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Coming to stay or to go? Stay intention and involved uncertainty of international students*

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Abstract

Countries compete for young talents to alleviate skilled-labor shortage. International students, who stay after graduation, allow host countries to overcome those challenges. This study investigates the factors associated with international students' intention to stay or to go after graduation. In contrast to the existing literature, this analysis employs survey data collected at the beginning of the studies. This assures that the analysis is not distorted by attrition and provides policymakers with more time for interventions. At the same time, it requires to deal with uncertainty as the actual migration decision will only be due in a few years. This study introduces a set of uncertainty models to the migration context to account for this. It finds that the results are largely robust across the different models: lower economic growth in the home country, a stay in the host country before the studies and being enrolled in a Bachelor program instead of a Master program are significantly associated with the intention to stay with certainty. Furthermore, Master students are found to be more uncertain than Bachelor students.

JEL-Classification: F22, J24, I23

Keywords: Stay intention, International students, Uncertainty, Labor shortage

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1 Introduction

The shift in the importance of production factors, from physical to human capital, is one important reason for competition for skilled talents in order to increase a country's productivity and prosperity (Reiner 2010). When endogenous potentials, i.e. skilled labor within a country, are scarce, countries search for exogenous potentials, i.e. skilled labor from abroad. Universities can play an important role in this international competition as they attract highly talented young individuals from around the globe and provide them with the possibility to build up human capital (Glaeser et al. 2001). International students, however, will only directly contribute to the economic development of the host country if they decide to stay and become part of the host country's labor force after their studies (Hooijen et al. 2017).[1] In this paper, we examine the factors associated with the intention of international students to stay or to go after graduation, while explicitly considering the uncertainty of this future decision.

The related literature on that topic can broadly be divided into theoretical studies that model the migration intention and actual decision, respectively, and empirical studies dealing with students' intentions to stay or to go after graduation. With respect to the actual migration decision the standard human capital model of migration predicts that migration occurs whenever lifetime earnings in a foreign country exceed lifetime earnings in the current country of residence (Sjaastad 1962; de Haas and Fokkema 2011).[2] Given the large number of possible destinations after graduation, it is difficult to collect data on actual (non-)migration. Therefore, this study investigates the intention to stay in the host country after graduation. According to the theory of planned behavior, the intention for a particular action is (almost always) a necessary pre-condition for a behavior (Ajzen 1991). When analyzing a behavior that lies in the future, such as permanently migrating after graduation, intentions to engage in such a behavior are a meaningful proxy for the actual decision (Burda et al. 1998; Manski 1990; Papapanagos and Sanfey 2001; Uebelmesser 2006).

Empirical analyses on that topic either focus on the determinants of the intention to stay in the host country and to join its labor force or the intention to return to the corresponding home country. Kruanak and Ruangkanjanases (2014), for example, survey international students during their studies and investigate their intention to stay in Thailand after graduation. The authors illustrate that the level of social support and career opportunities are significant determinants of whether international students want to stay in the host country. Lin and Kingminghae (2017), also employing survey data collected during the studies, solely focus on one determinant of international students' intention to stay in China – the role of intimate relationships such as a marriage or a romantic relationship. They outline that intimate relationships indeed are a pull factor across borders, with their strength differing by gender.

[1] We abstract from benefits for the host country which could realize while students are still in the course of their studies or when they leave after graduation (see, for example, Pan 2013 on the general enhancement of international political and diplomatic relations through international students and Murat 2014 on effects on trade relations).

[2] In the case of highly skilled individuals, however, personal characteristics such as individual preferences are more important for the initial decision to emigrate as well as for the decision to return than monetary gains (Gibson and McKenzie 2009).

Hooijen et al. (2017) asked students in their final phase of studies about their intention to stay within the Euregio Meuse-Rhine after graduation. The authors find that, among others, individual characteristics, the perception of career opportunities and having social ties within the region are significantly associated with the intention to stay. Cheung and Xu (2015) as well as Soon (2010) analyze, in turn, the return intentions of international university students after completing their studies. Cheung and Xu (2015) use a survey of Chinese citizens studying in the United States and identify job opportunities in the home country and family ties to be the strongest predictors of return intentions. Soon (2010) investigates the intentions of international students who graduated at two universities in New Zealand. The analysis reveals that, for example, a longer stay duration in New Zealand significantly decreases the intention to return.

Yet, when surveying international students' intention (but not their actual decision) to stay or to migrate after graduation, i.e. at some point in time in the future, the survey response is characterized by uncertainty.[3] To account for this, Soon (2010) distinguishes between a definite return, possible return, possible no return and definite no return. The results show, among others, that studying commerce instead of science is significantly associated with being uncertain. Similarly, Hooijen et al. (2017) consider the uncertainty involved in students' intention to stay. They separately analyze certain stayers, certain leavers and uncertain students. Comparing the uncertain students with those who are certain to leave, reveals that Master students compared to Bachelor students are more likely to be uncertain.

One common feature of all these studies is that the students' migration intentions are surveyed at the middle or the end of their studies. However, this is potentially problematic for analyses as the sample might vary considerably between the semesters. Taking Germany as an example, it becomes apparent that a strong attrition bias exists as, on average, between 29 and 45 percent of international students do not graduate from institutions of higher education for various reasons (Heublein and Schmelzer 2018).[4] Exemplary data for the starting cohort of winter semester 2016/2017 shows that the attrition rate is especially high over the first semesters (German Federal Statistical Office 2019). Given this selection, factors driving the intention to stay may differ considerably for the initial complete sample of international students as compared to the later reduced one. Additionally, the identification of the factors that determine the intention to stay or to go at the beginning of the studies provides the policymakers with more time for policy measures to address international students according to their intention.

In the present paper, we analyse the factors that are associated with the intention to stay or to go after graduation of international students of a medium-sized university in Germany. In this context, Germany provides an interesting basis for research because it is not only the

[3] Sometimes the terms uncertainty and risk are used interchangeably even though they are two distinct concepts (Knight 2006, p.20). The expressed intention about an action lying several years in the future mainly involves uncertainty as uncertainty is primarily rooted in imperfect knowledge or the unpredictability of the future. In contrast, the literature refers to risk once particular outcome possibilities regarding an event in the future are known. Naturally, uncertainty and risk overlap to a certain extent (Williams and Baláž 2012, p.176).

[4] The drop out rate of international students is especially high in comparison with German students at institutions of higher education in Germany (SVR 2019).

sixth-largest destination country for international students (OECD 2018), but also because it is, like many other European countries, confronted with an ageing population (Deschermeier 2017; Plötzsch and Rößger 2015) and a declining labor supply (Fuchs et al. 2017) while demand for skilled labor is high (Maier et al. 2015). Our study distinguishes itself from related empirical papers mainly through two key points. First, and most importantly, we survey international students at the beginning of their studies and not at the end, so that our results are not distorted by the attrition that occurs during the course of the studies. This allows evaluating factors that are of importance for the whole sample of international students. To account for the larger uncertainty associated with a decision in the more distant future, we, second, borrow several model specifications on how to combine information on the willingness to pay and involved uncertainty in the context of contingent valuation (Martínez-Espiñeira and Lyssenko 2012) and apply it to the migration intention context. This enables us to derive factors that shape the intention to stay with certainty and hence are the most likely drivers of an actual decision later on. At the same time, we provide insights about the group of uncertain students which allows for targeted policy measures. The results of our analyses show that, next to career opportunities and a stay in the host country before the studies, being enrolled in a Bachelor program instead of a Master program is significantly associated with the intention to stay. This also holds in the presence of lower economic growth in the students' home country. Our main findings are largely robust to different approaches accounting for the uncertainty involved. Having been to Germany prior to enrolling at the German university and having a German partner is accompanied by a higher intention to stay with certainty. Further, Master students do not only exhibit a lower intention to stay, they are also significantly more uncertain.

This paper is structured as follows: In the next section, we present the dataset. The third section focuses on determinants of the intention to stay without taking uncertainty into account. It presents our empirical strategy and estimation results. Different approaches on how to take the uncertainty involved into account are conducted and discussed in the fourth section. A concluding section 5 summarizes our findings.

2 Data

To test which factors are significantly associated with the intention to stay in Germany after graduation, we use survey data of international students at the beginning of their studies at a medium-sized university in East-Germany, where demographic change and skilled-labor shortage are prevalent challenges (Burstedde et al. 2017).[5] On the basis of a questionnaire, students were asked, among others, to provide information on individual characteristics, their study program, the intention to stay in Germany after graduation and the reasons for this intention as well as the uncertainty involved. The questionnaire was available in both German and English.

[5] See Koenings et al. (2019) for a study on the importance of rankings for international and domestic students based on a related dataset.

The survey was conducted from mid-October until the end of November in 2016, 2017 and 2018, which constitutes the beginning of the winter semester of the respective years. Hence, international students completed the survey within the early weeks of their arrival in Germany. The intention to stay in Germany is, therefore, in most cases, not yet affected by a long experience of residing in Germany. Furthermore, and in contrast to the existing literature, the sample comprises all international students that arrived in the host country.

There exists a large difference in size between the sample of international students at the beginning of their studies and at the middle or towards the end of it. For illustration, figure 1 shows the attrition of international students, who began their studies in the winter semester 2016/2017 at a German university. Between the first and the second semester and between the second and the third semester the drop out rate was 22 % and 23 %, respectively. An additional 8 % dropped out between the third and the fourth semester. Those numbers correspond to an attrition of 45 % (around 32,000 international students) between the first and the fourth semester. Additionally, the composition of the groups of students in the first and in the fourth semester differs considerably. Our data on a small number of international students who are already in the last year of their study programs shows that significantly more international male students drop out during their studies. Students enrolled in a Bachelor program instead of a Master program and those with rather limited German language proficiency are also slightly more likely to leave the university without a degree. All in all, conducting the survey at the beginning of the studies and not at the end allows for an analysis of a different, and in particular, larger sample of skilled international students who might ultimately decide on staying in Germany after graduation. Factors driving the intention to stay may thus differ considerably for the initial complete sample as compared to the later reduced one with consequence for policy measures.

All students were surveyed by means of a paper-and-pencil questionnaire to guarantee a high response rate. Overall, 265 (2016), 244 (2017) and 274 (2018) questionnaires were completed, which corresponds to response rates of 56% (2016), 45% (2017) and 53% (2018), respectively, of all newly enrolled international students at the university excluding guest and short term students. To arrive at a relatively homogeneous sample of international students, those who only participate in language courses, or with a Bachelor degree from Germany are dropped as well as PhD students. Even though the analysis of those groups might be insightful (see, for example, the analysis for PhD students by Hooijen et al. 2017 or Soon 2010), the group sizes are too small to draw rigorous inference. Our final sample comprises 578 international students. Table A1 in the Appendix compares the sample used in this study to a sample of all first-year international students of the university and the corresponding universe of international students in Germany. Whereas our sample is fairly representative in regards to all international students at the university, it is somewhat different in comparison to the group of international students in Germany. Compared to international students in Germany, Europeans[6] and students studying engineering are underrepresented in our sample, while females, Asians and Master students are overrepresented.

[6] Students were grouped into origin regions on the basis of their country of birth. In few cases, when no country of birth was indicated, students' citizenship was used to determine their region of origin.

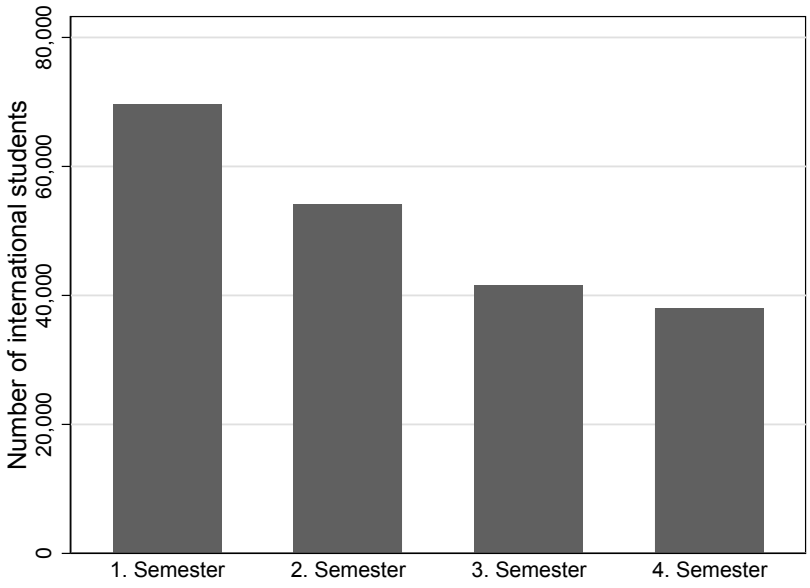

Figure 1: Number of international students over the first four semesters in Germany (Source: German Federal Statistical Office 2019)

Notes: Figure 1 displays the number of international students (without PhD students) who began their studies in the winter semester 2016/17 over their first four semesters at universities in Germany.

To identify international students' intention to stay in Germany, we use the survey responses to the question: "From your current point of view, where will you most likely reside after graduating from this university?". The respondents could choose from four answers: (1) In Thuringia, (2) In Germany (somewhere), (3) In my home country and (4) In a third country. Given the purpose of examining international students' intentions to stay in Germany, the answers are transformed into a binary variable taking the value of one if the respondent plans to stay in Thuringia or Germany and zero otherwise. The descriptive statistics in Table 1 show that 55% of the international students have the intention to stay in Germany.

In line with the existing literature, this study investigates five factors in the analysis of the determinants of the intention to stay in or to leave Germany after graduation: Individual characteristics, study characteristics, reasons to migrate, already existing social ties in Germany, and macro-economic conditions in the origin country.

The factor 'individual characteristics' encompasses students' gender, age, patience and risk-lovingness.[7] Since risk-loving and patient individuals are more likely to migrate (see, for example, Gibson and McKenzie 2009 or Roca Paz and Uebelmesser 2019), these charactersitics may play a role in the intention to stay or to leave Germany after graduation. We additionally include information on the type of the relationship of the respondents. Having a partner residing in a particular country can work as a pull factor to migrate to that country (Lin and

[7] Patience and risk-lovingness are self reported on a 11 points Likert-type scale ranging from 0 (risk-averse/ very impatient) to 10 (risk-loving/ very patient). For simplicity, the answers have been deflated to binary variables with the value of one if the level is 7 or higher.

Table 1: Descriptive statistics

	Count	Mean (Percent)	SD	Min	Max
Intention to stay	578	0.554	0.498	0	1
Individual characteristics					
Male	578	0.389	0.488	0	1
Age	578	24.159	3.648	18	41
Patience	578	0.642	0.480	0	1
Risk-loving	578	0.486	0.500	0	1
Feeling welcome in Germany	578	0.789	0.408	0	1
Type of relationship					
No partner (R)	467	(80.8)			
Non-German partner	42	(7.3)			
German partner	69	(11.9)			
Study characteristics					
Type of degree					
Bachelor (R)	110	(19.0)			
Master	389	(67.3)			
Others/ No Information	79	(13.7)			
Field of study					
Social Sciences (R)	51	(8.8)			
Humanities	111	(19.2)			
Economics/ Business/ Law	102	(17.6)			
Medicine	31	(5.4)			
Natural Sciences	206	(35.6)			
Engineering	18	(3.1)			
No information	59	(10.2)			
Reasons to migrate					
Scholarship from Germany	578	0.263	0.441	0	1
Scholarship from another country	578	0.156	0.363	0	1
Proximity to family/ partner	578	0.583	0.493	0	1
Own/ partner's career chances	578	0.874	0.332	0	1
Administrative reason	578	0.445	0.497	0	1
Social ties in Germany					
In Germany before	578	0.519	0.500	0	1
German questionnaire	578	0.502	0.500	0	1
Many German friends	578	0.163	0.369	0	1
Macro-economic conditions					
GDP p.c. (constant 2010 Thousand-US$)	578	10.106	12.807	.5111874	107.8653
GDP p.c. growth (%)	578	3.358	3.360	-9.444243	12.10102

(R) indicates reference category in regressions. Macro-economic conditions relate to students' citizenship/ country of birth and are observed one year prior to the beginning of studies in Germany.

Kingminghae 2017). While a German partner is expected to increase the likelihood to stay in Germany, the opposite pertains when the partner resides in a foreign country. Furthermore, feeling welcome in Germany is included as it is expected to be positively associated with having the intention to stay.[8]

The 'study characteristics' factor includes information on the field of study as well as the type of degree students are enrolled in. With respect to the intention to stay after graduation, Hooijen et al. (2017) find for example that students enrolled in a Master program are more likely to have the intention to stay than students in a Bachelor program.[9] The authors also show that students studying law and medicine/ health exhibit a significantly higher intention to stay compared to students studying social sciences.

The 'reasons to migrate' factor tests, among others, whether having a German scholarship or a scholarship from another country is significantly associated with the intention to stay or to go. A scholarship from a particular country may tie students more closely to that country. Furthermore, as the human capital model of migration builds on the idea that migration is partially driven by better career opportunities in a foreign country, we include the importance of students' own and their partner's career opportunities for their migration intention as part of the 'reasons to migrate' factor. Kruanak and Ruangkanjanases (2014) find that international students with a strong focus on career opportunities have a higher intention to stay in Thailand. Analyzing return intentions, de Haas and Fokkema (2011) find that the most important reasons to return are family-related and work-related reasons. Accordingly, we additionally include an indicator for the importance of the proximity to partner/ family and an administrative reason (visa regulations). Both are expected to be negatively correlated with the intention to stay in Germany.

'Social ties in Germany' comprise an indicator on whether the respondent has visited Germany before enrolling at the German university as well as an indicator for German language proficiency.[10] Moreover, this factor includes a variable about German friends.[11] Haug (2008) and de Haas and Fokkema (2011) have shown that having social ties in the destination country drives migration into that country or the intention to stay within that country.

Since the standard human capital model of migration predicts that individuals migrate whenever they expect a net economic gain through migration, we include 'macro-economic conditions' as a further factor in the analysis. Those macro-economic conditions of the origin

[8] The welcome feeling is a binary variable. Respondents indicated on a 5 point Likert-type scale whether they 'strongly disagree' (1) or 'strongly agree' (5) to feeling welcome in Germany. The binary variable takes a value of one if respondents either answered with 4 or 5 and a value of zero otherwise.

[9] In Germany there are still some fields of study which are not yet divided into a Bachelor and Master degree, for example, medicine. Those students and those who did not state their degree are grouped into the "Others/ No Information" category.

[10] Having answered the questionnaire in German instead of English is employed as a proxy for German language proficiency. Having chosen to answer the questionnaire in German instead of English highly correlates with the self-assessed German language skills (see Table A2 in the Appendix).

[11] Many German friends is a binary variable. Respondents indicated on a 5 point Likert-type scale whether they 'strongly disagree' (1) or 'strongly agree' (5) to having many German friends. The binary variable takes a value of one if respondents either answered with 4 or 5 and a value of zero otherwise.

countries are observed in the year prior to the beginning of the studies in Germany. To control for the prosperity of the origin country and, hence, for possible economic gains through migration to Germany, we test whether GDP per capita and the annual growth rate of GDP per capita taken from World Bank (2019) are associated with the intention to stay.[12] We expect that having a less prosperous origin country or an origin country where the economy faces an economic downturn are associated with a higher intention to stay in Germany.

Descriptive statistics on these factors are displayed in Table 1. The average students' age in the sample is 24 and 39% of the students are male. 64% consider themselves as patient and 51% as risk-averse. Most of the international students feel welcome in Germany (79%). 81% are single and 12% have a German partner. Furthermore, Table 1 shows that around 26% receive a scholarship from Germany, while around 16% receive one from another country. The most important reason to migrate after graduation are own or partner's career chances with 87%. The administrative reason only plays a role for 44%. 16% of the individuals in the sample indicate to have many German friends and 52% have visited Germany before. Half of the international students have a good knowledge of the German language as they chose the German over the English questionnaire.

3 Determinants of the intention to stay

3.1 Estimation Strategy

We run a binary choice model to estimate which factors are significantly associated with the international students' intention to stay. Given the individual intention to stay int_i for individual $i = 1, ..., N$ and the latent propensity to stay int_i^*, the model is formulated as follows:

$$\begin{aligned} int_i &= \begin{cases} 1 \text{ for } int_i^* > 0 \\ 0 \text{ for } int_i^* \leq 0 \end{cases}, \text{ where } int_i^* = \beta' X_i \quad \text{and} \\ \beta' X_i &= \beta_0 + \beta_1' Individual_i + \beta_2' Study_i + \beta_3' Reason_i + \beta_4' Social_i + \beta_5' Macro_i \\ &\quad + \beta_6 d_{2017} + \beta_7 d_{2018} + \varepsilon_i \end{aligned} \tag{1}$$

with $Individual_i$ capturing 'individual characteristics', $Study_i$ 'study characteristics', $Reason_i$ 'reasons to migrate', $Social_i$ 'social ties in Germany' and $Macro_i$ 'macro-economic conditions' of the origin countries. d_{2017} and d_{2018} are binary indicators for the respective years to control for cohort differences. ϵ_i is the idiosyncratic error term of international student i. The corresponding model's likelihood function is given by

$$L = \Pi_{i=1}^{N} F\left(\beta' X_i\right)^{int_i} \left[1 - F\left(\beta' X_i\right)\right]^{1-int_i}. \tag{2}$$

[12] We also estimate models that include additional indicators for the macro-economic condition of a country (for example, Freedom House Democracy Scale, Transparency International's (Public Sector) Corruption Perception Index and United Nations' Human Development Index). Since all additional macro-economic variables highly correlate with GDP per capita, they are not part of the final model.

For the following estimations, a cumulative normal distribution for F, i.e. a standard probit model framework, is chosen. We report average marginal effects, where marginal effects for dummy variables are calculated as discrete changes from the respective base level.

3.2 Results

Table 2 displays the estimation results when the different factors are stepwise included. We focus on interpreting the results of the full model only as the results are similar across all specifications. As to the 'individual characteristics', we do not find a significant association with gender which is a rather common finding (see, for example, Waldorf 1995; Soon 2010 and Hooijen et al. 2017). Age, however, turns out slightly significant. While this is in line with Hooijen et al. (2017) who also find that the intention to stay significantly increases with age, Soon (2010) does not find a significant association between the two variables. Patient international students are less likely to stay in Germany while, in contrast to our hypotheses derived above, neither risk-lovingness nor feeling welcome are significantly associated with the intention to stay. As expected, having a German partner is associated with a 14.6 percentage points higher propensity to stay compared to having no partner.

Being enrolled in a Master program is associated with a 23.3 percentage points lower probability to exhibit an intention to stay in Germany compared to a Bachelor program.[13] This result might be driven by the fact that a Bachelor program has a longer duration than a Master program and, hence, the Bachelor students are more likely to integrate in the host country (de Haas and Fokkema 2011; Waldorf 1995). Some might argue that Bachelor students want to stay in Germany only to acquire an additional degree and do not seek to become part of the host country's labor market. The longer study period in the host country, however, would further extend their staying period in Germany which in turn would increase the likelihood that they ultimately stay (de Haas and Fokkema 2011; Waldorf 1995). Additionally, an analysis on a reduced sample of international students for which it is possible to control for the intention to apply for a subsequent degree shows that the large and highly significant Master effect is robust to this concern. The result that the intention to stay is significantly lower for Master students compared to Bachelor students is in contrast to most of the literature. For example, Esser and Gillessen (2014), evaluating international students at German universities during the winter term 2013/14 via an online survey, find that Bachelor students have similar staying intentions as Master students. Furthermore, analyzing the intention to stay within the region, Hooijen et al. (2017) also find that Bachelor students are less likely to stay. Abstracting from the fact that the regions investigated are different, two possible reasons might drive the difference in the results between the results by Hooijen et al. (2017) and ours. Firstly, Hooijen et al. (2017) focus on students in the final phase of their studies, while we investigate them when enrolling at the university. Furthermore, we ask international students only, while Hooijen et al. (2017) take all students into account.

Furthermore, Table 2 shows that international students enrolled in economics/ business/ law,

[13] A separate analysis for German-language Master and English-language Master programs shows that they do not differ significantly.

natural sciences and engineering exhibit on average a higher intention to stay in Germany than international students studying social sciences. This result partially mirrors the result of the analysis by Hooijen et al. (2017). Additionally, Soon (2010) finds that students enrolled in more capital-dependent disciplines such as science compared to humanities exhibit a higher intention to stay.

The different origins of funding do not play a significant role in explaining the migration intention. However, the proximity to one's family or partner as well as own or partner's career chances do. Students who value own or partner's career chances highly are more likely to stay in Germany after graduation. In contrast, those students for whom the proximity to their family or partner is important are less likely to stay in Germany after graduation. Having been in Germany before studying is associated with a 14.3 percentage points higher intention to stay in Germany. Surprisingly, and in contrast to previous studies, a higher German language proficiency, i.e. choosing the German over the English questionnaire, is not significantly associated with the intention to stay.[14] With respect to macro-economic conditions, the results show that, as expected, international students from countries with unfavorable economic situations are more likely to have the intention to stay in Germany after graduation.[15]

[14] While there is a substantial number of international Bachelor students who choose to fill out the German questionnaire, there is no multicollinearity between German questionnaire and Bachelor degree. No significant relationship between having the intention to stay and language proficiency can be found without controlling for the type of degree. In addition, an analysis of a smaller number of observations employing self-rated German skills instead of the language of the questionnaire does not alter the results compared to those shown in Table 2.

[15] Through the inclusion of GDP variables we automatically control for differences between origin regions. We also run regressions separately for EU and non-EU countries given the different rules guiding immigration to Germany. The results were qualitatively similar, which might be due to the preferential rules guiding access to the German labor market for international graduates from German universities.

Table 2: Determinants of the intention to stay (stepwise inclusion)

	(1) Stay intention		(2) Stay intention		(3) Stay intention		(4) Stay intention		(5) Stay intention	
Individual characteristics										
Male	0.086**	(0.042)	0.045	(0.042)	0.043	(0.042)	0.054	(0.041)	0.042	(0.041)
Age	0.006	(0.006)	0.012**	(0.006)	0.013**	(0.006)	0.012*	(0.006)	0.010*	(0.006)
Patience	−0.140***	(0.043)	−0.133***	(0.042)	−0.124***	(0.042)	−0.099**	(0.042)	−0.096**	(0.042)
Risk-loving	0.063	(0.042)	0.067	(0.042)	0.056	(0.042)	0.049	(0.042)	0.045	(0.042)
Feeling welcome in Germany	−0.094*	(0.050)	−0.062	(0.050)	−0.063	(0.049)	−0.071	(0.049)	−0.065	(0.048)
Type of relationship										
Non-German partner	−0.012	(0.082)	0.010	(0.079)	0.001	(0.079)	−0.015	(0.078)	−0.014	(0.077)
German partner	0.191***	(0.061)	0.154**	(0.062)	0.171***	(0.061)	0.142**	(0.063)	0.146**	(0.062)
Study characteristics										
Type of degree										
Master			−0.260***	(0.050)	−0.260***	(0.050)	−0.247***	(0.053)	−0.233***	(0.053)
Others/ No information			−0.094	(0.074)	−0.080	(0.073)	−0.066	(0.072)	−0.060	(0.072)
Field of study										
Humanities			0.022	(0.081)	0.035	(0.080)	0.042	(0.078)	0.056	(0.076)
Economics/ Business/ Law			0.120	(0.083)	0.118	(0.081)	0.155*	(0.081)	0.141*	(0.080)
Medicine			0.269**	(0.112)	0.258**	(0.112)	0.203*	(0.117)	0.164	(0.119)
Natural Sciences			0.148**	(0.075)	0.139*	(0.075)	0.183**	(0.076)	0.176**	(0.075)
Engineering			0.368***	(0.119)	0.363***	(0.120)	0.377***	(0.121)	0.341***	(0.128)
No information			−0.031	(0.094)	−0.020	(0.093)	0.033	(0.092)	0.037	(0.091)
Reasons to migrate										
Scholarship from Germany					0.062	(0.050)	0.060	(0.049)	0.038	(0.049)
Scholarship from another country					−0.018	(0.061)	−0.024	(0.060)	0.003	(0.059)
Proximity to family/ partner					−0.123***	(0.041)	−0.136***	(0.041)	−0.131***	(0.040)
Own/ partner's career chances					0.127**	(0.061)	0.118*	(0.060)	0.120**	(0.059)
Administrative reason					0.032	(0.040)	0.037	(0.040)	0.033	(0.040)
Social ties in Germany										
In Germany before							0.162***	(0.041)	0.143***	(0.043)
German questionnaire							−0.003	(0.053)	0.011	(0.053)
Many German friends							0.058	(0.054)	0.071	(0.053)
Macro-economic conditions										
GDP p.c.									−0.002	(0.002)
GDP p.c. growth									−0.020***	(0.006)
Observations	578		578		578		578		578	
Pseudo-R^2	0.038		0.094		0.110		0.133		0.146	
Log-Likelihood	-382.329		-359.959		-353.557		-344.620		-339.385	
AIC	782.657		753.918		751.114		739.240		732.770	

Table displays average marginal effects resulting from probit model estimation. Standard errors in parentheses:*p<0.10, **p<0.05, ***p<0.01. Regressions include a 2017 and a 2018 dummy. Reference category for type of degree is Bachelor degree, for field of study social sciences and for type of relationship no partner.

4 Determinants of the intention to stay taking uncertainty into account

As our data on migration intention is collected at the beginning of the respective study program, the actual behavior lies at least two to three years in the future.[16] Hence, the migration intention involves a high degree of uncertainty. To assure that the identified determinants are not distorted by the uncertainty involved, in the following, special attention is placed on uncertainty.

4.1 The role of uncertainty

Since an intention always involves some uncertainty, we are not the first to take uncertainty into account in the migration context. Previous literature mainly uses a reply-option 'not sure' to the question on the intention to stay or to go and groups students into a stayer category, a leaver category and an uncertain category. The analyses of those categories show that the uncertainty involved differs significantly across study fields (Soon 2010), the types of degree (Hooijen et al. 2017), the levels of sociocultural integration as well as the language proficiency (de Haas and Fokkema 2011). For example, Master students are found to be more uncertain than Bachelor students (Hooijen et al. 2017) and immigrant groups with a higher sociocultural integration are less likely to be uncertain (de Haas and Fokkema 2011). Compared to the previous studies, however, we are the first who make use of a follow-up question to the question about the intention to stay: "How certain are you about this choice?", which allows answers on a seven-point Likert-type scale from (1) 'very certain' to (7) 'not certain at all'. This provides us with the possibility to distinguish more precisely between different levels of uncertainty.

Plotting the mean of the intention to stay over the seven uncertainty levels gives a first impression of the role of uncertainty in our sample. Figure 2 suggests that the relationship between the intention to stay and the uncertainty involved is of a non-linear nature. Hence, rigorous approaches are necessary to better understand how the importance of the determinants for the stay intention changes, when taking uncertainty into account.

4.2 Estimation Strategies

In a first step, we replicate the analyses of stay intention and involved uncertainty employed in the previous literature (uncertainty models I) and in a second step, we run several further models taking the whole range of uncertainty levels into account (uncertainty models II). Our second step follows the approach by Martínez-Espiñeira and Lyssenko (2012), who analyze the uncertainty involved when studying the willingness to pay for a whale conversation program.

For the uncertainty models I, we divide the sample into certain stayers, certain leavers and

[16] The standard curricula in Germany for Master programs take two years and for Bachelor programs three years.

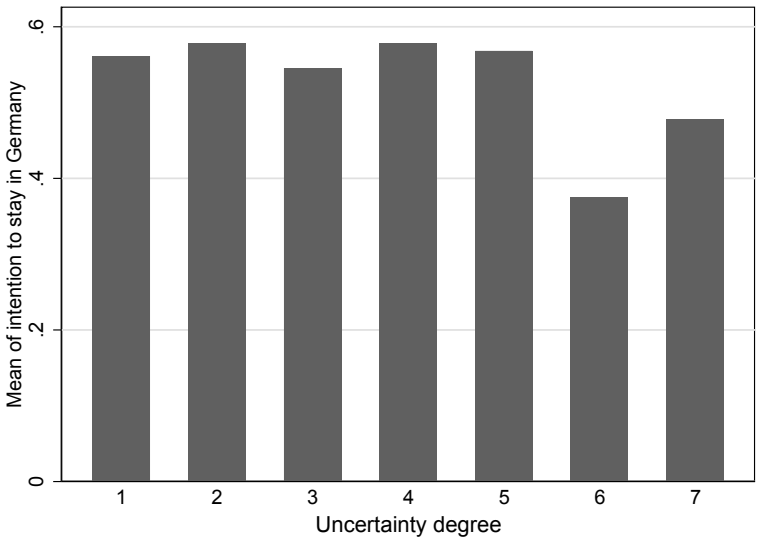

Figure 2: Mean of intention to stay over uncertainty

uncertain students. All respondents are considered as uncertain students if they indicate an uncertainty level of five or higher. The remaining students are grouped into certain stayers or certain leavers according to whether they intend to stay in Germany or not. For those different groups we conduct pairwise probit models similar to the specification outlined in section 3.1. By doing so, we partially replicate the small literature on migration intention which takes uncertainty into account (Hooijen et al. 2017; Soon 2010; de Haas and Fokkema 2011).

For the uncertainty models (II), we take the whole range of uncertainty (1-7) into account and test in detail how the importance of different factors for the intention to stay varies with uncertainty. There are several ways of how to proceed (Martínez-Espiñeira and Lyssenko 2012). Overall, we employ five different uncertainty models to investigate the relationship between the intention to stay, the whole range of the involved uncertainty and the factors under study. Important to note is that so far there is no theoretical argumentation from which one could identify one model to be superior over another model (Martínez-Espiñeira and Lyssenko 2012, p.132).

One of the most straightforward models is to include uncertainty as a further covariate in the model laid out in equation (1) (Model 1). Second, we recode the answers to the uncertainty question and construct a variable *sure* which takes on values ranging from $\frac{1}{7}$ "very uncertain" to $\frac{7}{7}$ "very certain". To put more emphasis on those respondents who are more certain, the estimation of equation (1) is weighted by the *sure* variable (Model 2). To put even more emphasis on the certain respondents, we follow Martínez-Espiñeira and Lyssenko (2012) who suggest to weight the estimation equation (1) by a $sure^2$ variable (Model 3). A different way

to take uncertainty into account is to calculate a new variable *certain-intention* such that

$$\text{certain-intention} = \begin{cases} 0.5 + \frac{sure}{2} & \text{if } i \text{ has intention to stay} \\ 0.5 - \frac{sure}{2} & \text{if } i \text{ has intention to leave (Model 4).} \end{cases} \quad (3)$$

This new variable has a value of one if the respondent wants to stay in Germany and is very certain about it. On the contrary, *certain-intention* is zero if the respondent is very certain to leave after graduation. Values close to 0.5 indicate an uncertain individual.[17] Following the strategy by Martínez-Espiñeira and Lyssenko (2012), we employ as the last *uncertainty model* the model suggested by Li and Mattsson (1995) (Model 5). This model uses weights and employs a recoded dependent variable such that, for example, a relatively uncertain individual with an intention to stay becomes a relatively certain individual without an intention to stay and vice versa. In detail, the weighting variable is the *sure* variable as long as the value of *sure* is larger than 0.5. If *sure* is smaller than 0.5 the weighting variable is $1 - sure$. The dependent variable is one if the respondent is willing to stay with certainty ($sure > 0.5$) or willing to leave with uncertainty ($sure < 0.5$). In all other cases the dependent variable is zero. Hence, having the intention to stay or to leave with full certainty, for example, results in the dichotomous-choice model weighted by the *sure* variable (Model 2).[18]

4.3 Results

First, we investigate the estimation results for the uncertainty models I. The results of the pairwise comparisons between certain stayers, certain leavers and uncertain students are displayed in Table 3. Column (1) compares certain stayers and certain leavers (reference category) and, hence, abstracts from uncertain students. The results in column (1) show that the same factors are of relevance for students' intention to stay or to go as when uncertainty is not specifically controlled for (Table 2). This provides an initial indication that our analysis does not seem to be distorted by uncertain individuals.

Column (2) of Table 3 displays the estimation results for the comparison between certain stayers and uncertain students (reference category). This allows us to see which factors are significantly associated with the intention to stay with certainty compared to the relevant factors for those who are uncertain to stay or to go. The results show that some factors significantly distinguish those groups from one another. For example, Master students compared to Bachelor students are more likely to be uncertain than certain to stay. Unsurprisingly, having a German partner instead of no partner is accompanied by a higher intention to stay with certainty. However, having been in Germany prior to the beginning of the study program is not differently associated with having the intention to stay for the two groups. In addition, those for whom own and partner's career chances are of importance are more certain.

[17] As for the last approach the dependent variable is of a continuous nature, an ordinary least squares method to estimate the relationships of interest is employed here.

[18] Martínez-Espiñeira and Lyssenko (2012) also employ asymmetric uncertainty models when investigating the relationship between willingness to pay and involved uncertainty in the context of contingent valuation which are not appropriate for our analysis.

Table 3: Uncertainty Models I: Comparing certain stayers, certain leavers and uncertain students

	(1) Certain stayers/ Certain leavers (ref.)		(2) Certain stayers/ Uncer. students (ref.)	
Individual characteristics				
Male	0.039	(0.044)	0.027	(0.047)
Age	0.010	(0.006)	0.009	(0.007)
Patience	−0.096**	(0.045)	−0.026	(0.048)
Risk-loving	0.028	(0.045)	−0.020	(0.049)
Feeling welcome in Germany	−0.085	(0.053)	0.025	(0.052)
Type of relationship				
Non-German partner	0.003	(0.082)	−0.008	(0.094)
German partner	0.143**	(0.066)	0.162***	(0.054)
Study characteristics				
Type of degree				
Master	−0.230***	(0.057)	−0.124**	(0.058)
Others/ No information	−0.046	(0.076)	0.015	(0.071)
Field of study				
Humanities	0.039	(0.082)	−0.022	(0.091)
Economics/ Business/ Law	0.123	(0.089)	−0.102	(0.095)
Medicine	0.150	(0.127)	0.060	(0.127)
Natural Sciences	0.161*	(0.083)	−0.003	(0.087)
Engineering	0.305**	(0.132)	0.126	(0.117)
No information	0.019	(0.098)	0.003	(0.107)
Reasons to migrate				
Scholarship from Germany	0.038	(0.054)	0.020	(0.056)
Scholarship from another country	−0.024	(0.062)	0.141*	(0.077)
Proximity to family/ partner	−0.117***	(0.043)	−0.093*	(0.049)
Own/ partner's career chances	0.119*	(0.065)	0.167**	(0.070)
Administrative reason	0.031	(0.044)	0.040	(0.046)
Social ties in Germany				
In Germany before	0.166***	(0.046)	0.054	(0.051)
German questionnaire	−0.016	(0.058)	0.027	(0.059)
Many German friends	0.061	(0.058)	0.065	(0.062)
Macro-economic conditions				
GDP p.c.	−0.002	(0.002)	−0.005**	(0.002)
GDP p.c. growth	−0.025***	(0.007)	−0.001	(0.007)
Observations	487		366	
Pseudo-R^2	0.170		0.114	
Log-Likelihood	-276.907		-181.957	
AIC	607.813		417.914	

Table displays average marginal effects resulting from probit model estimation. Standard errors in parentheses: *p<0.10, **p<0.05, ***p<0.01. Regressions include a 2017 and a 2018 dummy. Reference category for type of degree is Bachelor degree. Reference category for field of study is social sciences. Reference category for type of relationship is no partner.

The results displayed in Table 3 are only partially in line with the findings by Hooijen et al. (2017) who also employ groupwise comparisons. While Hooijen et al. (2017) find that the likelihood to be uncertain increases with age, age does not play a significant role in our results. In turn, their finding that Master students are more likely to be uncertain is mirrored by our results.

Our results in Table 3 are, however, sensitive to the way how the group of uncertain students is defined. Therefore, for a more comprehensive analysis we take the whole range of uncertainty levels into account. The results of the uncertainty models based on Martínez-Espiñeira and Lyssenko (2012) are displayed in Table 4 (uncertainty models II). With minor exceptions, all five models show qualitatively very similar results and, hence, give a relatively robust picture of the determinants of migration intention that are not distorted by uncertain individuals. These qualitative results are also very close to the baseline results (Table 2, column (5)) and the results from the analysis of certain indviduals only (Table 3, column (1)).

Including uncertainty as a further covariate to explain the intention to stay (Model 1) does not change the qualitative results and only marginally increases the explanatory power of the model compared to the baseline model where uncertainty is not taken into account. The second and third models put more emphasis on those respondents who are more certain in their intention compared to those who are not. Except for own and partner's career chances, which is not always significantly associated with the intention to stay, the qualitative results are very much in line with the baseline model. However, their size varies across the different models and thereby gives an indication about the uncertainty involved in this context. The average marginal effect for having a German partner, for example, increases with the weight that is put on the certain individuals indicating that having a German partner is associated with certainty. The same line of argumentation holds true for the average marginal effect for having been in Germany before. This is different from the results in Table 3, column (2), and points towards shortcomings of choosing an arbitrary threshold for separating uncertain from certain students. Own and partner's career chances are not significantly associated with the intention to stay when more emphasis is put on certain students (Model 3) indicating that those for whom career chances are of importance are generally more certain, either to stay or to go. This result is in line with the observations in Table 3, columns (1) and (2).

The qualitative results also largely stay the same compared to the baseline model when considering Model 4 and Model 5. Except for being patient and own and partner's career chances the same factors are significantly associated with the intention to stay. In comparison to the previous Models 1, 2 and 3, these models, however, change the size of the marginal effects by a larger extent.

Table 4: Uncertainty models II: Determinants of the intention to stay taking all uncertainty levels into account

	Model 1 covariate		Model 2 sure		Model 3 sure^2		Model 4 certain-intention		Model 5 recoding	
Uncertainty	−0.016	(0.012)								
Individual characteristics										
Male	0.042	(0.041)	0.068	(0.043)	0.093**	(0.046)	0.050	(0.032)	0.046	(0.043)
Age	0.010	(0.006)	0.008	(0.007)	0.006	(0.007)	0.007	(0.004)	0.006	(0.007)
Patience	−0.098**	(0.042)	−0.095**	(0.044)	−0.094**	(0.047)	−0.060*	(0.032)	−0.035	(0.045)
Risk-loving	0.047	(0.042)	0.043	(0.043)	0.049	(0.046)	0.025	(0.032)	−0.007	(0.044)
Feeling welcome in Germany	−0.073	(0.048)	−0.071	(0.048)	−0.080	(0.052)	−0.047	(0.036)	−0.094*	(0.049)
Type of relationship										
Non-German partner	−0.014	(0.077)	−0.012	(0.082)	−0.012	(0.088)	−0.006	(0.058)	−0.006	(0.082)
German partner	0.142**	(0.063)	0.151**	(0.066)	0.162**	(0.069)	0.123**	(0.050)	0.136**	(0.068)
Study characteristics										
Type of degree										
Master	−0.231***	(0.053)	−0.231***	(0.056)	−0.227***	(0.060)	−0.173***	(0.043)	−0.188***	(0.056)
Others/ No information	−0.056	(0.072)	−0.061	(0.075)	−0.062	(0.080)	−0.045	(0.059)	−0.025	(0.075)
Field of study	Yes		Yes		Yes		Yes		Yes	
Reasons to migrate										
Scholarship from Germany	0.038	(0.049)	0.028	(0.052)	0.014	(0.055)	0.031	(0.038)	0.045	(0.052)
Scholarship from another country	−0.005	(0.060)	−0.007	(0.062)	0.004	(0.067)	0.004	(0.046)	−0.018	(0.062)
Proximity to family/ partner	−0.130***	(0.040)	−0.123***	(0.043)	−0.119***	(0.045)	−0.092***	(0.032)	−0.080*	(0.043)
Own/ partner's career chances	0.121**	(0.059)	0.113**	(0.057)	0.089	(0.062)	0.078*	(0.046)	0.081	(0.060)
Administrative reason	0.031	(0.040)	0.036	(0.042)	0.043	(0.045)	0.034	(0.031)	0.030	(0.042)
Social ties in Germany										
In Germany before	0.142***	(0.043)	0.155***	(0.043)	0.165***	(0.046)	0.114***	(0.034)	0.148***	(0.044)
German questionnaire	0.009	(0.053)	0.004	(0.052)	0.010	(0.056)	0.004	(0.040)	−0.018	(0.053)
Many German friends	0.066	(0.053)	0.065	(0.055)	0.058	(0.058)	0.063	(0.041)	0.051	(0.054)
Macro-economic conditions										
GDP p.c.	−0.002	(0.002)	−0.002	(0.002)	−0.002	(0.002)	−0.002	(0.001)	−0.002	(0.002)
GDP p.c. growth	−0.021***	(0.006)	−0.023***	(0.007)	−0.024***	(0.008)	−0.014***	(0.005)	−0.019***	(0.007)
Observations	578		578		578		578		578	
(Pseudo)-R^2	0.148		0.158		0.164		0.179		0.109	
AIC	733.003		529.274		423.085		435.571		597.630	

Table displays average marginal effects resulting from probit model estimations when controlling for uncertainty by a covariate (Model 1), by weighting with *sure* (Model 2) or *sure*^{2} (Model 3). Model 4 displays coefficients resulting from an ordinary least squares estimation when having $certain - intention$ as dependent variable. Model 5 displays average marginal effects resulting from probit model estimation when calculating the dependent variable and weights according to Li and Mattsson (1995). Standard errors in parentheses:*p<0.10, **p<0.05, ***p<0.01. Regressions include a 2017 and a 2018 dummy. Reference category for type of degree is Bachelor degree, and for type of relationship no partner.

The similarity in terms of significance of the calculated effects in Table 4 and Table 2 shows that our analysis in the first place did not suffer from a bias introduced by uncertain students.[19] The exception is the only marginal importance of career opportunities and of being patient when taking uncertainty into account. This reveals that these might not be important factors when distinguishing between the intention to stay or to go with certainty but might play a more important role for those students who are uncertain. However, we find that the employed uncertainty models exhibit different magnitudes for the estimated marginal effects indicating that the choice of the uncertainty model is crucial when effect sizes matter. Therefore, we conclude, analogously to Martínez-Espiñeira and Lyssenko (2012), that it is open for further research to investigate empirically and/ or theoretically which model is the most appropriate to take uncertainty in migration intentions into account.

5 Conclusion

When endogenous potentials within a country are not sufficient to maintain or increase a country's productivity, international students remaining in the country after graduation are one source of exogenous potential to maintain or increase productivity, to overcome demographic challenge and skilled-labor shortage, and finally to survive in the global competition for talent.

This study employs survey data to analyze determinants of international students' intention to stay in Germany after graduation. By surveying students at the beginning of their studies we overcome problems faced by studies which use surveys conducted at the middle or towards the end of the studies when a non-negligible part of international students have already dropped out. Surveying students at an earlier point in time allows identifying factors which make it more likely for students to leave during their studies or after graduation. Additionally, it provides the host country's policymakers with more time for policy measures to address international students according to their intention. But at the same time it involves a higher degree of uncertainty. For this reason, this study applies several models to take uncertainty into account in order to assure that the results on the importance of particular factors for the intention to stay are not distorted by uncertain students.

All models show the significant difference between Master and Bachelor students and that having been in Germany before and having a German partner are significantly associated with the intention to stay with certainty. The importance of the proximity to family or partner and higher economic growth in the origin country are accompanied by a lower intention to stay with certainty.

Taking detailed information on uncertainty into account reveals several insights. First, the importance of career chances distinguishes certain students from uncertain students. Furthermore, it shows that Master students not only exhibit a lower intention to stay but are also more uncertain in their intention. This confirms earlier findings by Hooijen et al. (2017).

For host countries confronted with skilled-labor shortage and demographic change, the results

[19] The qualitative results also stay the same when estimating models based on Model 1 and additionally including an interaction between uncertainty and each covariate.

indicate that promoting visits of the host country by students prior to the beginning of their studies might be beneficial in alleviating the existing challenges and allowing for well-informed study choices. Additionally, the findings show that especially Master students and students who state that career chances are not of importance constitute possible target groups for policymakers as they are significantly more uncertain. Hence, providing Master students with information on the advantages staying in Germany over the course of their studies might be an effective way to decrease students' uncertainty and encourage (some of) them to stay. Naturally, a host country might also gain through international students who do not stay after graduation, for example, by increased trade. However, international students should not leave the host country due to a lack of information as this might lead to inefficient labor market outcomes or no match between skill supply and demand.

This study has outlined several approaches on how to take uncertainty into account when analyzing the intention to stay after graduation. Overall, and in line with the results of Martínez-Espiñeira and Lyssenko (2012) in the contingent valuation context, we find that the employed uncertainty models which take the whole range of uncertainty levels into account lead to somewhat different results. While this study provides researchers with a set of uncertainty models to employ in the context of migration intention, it is open for further research to investigate empirically and/ or theoretically which model is the most appropriate given a specific context.

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Appendix

Table A1: Descriptive statistics (shares): International students in first semester (for winter semesters 2016/2017, 2017/2018 and 2018/19)

	(1) Sample	(2) University	(3) Germany
Male	0.389	0.417	0.490
Age	23 (median)	23 (median)	n.a.
Field of study[*]			
Social Sciences	0.098	0.086	0.078
Humanities	0.214	0.230	0.232
Economics/ Business/ Law	0.197	0.229	0.203
Medicine	0.060	0.085	0.039
Natural Science	0.397	0.335	0.130
Engineering	0.035	0.036	0.299
Origin region			
Europe	0.318	0.286	0.498
America	0.057	0.063	0.088
Africa	0.083	0.076	0.061
Asia	0.542	0.572	0.339
Australia	0.000	0.002	0.004
Type of degree			
Bachelor	0.190	0.250	0.330
Master	0.673	0.646	0.335
Others/ No information	0.137	0.104	0.334
Observations	578	1536	142206

Shares of overall observations are displayed. [*] Does not contain a 'No information' category.[20] The number of observations in column (1) refers to the full sample used in this paper. The number of observations in column (2) contains all international students except guest students. Column (3) contains the number of all international students enrolled at universities in Germany. The last column does not contain information on the winter semester 2018/19 as the data is not yet available. Sources: Friedrich-Schiller-University (2016, 2017, 2018), German Federal Statistical Office (2017, 2018). Own computations.

[20] We abstract from this category in this descriptive comparison, as we assume no systematic bias between the missing information of the field of study and the variables of interest. In the regressions, this category is included.

Table A2: Correlation between choosing German questionnaire and self-assessed German language proficiency

	German language proficiency	
	Correlation	Observations
German language proficiency	1	505
German questionnaire	.6610656	505

German language proficiency is assessed on a 5 point Likert-type scale. The smaller number of observations is due to the missing values for "German language proficiency".