of the five years studied, implying that older students tend to have a lower probability of passing the admission test. In addition, based on the probit estimates for the years 2009-2013, it can be concluded that being from a German-speaking country (nationality) had a significant positive effect on the probability of passing the admission test in the years 2009, 2011 and 2013.

Probit (Assessment Year)	2009 Admission	2010 Admission	2011 Admission	2012 Admission	2013 Admission
Women	-0.69*** (0.120)	-0.57*** (0.132)	-0.58*** (0.141)	-0.69*** (0.147)	-0.54*** (0.152)
Age	-0.13** (0.046)	-0.14* (0.054)	-0.12* (0.052)	-0.17** (0.060)	-0.07 (0.053)
Foreign language / Eng. admission test	0.25 (0.289)	-0.31 (0.611)	0.45 (0.385)	0.37 (0.374)	-0.30 (0.188)
German-speaking foreign countries	0.48* (0.244)	0.31 (0.318)	1.15* (0.539)	0.33 (0.276)	0.59* (0.262)
Constant	1.51 (0.904)	1.69 (1.060)	0.30 (1.145)	2.56* (1.168)	0.14 (1.030)
Observations	781	666	751	460	545

Standard errors in parentheses
 *** p<0.001, ** p<0.01, * p<0.05

Table 8: Probit Regressions of the Probability of Passing the Admission Test for the Assessment Year (2009-2013)

5. CONCLUSION

To sum up the current investigation, in regard to the test sections “*Text analysis*”, “*Solving quantitative problems*” and “*Diagrams*”, as well as in terms of the overall scores achieved in the years 2009-2013, significant differences in means can be detected between men and women who take the admission test (at the 5% level of significance). The men consistently achieve significantly higher scores in these sections. These relationships are not observable in the sections “*Linguistic systems*” and “*Recognising patterns*”. The results for men in the “*Recognizing patterns*” question modules are better than for women but not significantly so. Women did better on the “*Linguistic systems*” question modules in three years, but these results are again not significant. Furthermore, it can be observed that the men taking the test were significantly older than women taking the test in the years 2009-2012.

Thus, a pattern emerges in the results of the individual test sections that correlates with the results of existing research on links between gender and performance on quantitative test elements (see discussion in Section 1). The results of the OLS regressions and probit estimates show that gender has a significant influence on the results. The question then becomes, where do these differences arise and to what extent could they represent discrimination against female applicants?

Worth considering could be to link these findings to the greater investigation of systems of academic preparation, which consistently document comparatively higher academic performance among women (see Europäische Kommission, 2009; ETH Zürich, 2008; Spinath, Eckert & Steinmayr, 2014).

It should also be explored whether a lower-than-average performance on the admission test is accompanied by a correspondingly low level of overall achievement in the course of studies. This in turn can only be analyzed with a longitudinal study of students.

The question is then, whether the existing tests reflect requirements in the field of business administration and economics. If gender represents a deciding factor in a student’s probability of success, then perhaps a discussion is called for on the requirements of the course of studies and the selection process using existing test modules. Reflections on the current selection process, such as those under way in the United States with the SAT (Atkinson & Geiser, 2009), are inevitable. Thoughts on multi-stage selection processes (Fischer, Schult & Hell, 2013; Calvin, 2000; Dlugosch, 2005; Hell, Trapmann, Weigand & Schuler, 2007) would be worth having.

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APPENDIX

Means Comparisons of Women/Men: T-tests

2009	Men			Women				
Variable	Mean	SD	n	Mean	SD	n	P1 Value	P2 Value
Text analysis	8.442718	3.161373	515	6.941423	2.744881	239	0.000	0.000
Solving quant. prob.	8.862136	3.662092	515	7.426778	3.281261	239	0.000	0.000
Linguistic systems	10.53398	3.451768	515	10.42678	3.51017	239	0.695	0.550
Diagrams	10.19417	4.058565	515	7.121339	3.580691	239	0.000	0.000
Recognising patterns								
Overall score	38.03301	11.24181	515	31.91632	9.965555	239	0.000	0.000
Age	19.51262	1.3456	515	19.09205	1.092324	239	0.000	0.000

2010	Men			Women				
Variable	Mean	SD	n	Mean	SD	n	P1 Value	P2 Value
Text analysis	9.220264	3.090959	454	8.053922	3.289337	204	0.000	0.000
Solving quant. prob.	9.940529	3.139647	454	7.990196	3.102502	204	0.000	0.000
Linguistic systems	11.51762	3.806976	454	11.71569	4.01445	204	0.552	0.536
Diagrams	10.37004	3.691716	454	6.848039	4.068556	204	0.000	0.000
Recognising patterns	9.070485	3.572567	454	8.730392	3.383655	204	0.242	0.313
Overall score	50.11894	12.6094	454	43.33824	13.63089	204	0.000	0.000
Age	19.49339	1.199227	454	19.07353	0.9671884	204	0.000	0.000

2011	Men			Women				
Variable	Mean	SD	n	Mean	SD	n	P1 Value	P2 Value
Text analysis	8.733333	3.103392	525	7.426471	2.912431	204	0.000	0.000
Solving quant. prob.	10.05905	3.557373	525	8.058824	3.337571	204	0.000	0.000
Linguistic systems	10.69524	3.88706	525	10.81863	4.171383	204	0.715	0.563
Diagrams	11.01905	3.823344	525	8.142157	3.915913	204	0.000	0.000
Recognising patterns	10.21143	3.466726	525	9.70098	3.582084	204	0.082	0.114
Overall score	50.7181	13.66043	525	44.14706	14.0291	204	0.000	0.000
Age	19.32571	1.1217	525	19.01471	1.373493	204	0.004	0.000

2012	Men			Women				
Variable	Mean	SD	n	Mean	SD	n	P1 Value	P2 Value
Text analysis	8.909699	3.427368	299	7.547945	3.133979	146	0.000	0.000
Solving quant. prob.	10.55184	3.798599	299	8.10274	3.479456	146	0.000	0.000
Linguistic systems	11.55853	3.811729	299	11.5137	3.909734	146	0.909	0.944
Diagrams	10.24415	4.052167	299	7.410959	3.899905	146	0.000	0.000
Recognising patterns	9.113712	3.786294	299	8.246575	4.045537	146	0.031	0.031
Overall score	50.37793	14.73027	299	42.82192	13.85326	146	0.000	0.000
Age	19.04682	2.143622	299	18.59589	1.080094	146	0.003	0.003

2013	Men			Women				
Variable	Mean	SD	n	Mean	SD	n	P1 Value	P2 Value
Text analysis	8.196474	2.93648	397	6.587838	2.682595	148	0.0000	0.0000
Solving quant. prob.	10.50126	3.909083	397	7.804054	3.665724	148	0.0000	0.0000
Linguistic systems	10.42569	3.714923	397	10.98649	3.763387	148	0.1217	0.1291
Diagrams	10.18136	3.731839	397	7.364865	3.740109	148	0.0000	0.0000
Recognising patterns	9.654912	3.969493	397	9.25	3.669835	148	0.2636	0.3918
Overall score	48.9597	14.21048	397	41.99324	13.65588	148	0.0000	0.0000
Age	18.86398	1.261968	397	18.62838	1.410748	148	0.0758	0.0031