The spatial patterns of student mobility before, during, and after the Bologna process in Germany

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Abstract: The paper contributes to the literature investigating students' spatial mobility. By focusing on German higher education students with a novel dataset providing data from 1999 to 2015, we evaluate the impact of the change from a one-tiered to the two-tiered study structure of bachelor and master degrees (Bologna reform) on their inter-regional mobility and its underlying drivers. Our analysis confirms the system change to slightly alter inter-regional mobility of students. However, differences distinguish between different fields of study and universities und universities of applied sciences and indicate that the German higher education system is fairly resilient in its allocation of students. A Bologna-Drain of students moving from rural to urban regions to study master programs, can partially be confirmed for students of business studies. Our results reject the idea of (low) tuition fees discouraging students from enrolling in specific locations.

Keywords: student mobility, Germany, Bologna, higher education

JEL: I23, I25, R12

Introduction

University regions are the main beneficiaries of human capital inflows, as in-migration to university regions usually exceeds out-migration (Winters 2011). Higher education institutions (HEI) upgrade the skill portfolio of their labor market regions by attracting students at different stages of their education which increases the human capital stock and results in spillover effects (Abel/Deitz 2012). In this sense, the educational period of students represents a window of opportunity for regions to attract and secure (future) human capital (Oggenfuss/Wolter 2019). Despite the importance of a necessary heterogeneity of human capital to foster regional development (Florida et al. 2008; Unger et al. 2011), well-established and renowned HEI are known to be key components of successful regions, with Stanford and MIT being the two classic examples. Yet, the effects of less prominent HEI should not be underestimated in this context (Andrews 2020).

The basis for this mechanism is students' geographical mobility. For a long time, in many countries, students were more or less faced with a one-shot decision about where to study, which in many cases also determined where they would look for their first job and potentially shape this regions' skill portfolio (Moschner 2010). Over time, relatively stable patterns of mobility emerged solidifying the potencies of regional labor markets.

In the early 2000s, the Bologna process (BP) had the potential of a massive disruption to these patterns by introducing (or at least substantially easing) the possibility to re-consider this choice with the establishment of the Bachelor and Master structures replacing the traditional one-tiered five-year programs . The additional choice after the completion of the Bachelor, gives students the opportunity to re-evaluate their current location (Heine 2012). Moreover, it may also feed into their initial decision about where to study after leaving high school by reducing its severeness by alleviating its perceived (five-year) irreversibility.

So far, little research has been conducted on whether this potential shake-up actually materialized and altered students' mobility patterns, which motivates the present investigation. As an empirical example, we study Germany and the Bologna-process-induced change from a one-tiered study structure (OTSS) with Diploma, Magister and State Exam degrees to a two-tiered study structure (TTSS) with Bachelor and Master degrees in the early 2000s. With the exception of some early case studies (Ausprung/Hinz 2011; Heine 2012) and survey-based approaches (Kaiser/Rudel 2018; Kretschmann 2017, Lörz et al. 2015; Neugebauer et al. 2016), this aspect of the Bologna-process has received little scientific attention so far, especially from a macro-perspective (Mollica/Petrella 2017). Therefore, we present the first investigation from a macro-perspective for a transforming higher education system (HES) which incrementally introduced the TTSS.

Employing gravity panel regression techniques, we explore shifts in the spatial patterns of student mobility by utilizing information on the complete inter-regional student flows for three fields of study (Business Studies, Engineering, and Natural Science) in Germany, for the time before (1999-2002), during (2003-2008), and after (2009-2015) the peak of the Bologna-process. We differentiate between types of degrees (Diploma, Bachelor, Master) and types of HEI (universities and universities of applied sciences (UAS)).

Our results suggest that student mobility patterns proved to be relatively resilient with respect to the Bologna process with their basic structures and mechanisms remaining in place. However, we identified some notable shifts. For instance, with the exception of natural sciences students at UAS, we find an increased mobility of Master students in comparison to Bachelor and traditional Diploma students. We also confirm changes in the relative importance of several locational factors. Notably, locational factors generally did appear to not matter much when students choose their Bachelor programs during the transition phase of the reform between 2003 and 2008. In the case of business studies students, the Bologna-process and the (now) easier mobility of these students supported a further enriching of urban labor markets with graduates from Master programs. Interestingly, the same cannot be said for students in engineering and natural sciences, which is likely related to attractive studying and working conditions for related professions in less urbanized regions. Moreover, we observe university and UAS students to converge in terms of their locational choice. Students who (still) seek a Diploma degree are willing to move to places further away from home.

The paper is structured in the following way: In section 2, the theoretical background and related literature are presented. The transformation of the HES in Germany is explained in section 3. Thereafter, section 4 contains the empirical approach of our study. Finally, our findings are presented and discussed, and policy recommendations are given in section 5.

Theoretical Background and related literature

Within-country student mobility is often explained by rational choice theory, models of status-attainment, and life course theory, which translate into two main streams in the empirical literature (Dotti et al. 2013). First, there are studies that are based on the status attainment models like the Wisconsin model of Educational and Occupational Attainment or the Blau-Duncan's model, which focus on determinants such as the parents' education, individual educational attainment, socio-economic status, mental ability, and other influences from peers and family (Haller/Portes 1973). Consequently, many of these studies concentrate on socio-economic and parental background as well as individual motivations on the base of (semi-)structured interviews and surveys.

In the second literature stream the main theoretical base is Rational Choice Theory (RCT), according to which students tend to maximize their individual utility when choosing where to study. The individual utility is lowered by more than monetary costs, also social and psychological costs matter in this context, all of which are held to counteract distance in a migration decision (Sjaastad 1962). Given that students' utility is improved by better quality of living and studying, studies within this stream are particularly interested in evaluating the importance of the quality of universities (e.g., Bratti/Verzillo 2019) and locational factors in students' locational choices. Within this stream, frequently a life cycle perspective is taken, i.e., students' decisions are contextualized by the biographical point of time of their choice (Elder et al. 2003: 12). Over the course of their life, certain aspects gain in importance while others decrease. For instance, while at the beginning of their study programs, students tend to be more focused on the content of their programs and the attractiveness of the university's location, at a later stage, aspects related to the situation in the labor market and career prospects become more important.

Fielding (1992) combines RCT and life course theory relating them to the geographical mobility of students. More precisely, he argues that the strong migration tendencies towards the south-east of England and especially the London region reflect that these locations represent so-called escalator-regions. That is, by moving there from less prosperous regions, students enter a window of opportunity to improve their social situation, as it increases their chances of getting well-paid jobs after graduation.

While there are many reasons for students not to leave their home region, it is argued frequently that most of them correlate with geographical distance. It is therefore (still) the most critical, and deterring, factor for student migration, even when controlling for various dimensions of socio-economic status and when considering a wide range of (dis-)advantages of the origin and destination region (e.g., Dotti et al. 2013 for Italy, Gibbons/Vignoles 2012 for England, Alm/Winters 2009 for Georgia/USA). The mobility-reducing effect of distance still holds when HEI-specific factors like quality and program scope are taken into consideration (Bratti/Verzillo 2019; Sá et al. 2004). In the empirical literature aspects such as socio-economic status and pre-college experiences often overshadow the role of geography (Hillmann 2016: 1011). However, there are many reasons why distance still matters. For instance, emotional costs rise with distance because changing locations involves giving up social ties and increasing transaction costs (Denzler/Wolter 2010 for Switzerland; Dotti et al. 2013 & 2014 for Italy; Winters 2011 for the USA). There is also strong evidence of potential students living further away from a HEI being less likely to participate in a higher education program, despite there are some programs like education, medicine or arts that are able to attract students living far away from a HEI (Denzler/Wolter 2010 for Switzerland; Frenette 2004 & 2006 for Canada; Sá et al. 2004 for the Netherlands, Suhohen 2014 for Finland). Distance is a cost factor and, therefore, an equity problem. Its impact on students' decisions is strongly shaped by the socio-economic background and seems to cause a selection process at the Master level in Germany (Krawietz 2008, Lörz et al. 2015). In any case, "the decision process of prospective students has an obvious spatial dimension" (Sá et al. 2004).

Students moving from one region to another cannot be understood by looking at characteristics of the HEI region alone. As pointed out above, it represents a choice between multiple alternatives. Besides staying in their home regions, independently of the subject of interest, students usually can choose between multiple places to study, which have different benefits and disadvantages. Crucially, these are evaluated in a relative manner, what does a location offer in relation to students' default options, i.e., their home regions? Researchers model this by means of the origin-destination-framework (Wielgoszewska 2018). By comparing their home and potential HEI destination regions, studies identify push and pull factors. The former represent factors that support moving away from their home regions to any other location that is relatively more attractive in this dimension. Pull factors, on the other hand, attract students to specific locations that are superior in this dimension compared to their home regions. For instance, low unemployment rates in the HEI destination location have been identified as a pull factor and high unemployment rates in the location of origin act as a push factor (Cooke/Boyle 2011; Dotti et al. 2013; Lourenço/Sá 2019). Rents (Dotti et al. 2013) and future incomes play similar roles provided they differ between the HEI and the home region (Sá et al. 2004). The overall state of the local economy can also be a push or a pull factor for students depending on the economic situation on-site (Tosi et al. 2019). Interestingly, while they seem rather straightforward, these empirical results are not unambiguous across HES and country (Psycharis et al. 2019). Apparently, other conditions and the overall institutional set-up matter. For instance, in some countries, tuition and the costs of visiting a HEI may be significant in the choice process (Alm/Winters 2009; Dotti et al. 2013; Dwenger et al. 2012; Sá et al. 2004; Wakeling/Jeffries 2013). While tuition fees in Germany are generally relatively low, they may still impact students' locational choice and in particular for those from lower-income families (Kretschmann et al. 2017; Lörz et al. 2015; Neugebauer et al. 2016; Spiess/Wrohlich 2010).

As we will describe in the subsequent section, the BP (in Germany) has altered the possibilities of students to choose their study location. More precisely, it has introduced an opportunity to re-evaluate the initial choice at a later stage of their education. Traditionally, it was rather difficult to switch study locations during the traditional five-year Diplom, Magister and State Exam programs. The BP divided this into the three-year Bachelor and two-year Master program with an easy possibility to switch locations in between. Yet, the additional opportunity to (re-)consider their place of study, is only one aspect of the BP. Notably, in the last years, the role of HEIs has changed (Perna 2006). Today, the HEIs cater to their costumers (students) and actively engage in marketing as well as branding (Han 2014; Vrontis et al. 2007). Therefore, students get more information on the one hand, which will enhance their decision. At the same time, the decision about where to study also becomes more complex and potentially distorted by selective information or information overload. Consequently, a "rational" choice, as theories from economic, sociological, and psychological perspectives would suggest, is (despite the better access to more information) as unlikely as ever (DesJardins/Toutkoushian 2005: 216). Nevertheless, at least the re-evaluation of their study location can be expected to have become more rational because of higher levels of accumulated knowledge about study programs after having obtained a Bachelor's degree (de Boer et al 2010; Holdsworth 2009).

In light of the above discussion, we expect that these changes in the overall system of study choice and admission have translated into different spatial mobility patterns of students. The life-course approach suggests that decisions at an early stage of an academic career, e.g., after high school, will be strongly impacted by the social and cultural attractiveness of locations. Moreover, relations to (high school) friends and family are of higher importance (Perna 2006). In contrast, at a later stage, students tend to be more concerned about the job market and their professional career. Consequently, this will play a bigger role when deciding about where to study their Master.

This is summarized in our two hypotheses:

H1: The choice of study location is stronger shaped by the economic attractiveness of the HEI destination region for students transitioning from Bachelor to Master than when high school students choose where to study for their Bachelor.

H2: The decision of where to study is stronger shaped by HEIs' proximity to students' home regions for students transitioning from high school to Bachelor than for those advancing from Bachelor to Master.

Crucially, the BP may have substantial consequences for regional job markets and general spatial inequality. A greater mobility of students towards already prosperous agglomerations will potentially fuel a brain-drain from regions without or with small HEI (Author et al. 2018) and add, in form of a more potent labor pool, to the advantages of agglomerations and economically flourishing regions (e.g., Dotti et al. 2013). Especially, this could be the case for specific fields of study like Economics in which case graduates tend to be more mobile and move to agglomerations (Venhorst et al. 2010).

The transformation of the German HES

Starting in 1999, the BP has massively reformed the HES in Germany. The traditional one-tiered-system with a 4 to 6-year degree structure, comprising the degrees of Diploma, Magister, and State Examination, was transformed into TTSS with a 3-4-year Bachelor and a 1-2-year Master's degree. Today, just 6.5 % of all degree programs have not been transformed to this system. Consequently, the transformation of the HES towards the new system can be considered as completed[i] (HRK 2018).

As pointed out above, the reorganization of the HES implies today's students having a much greater mobility potential than in the previous system. Their locational decision process that originally included more or less one decision (from upper-secondary school to higher education) has been extended by an additional opportunity to alter their locational choice (transition between Bachelor and Master).

In Germany, 53% of the Bachelor students at UAS, and 77% of the Bachelor students at universities continue a Master program (Rehn et al. 2011). These numbers are high compared to other European countries (de Boer et al. 2010). Furthermore, many students also reconsider their locational choice at this stage (Heine 2012; Lörz et al. 2015).

The attractiveness to move has grown during the transition phase. In particular, the number of potential study locations has substantially increased in Germany (HRK 2019), which was especially driven by the convergence of universities and UAS. In contrast to pre-BP times, today, the two institutions share the same study system (Bachelor-Master-degrees) and have become very similar in terms of pushing research, as well as attracting students. The UAS have therefore become serious alternatives to the classic universities and consequently have enlarged the opportunity set for students.[ii] Nevertheless, about two-thirds of the HEI students are still enrolled in universities and only one third at UAS (Turner 2019). The still existing difference between the two also shows in the structure of students. Students at UAS tend to be older, they have more frequently a vocational training background, and have less educated parents (Neugebauer et al. 2016). This translates into different mobility patters as well, as students from higher-income families tend to be geographically more mobile (Spiess/Wrohlich 2010). Another crucial development in this context is the ever-increasing student numbers that surged from around 1.8 in 1999 to around 2.9 million students in 2020 (BMBF 2020). Other countries facing similar changes of their HES witness growing numbers of students who would not have pursued an academic career before the BP (Capellari/Lucifora 2009 for Italy). For this reason, as the growth exceeds the expansion of HEI's capacities, increasing student numbers could lead to growing competition for study places and a potential reorganization of mobility patterns.

In sum, the HEI system changed dramatically towards increased incentives and lower obstacles to change locations during the period of study. Most crucially, it added an opportunity to re-consider students' initial locational choice, which, in light of the life-course perspective, can be expected to be seized by many to improve their chances for an easy transition to their post-educational professional careers. The question of whether this has altered mobility patterns on a larger scale will be explored on the basis of the three hypotheses in the remainder of the paper.

Empirical method - A zero-inflated model approach

As pointed out above, we aim to explain the intensity of inter-regional student mobility in Germany with regional characteristics of students' home and destination locations. Similar to Dotti et al. (2013), we consider all locations in the country at the level of districts. However, we have to account for the fact that while each student has only one home location within a district, there might be multiple HEI in a district. The latter prevents just looking at district-to-district mobility. We therefore consider all potential home districts in combination with all potential HEI within districts. Put differently, we model to what extent HEIs attract students from all districts in Germany and how this has changed from the time before, to the time during, and to the time after the implementation of the BP.

Our units of observation are pairs of HEIs (destinations) and districts (origins) for which we observe a flow (number of students) intensity. As is common in these types of settings, we apply a modified gravity regression approach with the number of students moving from district A to HEI 1 at time t as a dependent variable (Dotti et al. 2013). Most HEI receive students from a limited set of locations implying that the distribution of the dependent variable is dominated by zero values and few cases having relatively large numbers. To address the excess of zeros, we use a zero-inflated Poisson model (ZIP). We refrain from using a negative binomial regression because the high amounts of zeros are accompanied by many low and few high values (f).[iii]

A zero-inflated model consists of two parts: the binary part, which models the existence of zero counts (no student mobility), and the count part, which represents the intensity of mobility conditional on the existence of a positive count in the first place (positive numbers of students moving). The model provides a distinct set of coefficients for each of these parts. However, we restrict the presentation and discussion to the count part of the zero-inflated regression models, which we see as being more meaningful than the zero-part. The latter models the existence of a positive flow between locations, which might be minor in many instances. The results of these models can be obtained upon request from the authors.

To account for potential differences between fields of study, types of HEI, and periods, separate models are run for each of these situations.

Data

Our data is collected from several sources. The basis is microdata of the Research Data Centres of the Statistical Offices of the Federal States. Every student and his or her characteristics such as age, origin, previous field of study are recorded for the years from 1995 to 2015 in a cross-sectional database with no linkage to the educational biography of the students (RDC 2019). The data files are available for every summer and every winter term. However, just winter term files register all students. The data covers 814 HEIs and differentiates between 402 districts of origin (German NUTS-3 regions after recoding local government reforms (DESTATIS 2019)). Due to changes in the delineation of districts in the 1990s in Germany, many regional statistics are difficult to compare over time. However, since 1999, the delineation is relatively stable or allows for aggregating consistently. We, therefore, restrict our time of observation to 1999 and the most recent years for which data is available (2015).

We geolocated all 814 HEI locations using Google Maps (Google 2018) and created 327.228 pairs of HEI – district with their according numbers of students moving from their origin (district of university entrance Diploma) to their destinations (HEI location). Due to confidentiality, counts have to be aggregated to a minimum of 3 students per combination. Consequently, personal information, like gender, age, and previous study programs or academic degrees remain unavailable. However, we obtained the exact numbers of students per year for each HEI-district pair. Similar to Winters (2011), we concentrate on domestic migration in Germany and neglect all international mobility, as that may have very different mobility patterns and motives.

In contrast to most of the literature but in line with Ciriaci (2014) and Dotti et al. (2013), we differentiate between fields of studies as these are known to show distinct geographical mobility patterns. More precisely, we consider three distinct fields of study: engineering, natural sciences, and business studies. Students of business studies are known to be the most mobile group, with more than half of them having changed their HEI in Germany during their period under study (Heine 2012). In contrast to this finding, natural science and engineering students are known to be the least mobile group in Germany (Haussen/Uebelmesser 2018; Heine 2012). Hence, we collected the numbers for these three different fields of study and evaluated their mobility patterns in separate models to control how consistent mobility effects are across different fields of study before, during, and after the implementation of the Bologna reform.

To isolate the effect of the HES transition, all models are estimated for three periods (prior 2002, 2003-2008, and the years after 2009) with the first period representing the time in which the traditional system dominated (primarily Diploma-based study programs). The second period encompasses the time in which most study programs were re-organized to the Bachelor-Master system. The third period shows the period after most of the transitions were completed, and mostly Bachelor and Master programs were offered.

Through running separate models, we consider differences between universities and UAS as well as the three types of degrees (Diploma, Bachelor, Master). Each combination of fields of study, period, type of HEI, and types of degrees represents an individual scenario for which a regression model is estimated. Our variables and descriptions can be found in table 1.

Variable	**Description**
log(distance)	Logged distance from the centroid of the home district to HEI
Within state	dummy for mobility within the state (0 = no, 1 = yes)
West-East	Dummy for mobility from west to East Germany (0 = no, 1 = yes)
East-West	Dummy for mobility from east to West Germany (0 = no, 1 = yes)
Orig:agglomeration	Dummy for an origin in agglomeration (0 = no, 1 = yes)
Dest:agglomeration	Dummy for agglomeration as a destination (0 = no, 1 = yes)
Orig:rural	Dummy for the rural region as the origin (0 = no, 1 = yes)
Dest:rural	Dummy for the rural region as a destination (0 = no, 1 = yes)
HEI type	Dummy for HE type university and UAS (0 = no, 1 = yes)
log(Dest:studs field of study)	Logged Number of students in the field of study at the HEI
log(Dest:studs)	Logged total number of students at the HEI
log(Dest:pop)	Logged total population at HEI district
log(Dest:pop density)	Logged population density at HEI district
log(diff pop density)	Logged difference between population density at home and HEI district

log(Orig:pop)	Logged total population at home district
log(Orig:pop density)	Logged population density at home district
log(Orig:GDP)	Logged gross domestic product at home district
log(Dest:GDP)	Logged gross domestic product at HEI district
Dest:tuition fee	Dummy for tuition fee at HEI district (0 = no, 1 = yes)
Orig:tuition fee	Dummy for tuition fee at home district (0 = no, 1 = yes)

Tab.1: Variables and descriptions; source: own compilation

As we also include some models for situations with and without tuition fees, we estimate 54 ZIP-models in total (see Appendix: Tab. 2-7). Summary statistics for the different years of observations are available upon request.

The information on student flows was combined with secondary regional data obtained from the INKAR database (INKAR 2018). This database contains information about secondary statistics on different scales like municipalities, districts and regions, and for several topics like economic, demographic, and social indicators. Using this data and mirroring the factors discussed in the previous section, the following explanatory variables were created. If not relational in nature, i.e., the variable characterizing the relationship between the district of origin and destination HEI, all variables are created in two versions. The first approximates the conditions in the students' district of origin (Orig:) and the second that in the district of the HEI (Dest:). Consequently, we assigned all HEI to their corresponding districts.

The first is (air-line) distance from the district of origin to the HEI. It is one of the focal variables in the models (log(distance)), which relates to hypothesis 2. We thereby improve upon many existing studies that do not rely on exact distances (Spiess/Wrohlich 2010; Lourenço/Sá 2019). Alternative measures found in the literature are distances to other metropolises (Winters 2011) or rail-network-distances (Gibbons/Vignoles 2012). However, in line with Lourenço/Sá (2019), we expect strong correlations between the different measurements and, therefore, choose air-line distance for our models.

We also consider if students' district of origin and their HEI are located within the same federal state (Within state) to capture potential institutional boundaries as well as considering an alternative measure of geographic distance and control for cultural similarities (Alm/Winters 2009; Buenstorf et al. 2016). We also differentiate if a relation implies moving from (or to) locations in the former German Democratic Republic (GDR) (West-East & East-West). Moreover, a differentiation is done between mobility to and from agglomerations (Orig/Dest: agglomeration) and rural areas (Orig/Dest: rural) (Venhorst et al. 2010). We use the definition of agglomerations by the BBSR (2009), which relies on population density and inhabitants and is widely used in studies about Germany (Buenstorf et al. 2016). Accordingly, agglomerations are defined as regional metropolises with more than 300,000 inhabitants or a population density of 300 inhabitants per square kilometer (BBSR 2009). Rural regions are differentiated from the regional metropolis that has more than 100,000 inhabitants or 100 inhabitants per square kilometer (BBSR 2009). Lastly, there are urbanized regions that do not qualify as any of these two and are not included. These dummy variables are complemented by the total population (Orig/Dest: pop) and the population density of the region of origin and destination (Orig/Dest: pop density). Student migration is often affected by these variables, and we, therefore, control for both (e.g., Faggian et al. 2007). To further capture mobility between rural and urban origin, we also add the relational variable difference in population density (Diff pop density).

University rankings for Germany are not used in our analysis for several reasons. First, rankings are not available for every field of study and every university (Zeit Campus 2020). Second, the data sources for rankings are mainly based on the responses of students and are not fully representative (Zeit Campus 2020). Third, rankings do not play a major role in the decision process of students in Germany (Weisser 2020:112). A better indicator is to account for more saturated student programs and HEI that are potentially more attractive (e.g., Ciriaci 2014). Therefore, we consider the number of students in the same field of study at the HEI (Orig/Dest: studs field of study) and the total numbers of students at the HEI (Orig/Dest: studs) as controlling variables because the size of HEI still matters with regard to research performance and reputation.

Further indicators are the gross domestic product (GDP) (Orig/Dest: GI) at the home and destination district. GDP reflects potential differences in terms of economic prosperity that are also closely related to employability (Dotti et al. 2013; Sá et al. 2004). Last but not least, we consider tuition fees at the HEI and HEIs of students' districts of origin (Orig/Dest: tuition fee). Some federal states have implemented these in the years after 2008/2009. Tuition fees are implemented state-wide, and hence, they are implemented into the model utilizing state dummies for students' states of origin and for that of the potential HEI. Notably, tuition fees are relatively low (~1,000 € per year) and were introduced and abandoned at different times during the observational period implying that they are not time invariant. This circumstance is considered in our model for the period after 2009. The abbreviations of the variables and descriptions can be found in table 1 in the Appendix.

Results on spatial factors impacting students' mobility

Before we will discuss our core findings concerning the relevance of economic attractiveness (hypothesis 1) and distance to home (hypothesis 2) in the next section, it is worthwhile to explore some general developments and insights from our regression models. Figure 1 gives an overview of the development of student numbers from 1995 to 2015. It visualizes the rapid increase in Bachelor's students since 2000, especially in the field of engineering sciences. Student numbers in natural sciences instead seem to have stabilized since 2011, whereas business studies still show a steady growth in student numbers. Diploma student numbers remained stable until 2005. Notably, the transition seems to have been quicker in the natural sciences and in business studies. Schuster et al. (2013) relate the late transition of engineering programs to the strong image assigned to the "Dipl.-Ing." degree. In addition, significant numbers of Master students are observable from 2010 because total numbers from the pairs of the district to HEI were too small for the previous years. Therefore, we start our statistical models from 2010 onwards.

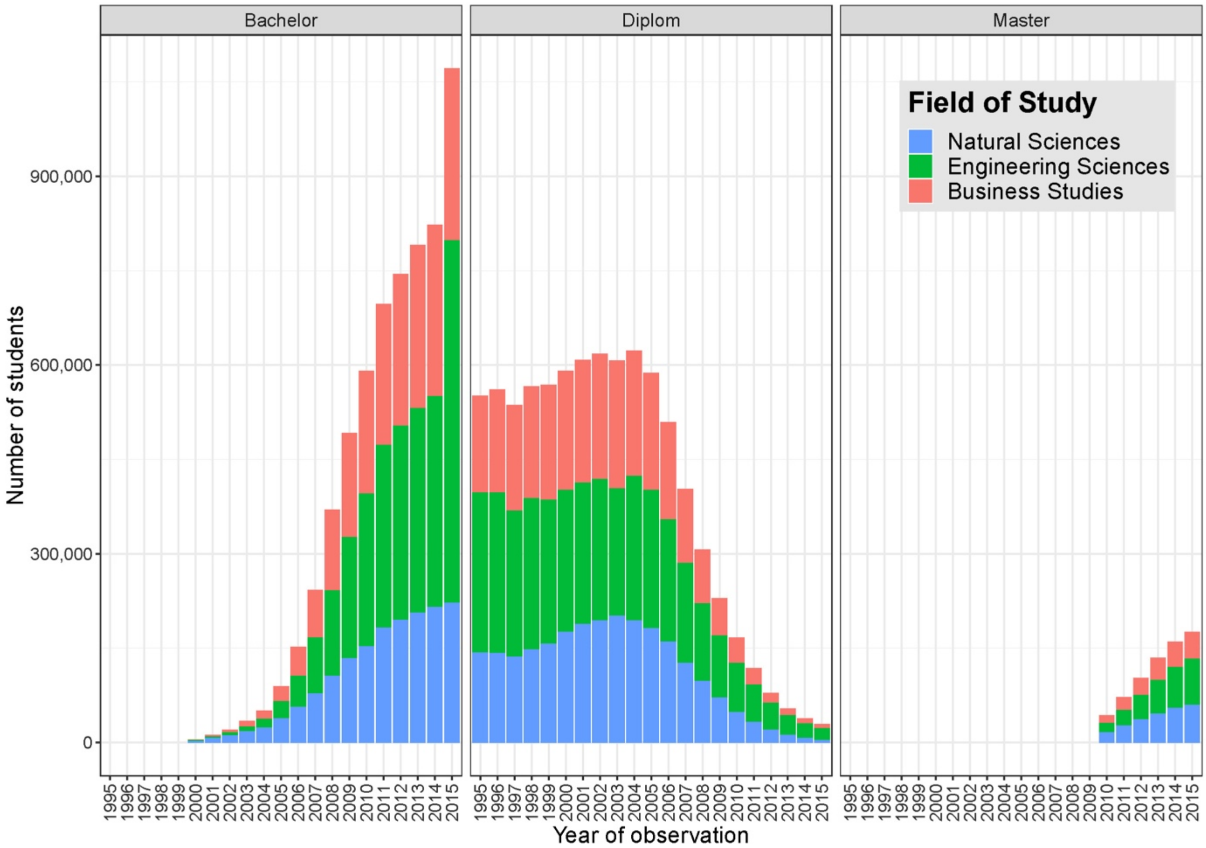

Figure 1: Student numbers in different fields of study and degree types 1995-2015; source: own compilation by RDC (2019)

Figure 2 shows the three strongest student flows from every origin to destination district. Not surprisingly, the largest German cities are also the most important destination regions, e.g., Munich, Berlin, and Hamburg. In addition, so-called “student cities” exert strong pull forces to their surrounding area and attract substantial student inflows, e.g., Tübingen, Bayreuth, Göttingen, Jena and Münster. Noticeably, there is a strong heterogeneity in the average distances of the top-3 student flows among locations reflecting, e.g., the specifies of locations (being remote vs. part of metropolitan areas) and differences in HEI’s specializations with respect to fields of study.

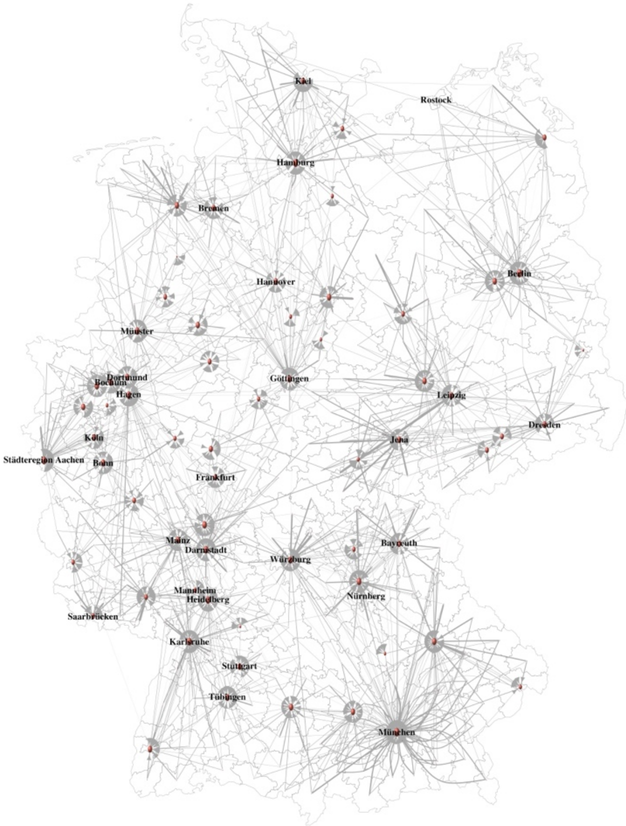

Figure 2: Top-3-flows from origin to destination region for every district; source: own compilation by RDC (2019)

Tables 2-7 show the results for the three different fields of study and different HEI types. The GDP of origin regions (Orig:GDP) is more complex and interrelated with student mobility as expected. For business studies students at universities, who come from economically more successful regions, there is a tendency toward higher mobility. However, this trend becomes weaker after the implementation of the BP (Tab.2). For every other field of study and UAS, one can see that the weaker the economic performance of the origin region the more mobile the students get, especially after the BP (Tab. 3-7). There are only some exceptions for Diploma students of business studies at UAS and Bachelor students of natural sciences at UAS and university in the phase of transition (Tab. 3-5), but effect sizes related to Orig:GDP are small.

Another interesting finding is the connection of east-west and west-east mobility for the different fields of study and HEI type. Except for engineering students at UAS, all Bachelor students are highly attracted to move from West to East, especially during the phase of transition. This could be explained by the different speed of spread of Bachelor programs across Germany, the available student places, lower costs of living, and the better student-to-teacher-ratio in East Germany (Lewin/Pasternack 2007). However, there is no general tendency for an East-West migration of students across the different fields of study and HEI type. In this, the finding differs from the Italian case (Dotti et al. 2013; 2014) and future research needs to explore the reasons behind it.

Differences in population density and total numbers in population do not seem to matter significantly across the different fields of study and HEI types. This circumstance does not differ from the mobility behavior of Diploma students before Bologna. Students of different fields of study and different HEI types vary considerably between degree types and across time. In comparison to other countries, tuition fees are found to play a complex role in Germany. Our empirical results suggest that they have a much lower impact on the decisions of students where to move for their study programs. In fact, in the case of Bachelor and Master students in the field of business studies, higher tuition fees even seem to attract students (Tab. 2-3)! Similar results are yielded for Bachelor students of natural sciences at UAS (Tab. 5). This contradicts our expectations and the results of Dwenger et al. (2012) and Alecke/Mitze (2012). While it is beyond the scope of the present paper to analyze this in greater depth, we believe that this effect is caused by the relatively (to other countries) lower magnitude of the fees and the potential signaling effect of tuition fees, as indications of better learning environments. Clearly, more research is needed on this issue to understand the relevant mechanisms of action.

Results on mobility and effects of BP

We hypothesized that students in general and master students in particular are increasingly attracted by good economic situations in HEI regions. This is not confirmed in all our models implying that students are not generally attracted by economically well-off districts. Only Diploma students of business studies at UAS after 2009 (Tab. 3), Diploma students of natural sciences at universities and engineering at UAS and Bachelor students of engineering in the phase of transition (Tab.4, 6), are attracted by high GDP in the destination region. However, Master students seem to be less repelled by higher GDP and accompanied higher costs of living in destination regions than Bachelor students after 2009 except for students of natural sciences at universities. This finding is in line with previous studies for the transition from Bachelor to Master in Germany (Lörz et al. 2015): The more advanced the study progress, the higher the costs for students in general. Consequently, students in Master programs do not tend to study in regions with higher GDPs because living expenses are higher in these regions. If we consider students' orientation towards agglomerations and their associated thicker labor markets, one can see that only Master students of business studies at universities are attracted by agglomerations in general. This finding shows the discrepancies between fields of study and HEI types as well as the changing mobility patterns due to the BP. More precise, we observe a positive trend related to the number of students in the field of study (*Dest:studs field of study*) at students' destinations for all fields of study and HEI types. Nevertheless, the size of HEI (*Dest:studs*) only matters for Master students of business studies and Bachelor and Master students of engineering at universities. We suspect that the attraction of size is due to its correlation with reputation and research resources, which appear to be more highly valued by students of business studies and engineering. Moreover, large universities are often located in agglomerations and thereby provide easier access to prolific labor regions, which appears to be more essential to Master students of business studies. Furthermore, students at UAS are highly attracted by rural UAS, especially for Master programs. This finding could be connected to the results by Busch/Weigert (2010) who verified a strong connection of UAS to local labor markets, which could be especially attractive for students who aim at a Masters' program and who also have designs on connecting with local employers.

Nevertheless, we must reject hypothesis **H1**, as the economic attractiveness of HEI destinations is not more important for Master students in all cases studied.

In contrast to hypothesis **H1**, our results confirm hypothesis **H2**. In general, students are less influenced by *distance* when deciding about where to take up their studies today compared to the past. This is particularly true for students of Bachelor and Master programs and less so for students of Diploma programs. This tendency is consistent across the transition and the phase after implementation. Accordingly, it seems to be the case that the increasing fragmentation of study programs spurs the spatial mobility of students, which strengthens the idea of a "Bologna-Drain" (Author et al. 2018). This is visible by the weaker effect of the variable *Within state* for Bachelor students in the phase of transition in contrast to the phase after the implementation of the BP (Tab. 2-7). However, an approximation of the within-state mobility (*Within state*) to the prior BP time is only apparent for Bachelor programs after 2009 and not for Master programs in general. Our findings clearly support our hypothesis. In particular, we find Master students to be more mobile, i.e., less constrained by distance, than students at the Bachelor level. This is also in line with Heine (2012) and support the idea of the decision where to start a Master's program being made more consciously and independently of social factors (de Boer et al. 2010). Across all fields of study, HEI, and types of degrees, *distance* is always having a deterring effect on student mobility (significantly negative coefficient). The same holds for study locations within the same federal state of students' regions of origin (*Within state*). Here, we also find a positive coefficient in the models for Bachelor and Diploma students. Notably, the effect sizes differ substantially. Distance effects are strongest for all Bachelor students at both HEI types after the system transition in 2009. Whereas between 2003-2008, the effects differ between fields of study and HEI type: Diploma students here are more negatively impacted in their mobility than are Bachelor students. The distance effect is most substantial for Bachelor students in the field of engineering of UAS in the period after 2009 (Tab. 7). It is rather weak for Diploma students of natural science at UAS (Tab. 5).

There are a number of potential explanations for these findings: First, new and heterogeneous Bachelor programs may have attracted many students and therefore acted as pull factors for HEI entrants during the transition phase. This circumstance diminished the role of distance. Subsequently to this phase, the "novelty" effect leveled off and mobility patterns adjusted to the initial ones during the "Diploma" era before 2002. This interpretation is supported by the significantly negative coefficients of Within state. Interestingly, we observe Diploma students to be more likely to leave their home states to study after the implementation of the BP than prior to this process. Most likely, this is due to the excellent reputation of the Diploma degrees (Schuster et al. 2013), which attracted them (independently of the distance) to places that (still) offered them. The finding can be seen as an indication that (some) students value certain types of degrees more than the attractiveness of regions. All in all, we do not find Bachelor students to reveal a preference to study in their home region that goes beyond that of Diploma students. In other words, the BP did not stimulate Bachelor student mobility across larger distances. This contrasts the effect of the BP on Master students which is in line with our hypothesis **H2**, the reform made geographic mobility easier and more attractive. In the case of business Studies students, this increased mobility leads to movements into more attractive labor markets, e.g., regions with higher GDP.

Discussion

In this paper, we studied the spatial mobility of students and identified push and pull factors using data for students in Germany. We analyzed to what extent the HES transition due to the BP altered students' spatial mobility. In general, we do not find the expected shake-up of existing student mobility patterns due to this transition. The nearest indication of such is observed for business studies students: Bachelor and Master students here show different behaviors than their counterparts studying Diploma programs before the transition. For this field of study, we partly confirm earlier findings based on questionnaires (Krawietz 2008; Heine 2012) with a nation-wide secondary-data-based analysis and implications from studies on graduate migration in the Netherlands (Venhorst et al. 2010). However, we do not observe massive changes in student mobility for two other fields of study (engineering and natural sciences).

There are three potential explanations for this paradox. First, the spatial allocation mechanisms might be mostly independent of the institutional set-up of study programs and the number of locational choices students have to make. Second, the “new” HES (still) stands in the shadow of the traditional one, which is rather resilient. In this case, it takes much more time before the students’ increased opportunities to be (spatially) mobile materializes into new geographical mobility patterns. Third, the transition primarily translated into qualitative changes. However, these aspects are not investigated in the current empirical study due to a lack of information on individual student and HEI characteristics. Only future research with individual-level data will resolve this issue.

Our study identifies several additional issues worth emphasizing. The study confirms the existence of substantial differences in students’ mobility patterns with respect to their fields of study. For instance, the preference for agglomerations became much stronger for students of business studies than for students in other fields. Business study students and students of natural sciences are also more attracted to locations in the East of Germany than for students of engineering. Similarly, we identify significant variance in the mobility patterns of students at universities and those at UAS. For instance, university students are more likely to stay in their home region than students at UAS who prefer studying in proximity to prolific labor markets. Most likely, UAS are more specialized and more connected to local labor markets than are universities (Jaeger/Kopper 2014). Accordingly, if students are less likely to find a fitting study program in their home region, they need to be spatially more mobile.

Our study has some significant shortcomings that need to be pointed out. First, while we can exploit a unique data source, it does have some limitations. Most notably, student flows of less than three students (given specific characteristics) are not observed due to confidentiality reasons. Second, our data does not include information on individual characteristics such as age, gender, parental background and household incomes, which are known to play a major role in student mobility (Sá et al. 2004). Third, our data is not a true panel so we cannot differentiate students making multiple moves and those that move just once. Naturally, their mobility patters might be very different.

Conclusions and implications

Our study investigates student mobility over a considerable period and identifies a number of (spatial) factors that shape these patterns. Noticeably, our results highlight the heterogeneity between study subjects that seems to be of much bigger relevance than the re-configuration of the system in the course of the Bologna-Transformation. Nevertheless, there is still a significant need for research on the long-term development of student mobility flows. As pointed out above, the relevance of individual characteristics is crucial in this context (Hossler/Gallagher 1987; Litten 1982; Perna 2006). However, we have yet to learn about what role these play in times of system transitions. For instance, students with limited economic resources might react differently to the transition than those that are economically better off (Lörz et al. 2015). In addition, there is still a high demand for research on student mobility on a small scale that explores in more detail intra-state and intra-regional mobility (Alm/Winters 2009). Such studies may also consider HEIs’ heterogeneity in terms of research and teaching quality to a larger degree than what our data allowed us to do. For example, such studies may be able to analyze the roles of rankings or word-of-mouth in students’ decisions (Bratti/Verzillo 2019; Ciriaci 2014).

In addition to more research, there are several further implications that can be drawn from our study. Most importantly, distance (still) matters. That is, local embeddedness, information asymmetries, and preferences for staying at home are strong factors potentially preventing an optimal allocation (match between the place of study and personal characteristics) of students. Further increasing the availability of information on study programs and locations will potentially reduce geography's relevance. Of similar importance is the finding that urban regions and economic agglomerations are more attractive to particular sets of students. While we observed only students of business studies to be particularly attracted to economically more prosperous regions, we have little doubt that similar results would be yielded for other groups of students. Consequently, by increasing the opportunities for spatial mobility, the Bologna reform has further added to the already large advantages of these areas and thereby fueled spatial inequality. To what extent this effect can be countered and potentially be compensated is yet to be explored.

Moreover, our study shows that (minor) tuition fees do not seem to impact location choices much. The same holds for financial aid for students moving to less preferable HEIs (Lourenço/Sá 2019). Accordingly, their current set-up is inappropriate to predict student flows at a larger scale. In light of the previous point, our study suggests that this policy tool might not be the first choice to address the spatial inequality of student concentrations in economically well-off regions.

Lastly, by making data on student mobility more easily accessible, political entities will not only help researchers on the matter, but it may also help HEI in sharpening their marketing efforts. Faggian/Franklin (2014) describe that the ability of policymakers, HEIs and their related regions to attract students is as important as attracting graduates. Therefore, data availability could help to create appropriate actions which not just relate to the own data in the HEIs, but in times of increasing competition could help to identify successful and less successful strategies and evaluate them over time. Again, it might also help in addressing the concentration of students in prosperous regions, as it will allow HEI in less well-off regions to more precisely target students for which they offer the best student conditions and programs. In this context, it may also help students to make more informed choices and deviate from potential herd-behavior that most likely benefits well-known HEI in prominent regions.

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[i] Of 19,559 degree-programs there are 8,832 Bachelor and 9,113 Master degree programs in the fall term 2018/2019 (HRK 2018). The numbers of State Examination degree programs, which mainly consist of legal studies and teaching degree programs, are stable since 2015 with ~1250 (HRK 2019).

[ii] The primary difference between universities and UAS is that UAS are not allowed to grant Ph. D. degrees, and, therefore, basic research is still being dominated by traditional universities.

[iii] The Vuong test has a significant z-test, and, therefore, the zero-inflated-Poisson model is preferred to the standard Poisson model.

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Appendix

Statistical models									
	Prior 2002 Dipl	**2003 to 2008 Dipl**	**After 2009 Dipl**	**After 2009 Dipl(+sf)**	**2003 to 2008 BA**	**After 2009 BA**	**After 2009 BA(+sf)**	**After 2009 MA**	**After 2009 MA (+sf)**
Intercept	-3.76 (0.08)***	-3.36 (0.05)***	-2.45 (0.15)***	-2.67 (0.16)***	-1.01 (0.12)***	1.63 (0.06)***	1.59 (0.06)***	0.67 (0.14)***	0.60 (0.14)***
log(distance)	-0.75 (0.00)***	-0.71 (0.00)***	-0.56 (0.00)***	-0.56 (0.00)***	-0.56 (0.00)***	-0.62 (0.00)***	-0.62 (0.00)***	-0.48 (0.00)***	-0.48 (0.00)***
Within state	0.51 (0.01)***	0.51 (0.00)***	0.24 (0.01)***	0.25 (0.01)***	0.28 (0.01)***	0.45 (0.00)***	0.46 (0.00)***	0.24 (0.01)***	0.23 (0.01)***
West-East	-0.07 (0.02)**	-0.07 (0.01)***	-0.08 (0.04)*	-0.06 (0.04)	0.06 (0.03)*	0.24 (0.01)***	0.30 (0.01)***	-0.09 (0.03)***	-0.05 (0.03)
East-West	-0.28 (0.03)***	-0.31 (0.01)***	-0.05 (0.02)	-0.05 (0.03)*	-0.46 (0.04)***	-0.31 (0.01)***	-0.38 (0.01)***	-0.34 (0.03)***	-0.42 (0.03)***
Orig:agglomeration	0.09 (0.01)***	0.06 (0.00)***	-0.04 (0.01)***	-0.04 (0.01)***	-0.08 (0.01)***	-0.09 (0.00)***	-0.09 (0.00)***	-0.18 (0.01)***	-0.17 (0.01)***
Dest:agglomeration	-0.22 (0.01)***	-0.21 (0.00)***	-0.20 (0.01)***	-0.18 (0.01)***	-0.12 (0.01)***	-0.09 (0.00)***	-0.10 (0.00)***	0.06 (0.01)***	0.05 (0.01)***
Orig:rural	0.19 (0.01)***	0.16 (0.00)***	0.12 (0.01)***	0.12 (0.01)***	-0.01 (0.01)	0.05 (0.00)***	0.05 (0.00)***	0.14 (0.01)***	0.13 (0.01)***
Dest:rural	-0.02 (0.01)*	-0.03 (0.01)***	0.08 (0.02)***	0.07 (0.02)***	0.15 (0.01)***	-0.09 (0.01)***	-0.10 (0.01)***	-0.10 (0.01)***	-0.10 (0.01)***
log(Orig:studs field of study)	0.25 (0.01)***	0.35 (0.01)***	0.44 (0.01)***	0.44 (0.01)***	0.40 (0.01)***	0.48 (0.01)***	0.48 (0.01)***	0.28 (0.01)***	0.27 (0.01)***
log(Dest:studs field of study)	0.62 (0.01)***	0.58 (0.00)***	0.55 (0.01)***	0.56 (0.01)***	0.47 (0.01)***	0.46 (0.00)***	0.46 (0.00)***	0.46 (0.01)***	0.47 (0.01)***

log(Orig:studs)	-0.05 (0.01)***	-0.11 (0.01)***	-0.12 (0.01)***	-0.13 (0.01)***	-0.22 (0.01)***	-0.05 (0.01)***	-0.05 (0.01)***	-0.05 (0.01)***	-0.04 (0.01)**
log(Dest:studs)	-0.08 (0.01)***	-0.04 (0.00)***	-0.24 (0.01)***	-0.25 (0.01)***	-0.01 (0.01)	-0.01 (0.00)	-0.01 (0.00)	0.04 (0.01)***	0.03 (0.01)***
log(Orig:pop)	0.33 (0.01)***	0.35 (0.00)***	0.29 (0.01)***	0.29 (0.01)***	0.32 (0.01)***	0.17 (0.00)***	0.17 (0.00)***	0.32 (0.01)***	0.32 (0.01)***
log(Dest:pop)	-0.04 (0.00)***	-0.07 (0.00)***	0.08 (0.01)***	0.07 (0.01)***	-0.07 (0.01)***	-0.12 (0.00)***	-0.13 (0.00)***	-0.15 (0.01)***	-0.15 (0.01)***
log(Diff pop density)	0.06 (0.00)***	0.06 (0.00)***	0.06 (0.00)***	0.06 (0.00)***	-0.00 (0.00)	0.05 (0.00)***	0.05 (0.00)***	-0.02 (0.00)***	-0.02 (0.00)***
log(Orig:GDP)	0.38 (0.02)***	0.19 (0.01)***	0.12 (0.03)***	0.15 (0.03)***	0.23 (0.02)***	0.14 (0.01)***	0.14 (0.01)***	0.05 (0.02)*	0.05 (0.02)*
log(Dest:GDP)	-0.13 (0.02)***	-0.07 (0.01)***	-0.11 (0.03)**	-0.04 (0.03)	-0.22 (0.02)***	-0.75 (0.01)***	-0.71 (0.01)***	-0.66 (0.03)***	-0.63 (0.03)***
year_dummy_2001	-0.01 (0.00)**								
year_dummy_2003		-0.02 (0.00)***			-0.16 (0.03)***				
year_dummy_2004		-0.02 (0.00)***			-0.21 (0.03)***				
year_dummy_2005		-0.01 (0.00)*			-0.30 (0.03)***				
year_dummy_2006		0.02 (0.01)***			-0.50 (0.03)***				
year_dummy_2007		0.05 (0.01)***			-0.69 (0.03)***				

year_dummy_2008		0.13 (0.01)***			-0.78 (0.03)***				
year_dummy_2010			0.21 (0.01)***	0.21 (0.01)***		-0.03 (0.01)***	-0.03 (0.01)***		
year_dummy_2011			0.30 (0.01)***	0.30 (0.01)***		-0.04 (0.01)***	-0.04 (0.01)***	-0.12 (0.02)***	-0.12 (0.02)***
year_dummy_2012			0.70 (0.01)***	0.68 (0.02)***		-0.05 (0.01)***	-0.06 (0.01)***	-0.17 (0.02)***	-0.19 (0.02)***
year_dummy_2013			0.87 (0.02)***	0.85 (0.02)***		-0.06 (0.01)***	-0.07 (0.01)***	-0.21 (0.02)***	-0.22 (0.02)***
year_dummy_2014			0.99 (0.02)***	0.96 (0.02)***		-0.03 (0.01)***	-0.06 (0.01)***	-0.21 (0.02)***	-0.24 (0.02)***
Orig:tuition fee				-0.06 (0.02)***			-0.13 (0.00)***		-0.14 (0.01)***
Dest:tuition fee				-0.00 (0.01)			0.10 (0.00)***		0.11 (0.01)***
AIC	187935.28	560615.97	79693.50	79528.26	122143.18	503718.45	495675.31	113100.06	112815.58
Log Likelihood	-93929.64	-280259.98	-39800.75	-39714.13	-61023.59	-251813.22	-247787.66	-56506.03	-56359.79
Num. obs.	47881	170004	85381	85381	81249	156760	156760	119726	119726
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$									

Tab. 2: Models Business Studies University, source: own compilation by RDC (2019)

Statistical models									
	Prior 2002 Dipl	**2003 to 2008 Dipl**	**After 2009 Dipl**	**After 2009 Dipl(+sf)**	**2003 to 2008 BA**	**After 2009 BA**	**After 2009 BA(+sf)**	**After 2009 MA**	**After 2009 MA (+sf)**
Intercept	-0.17 (0.09)	-0.04 (0.05)	-1.41 (0.19)***	-1.73 (0.19)***	4.35 (0.11)***	4.98 (0.05)***	4.89 (0.05)***	2.88 (0.26)***	3.04 (0.27)***
log(distance)	-0.72 (0.00)***	-0.69 (0.00)***	-0.44 (0.00)***	-0.44 (0.00)***	-0.55 (0.00)***	-0.62 (0.00)***	-0.62 (0.00)***	-0.38 (0.00)***	-0.38 (0.00)***
Within state	0.49 (0.01)***	0.36 (0.00)***	0.19 (0.01)***	0.21 (0.01)***	0.18 (0.01)***	0.21 (0.00)***	0.22 (0.00)***	0.18 (0.02)***	0.18 (0.02)***
West-East	-0.21 (0.03)***	-0.12 (0.01)***	-0.26 (0.03)***	-0.31 (0.03)***	-0.00 (0.02)	0.06 (0.01)***	0.10 (0.01)***	0.07 (0.07)	0.07 (0.07)
East-West	-0.27 (0.04)***	-0.27 (0.02)***	-0.12 (0.03)***	-0.06 (0.03)	-0.30 (0.04)***	-0.05 (0.01)***	-0.08 (0.01)***	-0.31 (0.08)***	-0.33 (0.08)***
Orig:agglomeration	0.04 (0.01)***	-0.02 (0.00)***	-0.22 (0.02)***	-0.20 (0.02)***	0.01 (0.01)	-0.08 (0.00)***	-0.08 (0.00)***	-0.09 (0.02)***	-0.09 (0.02)***
Dest:agglomeration	-0.30 (0.01)***	-0.31 (0.01)***	-0.36 (0.02)***	-0.37 (0.02)***	-0.10 (0.01)***	-0.10 (0.00)***	-0.10 (0.00)***	-0.00 (0.02)	0.01 (0.02)
Orig:rural	0.12 (0.01)***	0.15 (0.01)***	0.02 (0.02)	0.01 (0.02)	0.16 (0.01)***	0.12 (0.00)***	0.12 (0.00)***	-0.07 (0.03)**	-0.07 (0.03)**
Dest:rural	0.19 (0.01)***	0.17 (0.01)***	0.10 (0.02)***	0.08 (0.02)***	0.06 (0.01)***	0.10 (0.00)***	0.10 (0.00)***	0.36 (0.03)***	0.37 (0.03)***
log(Orig:studs field of study)	0.58 (0.01)***	0.42 (0.00)***	0.49 (0.01)***	0.49 (0.01)***	0.51 (0.01)***	0.39 (0.00)***	0.39 (0.00)***	0.41 (0.01)***	0.42 (0.01)***
log(Dest:studs field of study)	0.53 (0.00)***	0.43 (0.00)***	0.42 (0.01)***	0.42 (0.01)***	0.47 (0.00)***	0.42 (0.00)***	0.42 (0.00)***	0.37 (0.01)***	0.37 (0.01)***

log(Orig:studs)	-0.09 (0.01)***	0.01 (0.01)	0.02 (0.02)	0.03 (0.02)*	-0.14 (0.01)***	-0.06 (0.01)***	-0.07 (0.01)***	-0.15 (0.02)***	-0.16 (0.02)***
log(Dest:studs)	-0.11 (0.00)***	-0.07 (0.00)***	-0.08 (0.01)***	-0.08 (0.01)***	-0.08 (0.00)***	-0.08 (0.00)***	-0.08 (0.00)***	-0.12 (0.01)***	-0.12 (0.01)***
log(Orig:pop)	0.14 (0.01)***	0.19 (0.00)***	0.08 (0.01)***	0.07 (0.01)***	0.02 (0.01)**	0.12 (0.00)***	0.12 (0.00)***	0.14 (0.02)***	0.14 (0.02)***
log(Dest:pop)	-0.01 (0.01)	-0.02 (0.00)***	-0.04 (0.01)***	-0.05 (0.01)***	-0.13 (0.00)***	-0.20 (0.00)***	-0.20 (0.00)***	0.03 (0.01)*	0.03 (0.01)*
log(Diff pop density)	0.09 (0.00)***	0.06 (0.00)***	0.03 (0.01)***	0.03 (0.01)***	0.01 (0.00)**	0.01 (0.00)***	0.01 (0.00)***	-0.03 (0.01)***	-0.03 (0.01)***
log(Orig:GDP)	-0.24 (0.02)***	-0.19 (0.01)***	0.08 (0.03)**	0.16 (0.03)***	-0.01 (0.02)	-0.08 (0.01)***	-0.07 (0.01)***	-0.48 (0.05)***	-0.50 (0.05)***
log(Dest:GDP)	-0.11 (0.02)***	-0.18 (0.01)***	0.18 (0.03)***	0.23 (0.03)***	-0.21 (0.02)***	-0.61 (0.01)***	-0.57 (0.01)***	-0.12 (0.04)**	-0.14 (0.04)**
year_dummy_2001	-0.02 (0.01)***								
year_dummy_2003		-0.00 (0.00)			-0.18 (0.04)***				
year_dummy_2004		-0.02 (0.00)**			-0.40 (0.03)***				
year_dummy_2005		-0.01 (0.01)			-0.75 (0.03)***				
year_dummy_2006		0.03 (0.01)***			-1.07 (0.04)***				
year_dummy_2007		0.06 (0.01)***			-1.33 (0.04)***				

year_dummy_2008		0.14 (0.01)***			-1.55 (0.04)***				
year_dummy_2010			0.18 (0.01)***	0.17 (0.01)***		-0.01 (0.00)**	-0.01 (0.00)**		
year_dummy_2011			0.25 (0.01)***	0.23 (0.01)***		-0.03 (0.00)***	-0.03 (0.00)***	-0.08 (0.02)***	-0.08 (0.02)***
year_dummy_2012			0.59 (0.02)***	0.54 (0.02)***		-0.03 (0.00)***	-0.05 (0.00)***	-0.10 (0.02)***	-0.09 (0.02)***
year_dummy_2013			0.73 (0.02)***	0.67 (0.02)***		-0.03 (0.00)***	-0.06 (0.00)***	-0.23 (0.02)***	-0.21 (0.02)***
year_dummy_2014			0.85 (0.03)***	0.78 (0.03)***		-0.02 (0.00)***	-0.06 (0.00)***	-0.25 (0.02)***	-0.22 (0.02)***
Orig:tuition fee				0.02 (0.02)			-0.10 (0.00)***		-0.02 (0.03)
Dest:tuition fee				-0.16 (0.02)***			0.05 (0.00)***		0.09 (0.03)***
AIC	172811.62	530387.26	67223.62	66206.61	203326.17	1082384.04	1075991.86	37991.73	37954.24
Log Likelihood	-86367.81	-265145.63	-33565.81	-33053.30	-101615.08	-541146.02	-537945.93	-18951.87	-18929.12
Num. obs.	87623	314209	107662	107662	170807	345101	345101	127930	127930
***p < 0.001; **p < 0.01; *p < 0.05									

Tab. 3: Models Business Studies UAS, source: own compilation by RDC (2019)

Statistical models									
	Prior 2002 Dipl	**2003 to 2008 Dipl**	**After 2009 Dipl**	**After 2009 Dipl(+sf)**	**2003 to 2008 BA**	**After 2009 BA**	**After 2009 BA(+sf)**	**After 2009 MA**	**After 2009 MA (+sf)**
Intercept	-3.66 (0.07)***	-3.89 (0.04)***	-1.85 (0.10)***	-2.49 (0.10)***	-1.89 (0.08)***	-1.37 (0.05)***	-1.55 (0.05)***	0.26 (0.11)*	0.09 (0.11)
log(distance)	-0.71 (0.00)***	-0.70 (0.00)***	-0.59 (0.00)***	-0.59 (0.00)***	-0.63 (0.00)***	-0.67 (0.00)***	-0.67 (0.00)***	-0.55 (0.00)***	-0.55 (0.00)***
Within state	0.90 (0.01)***	0.87 (0.00)***	0.70 (0.01)***	0.73 (0.01)***	0.48 (0.01)***	0.84 (0.00)***	0.85 (0.00)***	0.53 (0.01)***	0.54 (0.01)***
West-East	-0.19 (0.02)***	-0.24 (0.01)***	-0.23 (0.03)***	-0.31 (0.04)***	-0.01 (0.02)	-0.00 (0.01)	0.00 (0.01)	-0.03 (0.02)	-0.02 (0.02)
East-West	-0.48 (0.03)***	-0.46 (0.01)***	-0.22 (0.04)***	-0.14 (0.04)***	-0.54 (0.06)***	-0.07 (0.01)***	-0.08 (0.01)***	-0.27 (0.03)***	-0.28 (0.03)***
Orig:agglomeration	-0.01 (0.01)	-0.01 (0.00)	-0.06 (0.01)***	-0.07 (0.01)***	-0.00 (0.01)	-0.07 (0.00)***	-0.08 (0.00)***	-0.04 (0.01)***	-0.05 (0.01)***
Dest:agglomeration	-0.03 (0.01)***	-0.08 (0.00)***	-0.07 (0.01)***	-0.06 (0.01)***	-0.05 (0.01)***	-0.05 (0.00)***	-0.05 (0.00)***	-0.01 (0.01)	-0.02 (0.01)*
Orig:rural	0.19 (0.01)***	0.18 (0.00)***	0.06 (0.01)***	0.03 (0.01)**	0.16 (0.01)***	0.17 (0.00)***	0.17 (0.00)***	0.13 (0.01)***	0.13 (0.01)***
Dest:rural	0.03 (0.01)***	0.04 (0.00)***	0.06 (0.01)***	0.03 (0.01)**	0.08 (0.01)***	0.01 (0.00)*	-0.01 (0.00)	0.08 (0.01)***	0.06 (0.01)***
log(Orig:studs field of study)	0.32 (0.01)***	0.24 (0.01)***	0.32 (0.01)***	0.26 (0.01)***	0.35 (0.01)***	0.41 (0.01)***	0.41 (0.01)***	0.32 (0.01)***	0.32 (0.01)***
log(Dest:studs field of study)	0.61 (0.01)***	0.59 (0.00)***	0.50 (0.00)***	0.49 (0.00)***	0.51 (0.00)***	0.51 (0.00)***	0.51 (0.00)***	0.46 (0.00)***	0.47 (0.00)***

log(Orig:studs)	-0.15 (0.01)***	-0.09 (0.01)***	-0.11 (0.01)***	-0.05 (0.01)***	-0.17 (0.01)***	-0.15 (0.01)***	-0.15 (0.01)***	-0.08 (0.01)***	-0.09 (0.01)***
log(Dest:studs)	-0.11 (0.01)***	-0.08 (0.00)***	-0.11 (0.01)***	-0.12 (0.01)***	-0.16 (0.01)***	-0.10 (0.00)***	-0.10 (0.00)***	-0.03 (0.01)***	-0.03 (0.01)***
log(Orig:pop)	0.42 (0.01)***	0.47 (0.00)***	0.39 (0.01)***	0.40 (0.01)***	0.43 (0.01)***	0.38 (0.00)***	0.39 (0.00)***	0.33 (0.01)***	0.33 (0.01)***
log(Dest:pop)	-0.06 (0.00)***	-0.07 (0.00)***	-0.02 (0.00)***	-0.02 (0.00)***	-0.03 (0.00)***	-0.04 (0.00)***	-0.05 (0.00)***	-0.08 (0.00)***	-0.08 (0.00)***
log(Diff pop density)	0.03 (0.00)***	0.04 (0.00)***	0.08 (0.00)***	0.07 (0.00)***	0.07 (0.00)***	0.04 (0.00)***	0.04 (0.00)***	0.03 (0.00)***	0.03 (0.00)***
log(Orig:GDP)	0.08 (0.01)***	-0.05 (0.01)***	-0.12 (0.02)***	-0.01 (0.02)	0.05 (0.02)**	-0.08 (0.01)***	-0.06 (0.01)***	-0.09 (0.02)***	-0.07 (0.02)***
log(Dest:GDP)	-0.02 (0.01)	0.04 (0.01)***	-0.21 (0.02)***	-0.13 (0.02)***	-0.13 (0.02)***	-0.31 (0.01)***	-0.28 (0.01)***	-0.50 (0.02)***	-0.46 (0.02)***
year_dummy_2001	0.00 (0.00)								
year_dummy_2003		-0.01 (0.00)**			-0.08 (0.02)***				
year_dummy_2004		-0.00 (0.00)			-0.13 (0.02)***				
year_dummy_2005		0.00 (0.00)			-0.20 (0.02)***				
year_dummy_2006		0.00 (0.00)			-0.26 (0.02)***				
year_dummy_2007		0.00 (0.00)			-0.34 (0.02)***				

year_dummy_2008		0.03 (0.01)***			-0.37 (0.02)***				
year_dummy_2010			0.08 (0.01)***	0.04 (0.01)***		0.02 (0.00)***	0.02 (0.00)***		
year_dummy_2011			0.15 (0.01)***	0.07 (0.01)***		0.04 (0.00)***	0.04 (0.00)***	-0.04 (0.01)**	-0.04 (0.01)***
year_dummy_2012			0.24 (0.01)***	0.09 (0.01)***		0.06 (0.00)***	0.04 (0.00)***	-0.06 (0.01)***	-0.09 (0.01)***
year_dummy_2013			0.29 (0.02)***	0.07 (0.02)***		0.07 (0.00)***	0.04 (0.01)***	-0.07 (0.01)***	-0.11 (0.01)***
year_dummy_2014			0.36 (0.02)***	0.10 (0.02)***		0.09 (0.00)***	0.04 (0.01)***	-0.07 (0.01)***	-0.13 (0.01)***
Orig:tuition fee				0.03 (0.01)**			-0.06 (0.00)***		-0.08 (0.01)***
Dest:tuition fee				-0.23 (0.01)***			-0.02 (0.00)***		0.00 (0.01)
AIC	229408.58	727790.53	148510.65	146914.75	183709.13	602968.34	600081.24	151350.70	150572.57
Log Likelihood	-114666.29	-363847.27	-74209.33	-73407.37	-91806.57	-301438.17	-299990.62	-75631.35	-75238.28
Num. obs.	53718	184338	137176	137176	146047	170959	170959	131256	131256
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$									

Tab. 4: Models Natural Sciences University, source: own compilation by RDC (2019)

Statistical models									
	Prior 2002 Dipl	**2003 to 2008 Dipl**	**After 2009 Dipl**	**After 2009 Dipl(+sf)**	**2003 to 2008 BA**	**After 2009 BA**	**After 2009 BA(+sf)**	**After 2009 MA**	**After 2009 MA (+sf)**
Intercept	-0.10 (0.14)	-0.13 (0.09)	-0.23 (0.33)	-0.31 (0.34)	2.73 (0.12)***	3.80 (0.07)***	3.84 (0.07)***	0.31 (0.30)	0.35 (0.30)
log(distance)	-0.66 (0.00)***	-0.66 (0.00)***	-0.37 (0.01)***	-0.37 (0.01)***	-0.57 (0.00)***	-0.65 (0.00)***	-0.65 (0.00)***	-0.41 (0.01)***	-0.41 (0.01)***
Within state	0.55 (0.01)***	0.46 (0.01)***	0.39 (0.02)***	0.34 (0.03)***	0.39 (0.01)***	0.42 (0.01)***	0.42 (0.01)***	0.40 (0.02)***	0.40 (0.02)***
West-East	-0.20 (0.07)**	-0.11 (0.03)***	-0.39 (0.06)***	-0.47 (0.06)***	0.12 (0.04)**	0.17 (0.02)***	0.20 (0.02)***	0.12 (0.36)	0.11 (0.36)
East-West	-0.36 (0.08)***	-0.20 (0.04)***	0.38 (0.05)***	0.44 (0.05)***	-0.16 (0.07)*	-0.15 (0.02)***	-0.20 (0.02)***	-0.02 (0.10)	-0.01 (0.10)
Orig:agglomeration	-0.10 (0.01)***	-0.09 (0.01)***	-0.11 (0.02)***	-0.12 (0.02)***	-0.00 (0.01)	-0.06 (0.01)***	-0.06 (0.01)***	-0.20 (0.03)***	-0.20 (0.03)***
Dest:agglomeration	-0.07 (0.01)***	-0.18 (0.01)***	-0.34 (0.03)***	-0.33 (0.03)***	-0.12 (0.01)***	-0.32 (0.01)***	-0.31 (0.01)***	-0.18 (0.03)***	-0.18 (0.03)***
Orig:rural	0.05 (0.01)***	0.08 (0.01)***	-0.10 (0.02)***	-0.09 (0.02)***	0.14 (0.01)***	0.18 (0.01)***	0.18 (0.01)***	-0.06 (0.03)*	-0.06 (0.03)*
Dest:rural	0.08 (0.01)***	0.10 (0.01)***	0.07 (0.03)*	0.06 (0.03)	-0.04 (0.01)***	-0.04 (0.01)***	-0.04 (0.01)***	0.14 (0.03)***	0.15 (0.03)***
log(Orig:studs field of study)	0.49 (0.01)***	0.49 (0.01)***	0.58 (0.01)***	0.57 (0.01)***	0.46 (0.01)***	0.45 (0.01)***	0.45 (0.01)***	0.37 (0.01)***	0.37 (0.01)***
log(Dest:studs field of study)	0.67 (0.01)***	0.58 (0.00)***	0.43 (0.01)***	0.43 (0.01)***	0.48 (0.00)***	0.49 (0.00)***	0.49 (0.00)***	0.44 (0.01)***	0.44 (0.01)***

log(Orig:studs)	-0.02 (0.01)	-0.06 (0.01)***	0.16 (0.02)***	0.17 (0.02)***	-0.06 (0.01)***	-0.11 (0.01)***	-0.11 (0.01)***	0.10 (0.02)***	0.09 (0.02)***
log(Dest:studs)	-0.12 (0.01)***	-0.11 (0.00)***	-0.23 (0.01)***	-0.25 (0.01)***	-0.11 (0.01)***	-0.11 (0.00)***	-0.11 (0.00)***	-0.11 (0.01)***	-0.11 (0.01)***
log(Orig:pop)	0.15 (0.01)***	0.22 (0.01)***	-0.15 (0.02)***	-0.15 (0.02)***	0.06 (0.01)***	0.15 (0.01)***	0.15 (0.01)***	0.15 (0.02)***	0.15 (0.02)***
log(Dest:pop)	-0.03 (0.01)***	0.01 (0.00)***	0.18 (0.02)***	0.18 (0.02)***	-0.09 (0.01)***	-0.06 (0.00)***	-0.06 (0.00)***	0.07 (0.01)***	0.07 (0.01)***
log(Diff pop density)	0.10 (0.01)***	0.09 (0.00)***	0.10 (0.01)***	0.10 (0.01)***	0.05 (0.00)***	0.01 (0.00)***	0.01 (0.00)**	0.04 (0.01)***	0.04 (0.01)***
log(Orig:GDP)	0.01 (0.03)	-0.15 (0.02)***	-0.03 (0.06)	-0.01 (0.06)	0.05 (0.02)*	-0.26 (0.01)***	-0.27 (0.01)***	-0.73 (0.06)***	-0.73 (0.06)***
log(Dest:GDP)	-0.53 (0.04)***	-0.49 (0.02)***	-0.03 (0.07)	0.00 (0.08)	-0.28 (0.03)***	-0.60 (0.01)***	-0.60 (0.01)***	0.10 (0.06)	0.09 (0.07)
year_dummy_2001	-0.05 (0.01)***								
year_dummy_2003		-0.03 (0.01)***			-0.09 (0.02)***				
year_dummy_2004		-0.01 (0.01)			-0.11 (0.02)***				
year_dummy_2005		0.03 (0.01)***			-0.28 (0.02)***				
year_dummy_2006		0.13 (0.01)***			-0.48 (0.02)***				
year_dummy_2007		0.26 (0.01)***			-0.60 (0.02)***				

year_dummy_2008		0.41 (0.01)***			-0.75 (0.02)***				
year_dummy_2010			0.19 (0.02)***	0.19 (0.02)***		0.02 (0.01)**	0.02 (0.01)**		
year_dummy_2011			0.39 (0.02)***	0.39 (0.02)***		0.01 (0.01)	0.01 (0.01)	-0.13 (0.02)***	-0.13 (0.02)***
year_dummy_2012			0.46 (0.03)***	0.44 (0.03)***		0.02 (0.01)*	0.02 (0.01)**	-0.01 (0.02)	-0.00 (0.02)
year_dummy_2013			0.73 (0.03)***	0.71 (0.03)***		0.02 (0.01)**	0.03 (0.01)***	-0.04 (0.02)	-0.04 (0.02)
year_dummy_2014			0.86 (0.03)***	0.83 (0.04)***		0.03 (0.01)***	0.04 (0.01)***	-0.05 (0.02)*	-0.04 (0.02)
Orig:tuition fee				0.10 (0.03)**			-0.08 (0.01)***		0.06 (0.05)
Dest:tuition fee				-0.16 (0.03)***			0.09 (0.01)***		-0.04 (0.05)
AIC	66695.83	226632.04	25391.06	25136.47	112994.95	408474.10	406748.92	24899.77	24870.80
Log Likelihood	-33309.92	-113268.02	-12649.53	-12518.24	-56449.47	-204191.05	-203324.46	-12405.89	-12387.40
Num. obs.	69451	258843	58584	58584	166726	307828	307828	108057	108057
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$									

Tab. 5: Models Natural Sciences UAS, source: own compilation by RDC (2019)

Statistical models									
	Prior 2002 Dipl	**2003 to 2008 Dipl**	**After 2009 Dipl**	**After 2009 Dipl(+sf)**	**2003 to 2008 BA**	**After 2009 BA**	**After 2009 BA(+sf)**	**After 2009 MA**	**After 2009 MA (+sf)**
Intercept	-6.37 (0.09)***	-4.99 (0.05)***	-0.05 (0.10)	-1.87 (0.11)***	-7.26 (0.15)***	-4.55 (0.06)***	-5.09 (0.06)***	-3.98 (0.13)***	-4.55 (0.14)***
log(distance)	-0.56 (0.00)***	-0.59 (0.00)***	-0.51 (0.00)***	-0.51 (0.00)***	-0.53 (0.00)***	-0.57 (0.00)***	-0.57 (0.00)***	-0.49 (0.00)***	-0.49 (0.00)***
Within state	1.10 (0.01)***	0.96 (0.00)***	1.02 (0.01)***	1.07 (0.01)***	0.68 (0.01)***	1.22 (0.00)***	1.23 (0.00)***	0.90 (0.01)***	0.91 (0.01)***
West-East	-0.31 (0.03)***	-0.44 (0.01)***	-0.49 (0.03)***	-0.49 (0.03)***	0.22 (0.05)***	-0.50 (0.01)***	-0.53 (0.02)***	-0.33 (0.03)***	-0.31 (0.03)***
East-West	-0.33 (0.02)***	-0.45 (0.01)***	-0.73 (0.01)***	-0.71 (0.01)***	-0.35 (0.04)***	-0.03 (0.01)**	0.01 (0.01)	-0.10 (0.03)***	-0.09 (0.03)**
Orig:agglomeration	-0.13 (0.01)***	-0.03 (0.00)***	-0.07 (0.01)***	-0.08 (0.01)***	-0.18 (0.01)***	-0.12 (0.00)***	-0.14 (0.00)***	-0.13 (0.01)***	-0.14 (0.01)***
Dest:agglomeration	0.01 (0.01)	-0.00 (0.01)	0.27 (0.01)***	0.24 (0.01)***	-0.32 (0.02)***	-0.18 (0.01)***	-0.19 (0.01)***	-0.22 (0.01)***	-0.26 (0.01)***
Orig:rural	0.20 (0.01)***	0.21 (0.00)***	0.14 (0.01)***	0.11 (0.01)***	0.21 (0.01)***	0.20 (0.00)***	0.19 (0.00)***	0.24 (0.01)***	0.24 (0.01)***
Dest:rural	0.30 (0.01)***	0.22 (0.01)***	0.20 (0.01)***	0.11 (0.01)***	0.22 (0.02)***	0.22 (0.01)***	0.18 (0.01)***	0.14 (0.02)***	0.11 (0.02)***
log(Orig:studs field of study)	0.00 (0.01)	0.14 (0.00)***	0.26 (0.00)***	0.24 (0.00)***	0.39 (0.01)***	0.28 (0.00)***	0.29 (0.00)***	0.28 (0.01)***	0.29 (0.01)***
log(Dest:studs field of study)	0.71 (0.01)***	0.65 (0.00)***	0.75 (0.00)***	0.75 (0.00)***	0.54 (0.01)***	0.71 (0.00)***	0.72 (0.00)***	0.64 (0.01)***	0.64 (0.01)***

log(Orig:studs)	0.12 (0.01)***	0.00 (0.01)	0.21 (0.01)***	0.19 (0.01)***	-0.40 (0.01)***	0.00 (0.01)	-0.03 (0.01)***	0.03 (0.01)**	0.02 (0.01)*
log(Dest:studs)	-0.00 (0.01)	0.02 (0.00)***	-0.22 (0.01)***	-0.25 (0.01)***	0.21 (0.01)***	0.05 (0.00)***	0.03 (0.00)***	0.04 (0.01)***	0.02 (0.01)*
log(Orig:pop)	0.48 (0.01)***	0.47 (0.00)***	0.21 (0.01)***	0.23 (0.01)***	0.66 (0.01)***	0.37 (0.00)***	0.37 (0.00)***	0.36 (0.01)***	0.36 (0.01)***
log(Dest:pop)	0.06 (0.00)***	0.01 (0.00)***	0.09 (0.00)***	0.10 (0.00)***	-0.09 (0.01)***	-0.03 (0.00)***	-0.03 (0.00)***	0.03 (0.01)***	0.04 (0.01)***
log(Diff pop density)	-0.06 (0.00)***	-0.01 (0.00)***	0.05 (0.00)***	0.04 (0.00)***	-0.07 (0.00)***	0.03 (0.00)***	0.03 (0.00)***	0.01 (0.00)	0.00 (0.00)
log(Orig:GDP)	-0.27 (0.02)***	-0.38 (0.01)***	-0.54 (0.02)***	-0.37 (0.02)***	0.05 (0.03)	-0.16 (0.01)***	-0.10 (0.01)***	-0.28 (0.02)***	-0.24 (0.02)***
log(Dest:GDP)	-0.20 (0.02)***	-0.10 (0.01)***	-0.88 (0.02)***	-0.51 (0.02)***	0.27 (0.03)***	-0.34 (0.01)***	-0.22 (0.01)***	-0.35 (0.02)***	-0.21 (0.03)***
year_dummy_2001	0.01 (0.01)*								
year_dummy_2003		-0.09 (0.01)***			-0.31 (0.03)***				
year_dummy_2004		0.04 (0.01)***			-0.18 (0.03)***				
year_dummy_2005		0.03 (0.01)***			-0.26 (0.03)***				
year_dummy_2006		0.02 (0.01)**			-0.34 (0.03)***				
year_dummy_2007		0.02 (0.01)***			-0.58 (0.03)***				

year_dummy_2008		0.11 (0.01)***			-0.75 (0.03)***				
year_dummy_2010			0.10 (0.01)***	0.07 (0.01)***		-0.06 (0.01)***	-0.07 (0.01)***		
year_dummy_2011			0.20 (0.01)***	0.15 (0.01)***		-0.08 (0.01)***	-0.10 (0.01)***	-0.15 (0.02)***	-0.15 (0.02)***
year_dummy_2012			0.27 (0.01)***	0.17 (0.01)***		-0.09 (0.01)***	-0.16 (0.01)***	-0.28 (0.02)***	-0.32 (0.02)***
year_dummy_2013			0.39 (0.01)***	0.22 (0.01)***		-0.06 (0.01)***	-0.16 (0.01)***	-0.32 (0.02)***	-0.39 (0.02)***
year_dummy_2014			0.54 (0.01)***	0.35 (0.01)***		-0.07 (0.01)***	-0.19 (0.01)***	-0.35 (0.02)***	-0.44 (0.02)***
Orig:tuition fee				-0.16 (0.01)***			-0.04 (0.01)***		-0.10 (0.01)***
Dest:tuition fee				-0.16 (0.01)***			-0.11 (0.01)***		-0.04 (0.01)***
AIC	122461.44	457607.36	147179.10	144717.97	62634.19	470219.20	467161.08	100860.62	100524.99
Log Likelihood	-61192.72	-228755.68	-73543.55	-72308.99	-31269.09	-235063.60	-233530.54	-50386.31	-50214.50
Num. obs.	35669	132503	85869	85869	59628	107711	107711	87226	87226
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$									

Tab. 6: Models Engineering University, source: own compilation by RDC (2019)

Statistical models									
	Prior 2002 Dipl	**2003 to 2008 Dipl**	**After 2009 Dipl**	**After 2009 Dipl(+sf)**	**2003 to 2008 BA**	**After 2009 BA**	**After 2009 BA(+sf)**	**After 2009 MA**	**After 2009 MA (+sf)**
Intercept	-2.11 (0.07)***	-1.72 (0.04)***	0.08 (0.10)	-0.59 (0.11)***	0.71 (0.08)***	0.86 (0.04)***	0.62 (0.04)***	-0.12 (0.16)	-0.01 (0.16)
log(distance)	-0.77 (0.00)***	-0.74 (0.00)***	-0.58 (0.00)***	-0.58 (0.00)***	-0.72 (0.00)***	-0.77 (0.00)***	-0.77 (0.00)***	-0.53 (0.00)***	-0.53 (0.00)***
Within state	0.74 (0.01)***	0.64 (0.00)***	0.36 (0.01)***	0.40 (0.01)***	0.46 (0.01)***	0.70 (0.00)***	0.71 (0.00)***	0.66 (0.01)***	0.66 (0.01)***
West-East	-0.27 (0.03)***	-0.22 (0.01)***	-0.46 (0.03)***	-0.42 (0.03)***	-0.16 (0.03)***	-0.05 (0.01)***	-0.05 (0.01)***	-0.05 (0.07)	-0.06 (0.07)
East-West	-0.27 (0.04)***	-0.24 (0.02)***	-0.33 (0.04)***	-0.33 (0.04)***	-0.17 (0.04)***	-0.05 (0.01)***	-0.05 (0.01)***	0.14 (0.05)**	0.14 (0.05)**
Orig:agglomeration	-0.06 (0.01)***	-0.06 (0.00)***	-0.07 (0.01)***	-0.07 (0.01)***	0.04 (0.01)***	-0.05 (0.00)***	-0.06 (0.00)***	-0.06 (0.01)***	-0.05 (0.01)***
Dest:agglomeration	-0.22 (0.01)***	-0.24 (0.00)***	-0.09 (0.01)***	-0.12 (0.01)***	-0.28 (0.01)***	-0.33 (0.00)***	-0.33 (0.00)***	-0.15 (0.01)***	-0.14 (0.01)***
Orig:rural	0.21 (0.01)***	0.18 (0.00)***	0.04 (0.01)***	0.03 (0.01)**	0.14 (0.01)***	0.19 (0.00)***	0.18 (0.00)***	0.04 (0.01)**	0.04 (0.01)**
Dest:rural	0.05 (0.01)***	0.06 (0.00)***	0.35 (0.01)***	0.37 (0.01)***	0.02 (0.01)**	0.06 (0.00)***	0.05 (0.00)***	0.17 (0.02)***	0.17 (0.02)***
log(Orig:studs field of study)	0.50 (0.01)***	0.39 (0.00)***	0.37 (0.00)***	0.36 (0.00)***	0.40 (0.01)***	0.40 (0.00)***	0.43 (0.00)***	0.53 (0.01)***	0.54 (0.01)***
log(Dest:studs field of study)	0.58 (0.00)***	0.58 (0.00)***	0.51 (0.00)***	0.50 (0.00)***	0.62 (0.00)***	0.57 (0.00)***	0.57 (0.00)***	0.53 (0.01)***	0.53 (0.01)***

log(Orig:studs)	-0.11 (0.01)***	-0.00 (0.01)	0.19 (0.01)***	0.21 (0.01)***	-0.10 (0.01)***	-0.06 (0.00)***	-0.10 (0.00)***	-0.25 (0.01)***	-0.25 (0.01)***
log(Dest:studs)	-0.13 (0.00)***	-0.13 (0.00)***	-0.20 (0.00)***	-0.19 (0.00)***	-0.17 (0.00)***	-0.09 (0.00)***	-0.09 (0.00)***	-0.09 (0.01)***	-0.09 (0.01)***
log(Orig:pop)	0.15 (0.01)***	0.17 (0.00)***	-0.01 (0.01)	-0.02 (0.01)*	0.18 (0.01)***	0.22 (0.00)***	0.22 (0.00)***	0.24 (0.01)***	0.24 (0.01)***
log(Dest:pop)	0.11 (0.00)***	0.06 (0.00)***	0.15 (0.01)***	0.14 (0.01)***	0.07 (0.00)***	0.05 (0.00)***	0.04 (0.00)***	0.06 (0.01)***	0.06 (0.01)***
log(Diff pop density)	0.08 (0.00)***	0.06 (0.00)***	0.10 (0.00)***	0.11 (0.00)***	0.05 (0.00)***	0.01 (0.00)***	0.01 (0.00)***	-0.01 (0.00)**	-0.01 (0.00)**
log(Orig:GDP)	-0.09 (0.02)***	-0.27 (0.01)***	-0.41 (0.02)***	-0.38 (0.02)***	-0.31 (0.02)***	-0.59 (0.01)***	-0.52 (0.01)***	-0.49 (0.03)***	-0.51 (0.03)***
log(Dest:GDP)	-0.10 (0.01)***	0.04 (0.01)***	-0.08 (0.02)***	0.09 (0.02)***	-0.14 (0.02)***	-0.35 (0.01)***	-0.29 (0.01)***	0.01 (0.03)	0.01 (0.03)
year_dummy_2001	0.01 (0.00)*								
year_dummy_2003		0.00 (0.00)			-0.09 (0.03)**				
year_dummy_2004		0.01 (0.00)**			-0.19 (0.02)***				
year_dummy_2005		0.04 (0.00)***			-0.40 (0.02)***				
year_dummy_2006		0.05 (0.00)***			-0.61 (0.02)***				
year_dummy_2007		0.10 (0.00)***			-0.76 (0.02)***				
year_dummy_2008		0.16 (0.01)***			-0.87 (0.03)***				

year_dummy_2010			0.12 (0.01)***	0.10 (0.01)***		0.01 (0.00)	-0.00 (0.00)		
year_dummy_2011			0.22 (0.01)***	0.18 (0.01)***		-0.02 (0.00)***	-0.03 (0.00)***	-0.08 (0.01)***	-0.08 (0.01)***
year_dummy_2012			0.31 (0.01)***	0.25 (0.01)***		0.01 (0.00)**	-0.04 (0.00)***	-0.15 (0.01)***	-0.15 (0.01)***
year_dummy_2013			0.51 (0.01)***	0.46 (0.01)***		0.01 (0.00)**	-0.07 (0.00)***	-0.23 (0.01)***	-0.22 (0.01)***
year_dummy_2014			0.58 (0.01)***	0.46 (0.01)***		0.02 (0.00)***	-0.09 (0.00)***	-0.28 (0.01)***	-0.26 (0.01)***
Orig:tuition fee				-0.21 (0.01)***			-0.10 (0.00)***		0.03 (0.02)
Dest:tuition fee				0.05 (0.01)***			-0.04 (0.00)***		0.02 (0.02)
AIC	267199.50	750630.45	128078.96	127474.70	229675.93	1212331.92	1206808.85	80229.63	80202.40
Log Likelihood	-133561.75	-375267.23	-63993.48	-63687.35	-114789.96	-606119.96	-603354.42	-40070.81	-40053.20
Num. obs.	102835	356827	161568	161568	197029	365075	365075	202081	202081
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$									

Tab. 7: Models Engineering UAS, source: own compilation by RDC (2019)