New region, new chances: Does university enrollment shape later job mobility?*

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Abstract

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Job mobility is an essential feature of an efficient labor market. However, it seems to be hard to motivate job seekers to move. We shed light on determinants of regional mobility in the early working life. We find that high school graduates who move to another labor market region (LMR), when enrolling at a university, are also more likely to move to a third LMR, when entering the job market. The distance to the closest university is applied as an instrument on the first movement decision. To overcome selection concerns and the influence by the surrounding area, we take a subset of graduates who went to high school in the suburban region of Munich. That makes the distance of the instrument differing only within 15 km. Experiencing a change in the residential region is a chance: for the individual to a greater selection for the first job and for the economy to an efficient distribution of labor.

Keywords: regional mobility, job mobility, distance, students, instrumental variable, enrollment, spatial

JEL-Codes: J61, R23, I23

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1 Early mobility and job mobility

Regional mobility is one of the decisive issues of the 21^{st} century. Globally, migration from the south to the north and from rural to urban regions will shape the world in the next decades. Nevertheless, regional mobility within already industrialized countries is also an important issue. Even mobility within a country has important effects, for instance on the efficiency of the labor market. From an individual's perspective, mobility seems to pay out in working life in the long run in monetary terms (Leary et al. (2014)).

A central issue in investigating outcomes of mobility, monetary or in other dimensions, is the selection on unobserved characteristics. For instance, it is often impossible to measure motivation. Whether an individual decides to move for a job, an apprenticeship or to study seems to be at least partly predetermined by her surrounding, her family background, the area she is living in and her intrinsic motivation. Therefore, research taking mobility as explanatory variable into account has to handle the issue of selection carefully. In our investigation, we focus exactly on this point by going one step back. Instead of asking if and in which dimensions mobility may pay out, we ask what actually shapes mobility for the first job. In this paper, we focus on regional migration of high school graduates and their decision to enroll at a university nearby or at a university where they would have to move to another labor market region (LMR) within Bavaria and how this movement decision affects the movement decision for the first job (possibly also outside Bavaria).

We apply an instrumental variable strategy to account for endogenous movements after graduating from high school , where the distance to the closest university is applied as the instrument on the decision to study within the home LMR or at another Bavarian university. However, there is still the issue of selection which is determined by the location a person lives. To handle selection by the area a person lives, we focus on graduates who went to high school in the greater area of Munich. Additionally, we control for parental characteristics. We use a survey containing very detailed information (on postal code level) on locations of university graduates, beginning with the place where they got their university entrance diploma, continuing with the place of their university and finishing with all locations up to roughly 1.5 years after graduation.

We find that the further a high school is located from the closest university, the more likely are its graduates to move to another university and that the decision to enroll at another university increases the likelihood to move again to a third LMR for the first job after graduating from university. We show that high-skilled workers' job mobility[1] is shaped by a relatively early mobility decision. Hence, a state who is interested in regionally flexible high skilled workers can set incentives to leave the home region when enrolling at a university.

[1] workers with a university or a university of applied sciences certificate

These incentives might be for instance more student homes only for students from other regions.

In contrast to the related literature, we focus on the decision where high school graduates enroll in their tertiary education institution and investigate how this decision effects later mobility. Also, our treatment varies only between 15 km, which is finer spatial variation than usual in that literature.

The paper is structured as followed. In Section 2, we present a selection of related literature, whereas Section 3 deals with the institutional setting and how we identify the effects of early mobility on later job mobility. Section 4 describes the empirical approach while Section 5 describes our estimation strategy. Section 6 describes the data we use and provides descriptive statistics. Finally, Section 7 presents the results, before Section 8 summarizes our results.

2 Related literature

In general, the literature has identified clear factors which affect the decision to enroll at a tertiary education institution, a university. These factors are primarily the parents' education and the household income (for instance Acemoglu and Pischke (2001) or Shea (2000)). Region factors play less important roles in this literature strand. Card (1993) applies as one of the first authors college proximity as an instrument for schooling to estimate the returns of schooling. Kjellström and Regnér (1999) use a Swedish data set to investigate the link between the distance between place of residence and the closest university on the one hand and enrollment rates at the other hand. They find a small but significant negative effect of distance on enrollment rates, controlling for a set of personal and parental characteristics. Kling (2001) shows that college proximity has a great impact on the transition from high school to college when taking family background into account. More recently, Frenette (2004) establishes this link for the Canadian Survey of Labour and Income Dynamics and finds a more pronounced effect for individuals from lower income families. These results are also found by Frenette (2006) who shows that the likelihood to enroll at a university decreases significantly if a person's residence does not lie within an acceptable "commuting distance" and that this effect is especially prevalent for people from the lower end of the income distribution again. For the case of Germany, Spiess and Wrohlich (2010) show a higher likelihood of university enrollment if the university is nearby when completing secondary education. They show that five years after high school graduation, 57% of those who live relatively far away from a university have enrolled while the share of people who enrolled at a university is 70% for those, living close to such an institution.[2]

[2] Far away is defined as more than 12.5 km to the closest university while closely located are those, having a university within a radius of 6 km to their residence.

Coming to the case of Germany and the question, how effects of mobility can be identified, research is relatively limited. The investigation of Krabel and Flöther (2014) uses a nation-wide survey among German graduates and finds a lower level of mobility for graduates in metropolitan areas and promising labor markets. At the same time, a higher level of mobility from school to university coincides with a higher mobility when starting the first job. The investigation models the employability of graduates by using a Heckman selection model and takes the results of this regression of employability on personal characteristics and explanatory variables for the determination of the probability of being mobile.

Spanning a more international context, Parey and Waldinger (2011) use the introduction and expansion of the European student exchange program ERASMUS as exogenous variable to determine whether staying abroad as a student increases the likelihood in working abroad at a later point in time. The authors find that a stay abroad increases the likelihood to work abroad later on by roughly 15%. A more heterogeneous picture is found by Di Cintio and Grassi (2013), investigating wage premia for Italia university graduates if they a) chose to study not in their home region or b) migrate within the country for the first job. The authors find small losses for students who migrate for studying (a)) but significant gains for movers for the first job (b)) by employing a matching procedure.

In general, Malamud and Wozniak (2007) find a higher level of mobility and higher willingness to move longer distances for college graduates than workers without a college degree by employing an instrumental variable approach. Similar results are found by Kodrzicki (2001) who evaluate the National Longitudinal Survey of Youth from 1979 to 1996. For the US, Groen (2004) show that students going to one state for college also tend to work later in that state as well. The authors look at a longer time horizon (10 to 15 years) and at a broader level of mobility. Also, in the US migration is more present than in Germany. Nevertheless, it established the link between tertiary education decision and job mobility.

When investigating the effects of mobility it is important to control for family characteristics (e.g. education of the parents but also own ability) to ensure that findings are causal. However, as the growing literature on urban economics has shown, the location where a person grows up might be central to her further career and development. Mion and Naticchioni (2009) show for the case of Italy that skills seem to be sorted spatially which is similar to the descriptive findings of Combes et al. (2012), showing the difference in skill and wage distributions between differently dense areas in France. Even more basically, Bosquet and Overman (2019) show a positive raw elasticity of roughly 4 percent between the size of the city, an individual is born and her later earnings.

3 Institutional background and identification strategy

Next, we give an overview over the German system of tertiary education and over the university landscape of Bavaria and of Munich. This is followed by a sketch of how we estimate the causal effect of movements.

3.1 German higher education system

The following part should briefly clarify the institutional background in Germany regarding admission to universities and applied universities. In general, students in Germany are not obliged to stay within regional boundaries when applying for a degree course. Except for medical degree programs[3] where application procedures are centralized, students have to apply at universities and applied universities directly for their preferred field. Since we leave out medical degrees and focus on diploma ("Diplom")[4], bachelor and master degrees, every student within our sample[5] basically had the possibility to apply to any university and university of applied sciences (UAS)[6] as long as she received a university entrance diploma. Public institutions are the main educator and are free of charge.

In total, Bavaria has twelve universities[7] and 19 universities of applied sciences [8]. Universities of applied sciences are tertiary education institutions were founded with the focus on a more practice-oriented education closer to needs of the economy. In comparison, universities are more focused on scientific education. To enroll at a university one needs a more general entrance diploma (*Allgemeine Hochschulreife*), whereas one can enroll at a university of applied sciences also with a vocational baccalaureate diploma (*Fachabitur*). The University of the Armed Forces Munich is only open to commissioned officers and officer candidates of the German army (Bundeswehr). Graduates of the University of Neuendettelsau usually become pastors. Except for the University of Eichstätt-Ingolstadt and the Catholic Foundation University Of Applied Sciences Munich, all universities and applied universities mentioned are public universities while the two exceptions are under

[3] i.e. pharmacy, human medicine, veterinary medicine and dentistry

[4] German degree before the Bologna reforms

[5] Due to the setup of the BAP we can only investigate students which decided to study at a tertiary education institution within the federal state of Bavaria.

[6] Throughout this paper, we will refer to university and mean both university and university of applied sciences.

[7] These universities are: University of Augsburg, University of Bamberg, University of Bayreuth, University of Erlangen-Nürnberg, LMU Munich (University of Munich), Technical University Munich, University of Passau, University of Regensburg, University of Würzburg, University of Eichstätt-Ingolstadt, University of the Armed Forces Munich, and University of Neuendettelsau.

[8] These are: Amberg-Weiden, Ansbach, Aschaffenburg, Augsburg, Coburg, Deggendorf, Hof, Ingolstadt, Kempten, Landshut, Munich, Neu-Ulm, Nürnberg, Regensburg, Rosenheim, Weihenstephan-Triesdorf, Würzburg-Schweinfurt, EVNH Nürnberg, and Catholic Foundation University Of Applied Sciences Munich.

ecclesiastical sponsorship.[9] The location of all universities and universities of applied sciences is shown in a map in Figure A.1.

The city of Munich hosts two universities and one university of applied sciences which are included in the data. The universities are among the biggest in Germany and are known for their excellence. Munich is also one of the wealthiest regions in Germany and has a strong labor market. Being born there, there is no need to enroll at another university for these reasons. For once, it is unlikely that one leaves Munich to get a better education, at least within Bavaria. Also, Munich's economic conditions should make it possible for every graduate to find a job in the Munich LMR. However, the housing market is very tight and rents are high therefore. Hence, we argue that if commuting times are getting too high with larger distances from the closest university, one might think of moving to another city, where living closer to a university is more affordable.

3.2 Instrumental variable estimation

Going back to the human capital theory of Becker (1994), high school graduates decide to go to university if the expected payouts outrun the expected cost of studying. This, very basic, argumentation should also hold for the decision whether to leave home to study or not as e.g. Mitze et al. (2015) argue. We think of costs as commuting which depends on the distance to the university and the costs of leaving a social group (family and friends) and find contact to a new group for instance. The cost of commuting are of course affected by the decision to move. At the same time, moving may come with benefits like making new friends or being able to choose from a wider field of study courses. To sum up, commuting costs can be minimized by moving whilst the social costs for setting up a new personal environment rise. Obviously, social costs can be seen as benefits, depending on personal preferences.

In general, these two important determinants (expected costs and benefits of leaving home to study) seem to be highly influenced by parental and peripheral characteristics. As one of the first authors Greenwood (1975) argues that migration (in general, not related to students) is highly influenced by socio-economic characteristics and the environment, a person is living in. Mchugh and Morgan (1984) show that the economic conditions of the destination area, i.e. the region the university or college is located in, seem to be important for students when deciding which educational institution to go to. This is confirmed by the more recent work of Agasisti and Dal Bianco (2007) for students in Italy.

In general, the decision to move is not exogenous. High school graduates might be influenced by their peripheral surrounding, for instance whether it is urban or rural and their

[9] Although under ecclesiastical sponsorship, the University of Eichstätt-Ingolstadt and the Catholic Foundation University Of Applied Sciences Munich are similar to the public universities since they do not charge tuition fees and are open to public.

parents during growing up. Therefore, regressing moving for university on moving for the first job will be highly biased. Although, whereas high school graduates coming from academic families in urban areas are more likely to study, it may be hard to argue a priori whether the bias for the movement decision is up-, or downwards sloping. To get an unbiased estimate, we employ an instrumental variable approach taking the (road) distance to the closest university as the instrument. As argued, this distance influences the decision to move for university. On the other side, this distance should not have a direct effect on the decision to move for the first job after graduation from university. Only an indirect effect through the first movement is assumed.

To assure an "as-good-as-random" allocation of the individuals, we take the two points stated at the beginning of this paragraph into account. First, we control for parental characteristics. Second, we only take high school graduates coming from the suburban area into account. We exclude high schools located in the countryside as these pupils have to move anyway if they go to university. We also exclude high schools within the central urban area, as cities are more heterogeneous than the suburbs. Third, focusing on Munich handles certain issues for us. Therefore, we do not have to deal with movers who enroll in a university with greater prestige. Also, for movers it is always cheaper to rent a place in another city than in Munich. On the other hand, non-movers can get to the university with public transport. Additionally, distance within the city is less important due to a relatively dense metro net. How we define the suburban area will be discussed in the next section.

4 Empirical approach

As argued in Section 3, we take a group of students which is similar in terms of the location they graduated from high school, control for parental characteristics, and use the distance from high school to the closest located university as instrumental variable for the decision to go to a university (of applied sciences) in Munich or to choose a university in another labor market region (LMR, *Arbeitsmarktregion*). The concept of labor market regions was developed by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). LMRs are usually sharply defined by the counties (*Kreise*) and federal states (*Bundesländer*) and are defined as regions where workers rather commute within, but not between.[10] We use this instrument of distance between high school and closest university to investigate how the movement decision between high school and university influences the likelihood to move to another city after graduating from university.

[10] More specific, LMRs are defined as regions where at least 65% of all wage earners with residence in this region also work in this region and that at least 65% of all paid jobs are filled with domestic workers (stemming from this region). Additionally, commuting times within a LMR should not exceed 45 minutes one way. For more information see https://www.bbsr.bund.de/BBSR/EN/Home/homepage_node.html.

The survey does not include questions about moving out. Therefore, we have to define movements based on the location of high school, chosen university and first job. Also, we do not know the location of the home (town) but only the high school the graduates went to. However, this should not differ a lot regarding the distance to the home, and therefore, the distance to the nearest university.

The group of interest for the analysis is a subset of all Munich high school pupils in our sample. We only take a set of students stemming from the suburban area to have them as similar as possible in unobservable and observable dimensions. The suburban area is defined as a donut with an inner radius of 15 km and an outer radius of 30 km. The center is Mary's Square (*Marienplatz*), the central square in the city center of Munich and the location of the town hall. In Munich, the average travel distance between the city center and a terminal stop of a suburban train (*S-Bahn*) is 39 km while this distance is 11 km when taking the metro (*U-Bahn*) instead of the suburban train.[11] We calculate distances as road distances by using the Stata tool *osrmtime* by Huber and Rust (2016) to account for the geography and streets which might reflect commuting more realistically and draw lines around the city center according to these distances.[12] UBy taking the inner circle at 15 km, we ensure that these people are far enough spatially located from the terminal stops of the metro, which shapes to a certain degree the border of the city. At the same time, taking 30 km as outer border ensures that all people within the ring between 15 and 30 km away from the city center are similarly close to a stop of the suburban train, and therefore, have equally good public transportation connections to the center of Munich.

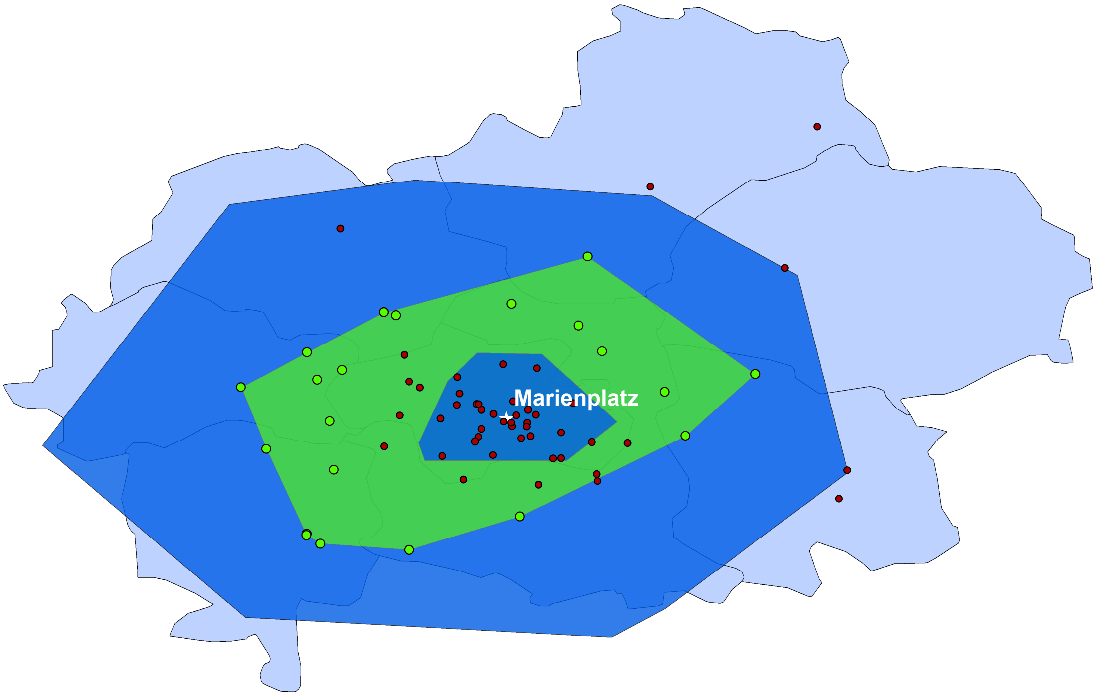
Figure 1 illustrates the group of interest for the analysis. In a pale blue the LMR of Munich is shown. The darker lines reflect the county borders. Each dot represents one high school. Green dots are part of the donut, and therefore, in our group of interest. The green area is the convex hull of these high school and should illustrate the donut. Red dots are high school which are not part of the analysis, either because they are too close to the city center or too far away from it. The other blue areas are the convex hull of the metro stations (inner blue area) and the suburban train stains (outer blue area). It can be seen that the green donut has a certain distance to them in each direction. In a robustness analysis, the two radius will be varied to account for high schools right at the border of the donut.

Coming to the distance to the closest university. Figure A.2 shows this distance for all students coming from a high school within the LMR of Munich. It can be seen that most of them visited a high school only a few kilometers away from a university. The furthest distance is more than 40 km. Although, only very few students come from such a far located high

[11] The distances are the arithmetic mean between Munich's city center, defined as the distance between Mary's Square and the public transport's terminal stops, measured by using Google Maps.

[12] The tool calculates distances between longitudinal and latitudinal specified places by using open source street maps. We used a street map of Germany provided by Geofabrik (http://www.geofabrik.de/).

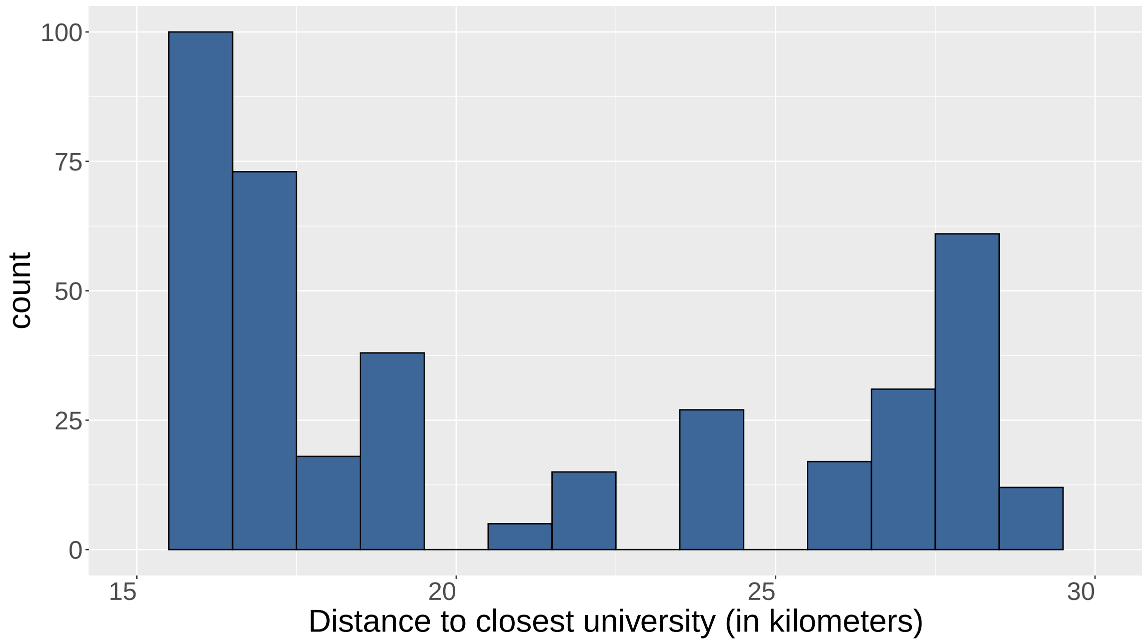
Figure 1: Selection of group of interest



Note: High schools are shown as dots. Green dots are part of the donut, whereas red dots lie in the inside circle or outside the doughnut. The green area is the convex hull of the green schools. The inner blue area is the convex hull of the metro stations, the outer blue area is the convex hull of the suburban train stations, and the bright blue ground is the shape of the LMR of Munich, with the darker lines showing the counties within the LMR.

school. If we restrict the sample to the persons within the donut as drawn in Figure 1, the distribution amongst people with respect to this relevant distance becomes relatively even as Figure 2 shows. At least there are high schools located close to the 15 km border, in the middle, and close to the 30 km border.

Figure 2: Distribution over distance to closed university (suburban region)



5 Estimation strategy

As explained above, we take a subset of individuals based on the distance of their high school where they received their university entrance diploma, to the city center. We want to know how the decision not to go to their closest tertiary education institution influences their future mobility behavior. Therefore, we implement a two-stage-least-squares instrumental approach (2SLS) to instrument the (possibly biased) variable of moving for the university by road distance to the closest university. We argue that for the decision to move the commuting distance to university is important. Therefore, we take the distance to the closed university as an instrument. As mentioned before, the survey does not include questions about movements. Because of this, we define moving as a change in the LMR. Therefore, the effect might be underestimated. In the group of the non-movers there are also some people who moved out from home but stay within Munich. According to the definition of LMRs, commuting times should be acceptable within these areas but not between. We argue that this holds true, no matter whether a person commutes to her job or to her university. Because of this, we define a person with a high school in a different LMR than the university she enrolled in as "moved for university". Analogously, if the indicated first residence after graduating from university lies in another LMR than the university and the high school, we define the graduate as having moved for the first job. Formally, we regress "move for university" (X_i) on "move for job" (Y_i):

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 parental_i + \beta_3 Z_i + \beta_4 county_i + \epsilon_i, \tag{5.1}$$

where X_i is possibly correlated with ϵ_i. Additionally, we control for parental characteristics ($parental_i$), further control variables (Z_i), and the county the graduates went to high school ($county_i$). The parental characteristics $parental_i$ contain in the base specification the father's occupational status.[13] The control variables Z_i contain gender, age, whether the graduate has children, and her partnership. The partnership can either be without a firm partner, having a firm partner but not living together, or living with a firm partner. Moreover, the high school grade, the broad subject, whether the graduates did an internship during her studies and whether she lived abroad are included in Z_i. As X_i is endogenous ($Cov(X_i, \epsilon_i) \neq 0$), we apply an instrument in the first stage:

$$X_i = \alpha_0 + \alpha_1 distance_i + \alpha_2 parental_i + \alpha_3 Z_i + \alpha_4 county_i + e_i, \tag{5.2}$$

where $distance_i$ stands for the distance to the closest university. As choice of living might not be random, we control for $parental_i$ and $county_i$. We argue that this makes $distance_i$ uncorrelated with ϵ_i and therefore exogenous ($Cov(distance_i, \epsilon_i | parental_i, county_i) = 0$).

6 Bavarian Graduate Panel

To investigate determinants of mobility, we use the Bavarian Graduate Panel (Bayerisches Absolventen Panel - BAP)[14], a survey amongst graduates from Bavarian universities and applied universities. The BAP is conducted by the Bavarian State Institute for University Research and Development (Bayerisches Staatsinstitut für Hochschulforschung und Hochschulplanung - IHF). The survey focuses on the transition from university to the labor market and aims to cover all Bavarian universities and universities of applied sciences with possibly all fields of study, if a field had at least 10 graduates in the respective survey year. The survey is conducted approximately every 2-3 years with the first cohort interviewed in 2003-2004.

In the survey, graduates are asked about their course of study, their first position at the labor market, socio-economic indicators and when and where they received their university entrance diploma. A distinct feature of the BAP with respect to other graduate surveys is the possibility to track persons spatially at a very granular level (up to post codes) since graduates indicate the post code of the school, they graduated from, the university where spatial information can be generated easily and the post code of their first position at the

[13] We decided to control only for the father's occupational status. Hence, we do not include the father's educational level or the same variables for the mother. We did this due to the high correlation between these variable to avoid collinearity. Results with another specification are available upon request.

[14] More information can be found at https://www.bap.ihf.bayern.de/en/bap-home, last checked 20.11.2019.

labor market.[15] Graduates are interviewed up to three times after graduation. Whereas the first wave takes place roughly 1.5 years after graduation with a focus on the transition from university to labor market, the second wave (approximately 5 years after graduation) and third wave (approximately 10 years after graduation) are more focused on employment history and on the job training.

For that reason, we only use the first wave of the BAP and concentrate on the two graduation cohorts of 2005/2006 and 2009/2010. We concentrate our investigation on these two cohorts mainly due to the fact that the questionnaire of the BAP varies relatively strongly between cohorts and the biggest overlap of variables which are important for our investigation exists in these two cohorts. The latest cohort (2013/2014) for instance has no such detailed information on the high school location. In total, 22,296 graduates participated in the first interview of these two relevant cohorts.[16]

From the twelve Bavarian universities all but the University of the Armed Forces Munich and the University of Neuendettelsau took part in the survey. As stated in Section 3, these universities are special in their aims. The University of the Armed Forces Munich is only open to commissioned officers and officer candidates of the German army (Bundeswehr). Graduates of the University of Neuendettelsau usually become pastors. In total, the university only has about 150 students. Also, from the 19 universities of applied sciences we have to leave out the EVNH Nürnberg and the Catholic Foundation University Of Applied Sciences Munich due to similar data restrictions.

As the survey took place at Bavarian universities, we have no information on graduates who went to high school in Bavaria but did not go to a Bavarian university, who drop out of university before graduating, or who did not study at all. Hence, we can only analyze mobility patterns of graduates who limited their mobility to the state they went to high school and conditioned on graduating. For job mobility, this limitation does not hold anymore. We observe graduates from a Bavarian university if she moves to another state or even to another country. The fact that we only have university graduates might be less critical as university graduates are more mobile compared to people without a university degree.

Furthermore, it does not seem to be problematic for our identification neither that we only investigate movement to a university within Bavaria for two reasons. Firstly, German students do not seem to be very mobile between states. Statistics from the Federal Statistical Office (2019) show that roughly 60% of all freshmen in Bavaria also stem from Bavaria[17] and that only

[15] Graduates do not directly indicate the post code of their employers office but the post code of their private address after beginning to work. Although this might not perfectly correlate with the employers address this represents the best possible proxy for first job location of graduates available.

[16] In 2005/2006 6,819 graduates participated which equals a respondent rate of 38.9%. For the cohort 2009/10 the respondent rate was 37.5% with 15,477 interviewed graduates.

[17] This percentage corresponds to the year 2014, the values for other years differ only slightly.

20% of all Bavarian high school graduates who decide to study leave Bavaria for enrollment. Secondly, this seems to hold true for the general population: According to Deutsche Post Adress (2018), more than 85% of all relocations in Germany happen within the same state (Bundesland).

To conclude this section and coming to the estimation results, I will present some descriptive statistics. In the data, Munich is shown as the LMR with the fewest movers when it comes to the first movement, compared to other LMRs (Table A.1, first column). Only 22 percent of all Munich high school graduates in our data move to a university outside Munich. Mainly cities from northern Bavaria have high shares (Amberg, Ansbach, Bamberg and Bayreuth). Noteworthy, these are cities with a university or a university of applied sciences. When it comes to job mobility, again, graduates stemming from the Munich LMR are the least mobile (Table A.1, second column). This shows that a majority stays in Munich at least for the first job. Even the majority of those who went to study in another city return for the first job to Munich (column 3). Nuremberg, the second biggest city of Bavaria, is second in the category of the returnees.

Table A.2 shows the job movement based on the LMR of a student's university. Column 1 shows the share of job movers who did not move for university, whereas column 2 shows the share of job movers who moved for university. Column 3 shows the returnees, i.e. students who came from another LMR and moved back there for the first job. For Munich, the share of students who did not move for studying and then moved for the first job is the lowest. But also students who came from another LMR to Munich for studying barely move again somewhere else for the first job. The share of returnees is the lowest as well. It is interesting to see, that in other cities at least one third of the "stayers" move to another place for the first job. So, that one could think that they make up for the missed opportunity when deciding where to enroll. Also, students who have already moved for the university seem to either move again for the first job or to return to their home LMR.

Focusing on the group of interest who stem from the Munich suburban region, Table A.3 shows the university destination, whereas Table A.4 shows the later first job destination. For the university, Augsburg, Passau and Regensburg are the favorite destinations. While Augsburg is a close city to Munich, Passau with 170 km and Regensburg with 125 km are cities with a medium distance to Munich. The destinations for the first job are wider spread. They are not limited by Bavaria or by the constraint to have a university. This makes them also less accumulated. The three top destinations are Ingolstadt, Augsburg and Düsseldorf. Again, while Ingolstadt and Augsburg are rather close to Munich, Düsseldorf is more than 600 km away and not located in Bavaria. Finally, Table A.5 shows that movers and non movers do not differ in observable characteristics. The biggest of very little differences is shown in the parental education. Anyhow, this was assumed in the empirical approach and is controlled for.

7 Regression results

The results presented in this section show a significant causal effect of early mobility on later mobility for the first job. Moreover, we show robustness checks with respect to observable characteristics, the exclusion restriction and the choice of the suburban region.

7.1 Effects of distance and of early movements

The results show that mobility for university (as a reminder, mobility is defined as enrolling at a university outside the home LMR) has an impact on later mobility for the first job. They show that a person having moved for university is around 60 percentage points more likely to move again for the first job than one who stayed in Munich for studying. The results are presented in Table 1 in the following way: First, showing our preferred specification with dummies for the county and controls for parental education and type of job from the survey. Second, all controls are removed but the county. The results remain very robust. Therefore, one might think that the parental background is less decisive. However, from a theoretical point of view, the results might not be interpreted causally anymore. Third, more controls are added, which increases the estimate only very slightly.

Both the biased linear ("OLS") and the instrumented ("IV") specification are presented in Table 1a. From the OLS to the IV, the estimate increases from around .1 to around .6. The F-statistic is greater than 10 and therefore, showing that the instrument is very strong. The first stage is also presented and shows high relevance of the instrument. Results are also presented for the Probit model (Table A.6). As both the dependent and the explanatory variable are dummys, one would estimate a probit IV. However, linear models are easier to interpret. Therefore, I will present mainly the linear specification.[18] Again, the instrumented, unbiased estimate increases comparing to the biased estimate. The marginal effect can be interpreted that a graduate having moved for university is two times more likely to move for the first job than a graduate who studied at her home university.

Returning to the linear model, the first stage estimate is in all specifications around .02, meaning that a 1 km increase in the distance increases the probability of moving for the

[18] All results estimated applying Probit models can be shown upon request.

Table 1: Regression results

(a) Panel A: Main results

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
Moved for university	0.0837*	0.0849*	0.0605	0.590**	0.526**	0.651**
	(0.0487)	(0.0476)	(0.0510)	(0.266)	(0.244)	(0.275)
First Stage						
Minimal distance to university	0.0228***	0.0237***	0.0228***			
	(0.00603)	(0.00594)	(0.00594)			
county FE	X	X	X	X	X	X
parental controls	X		X	X		X
further controls			X			X
Observations	359	367	346	359	367	346
$F-stat$				14.309	15.953	14.701

(b) Panel B: Intent to treat / reduced form

	(1) Moved for first job	(2) Moved for first job	(3) Moved for first job
Minimal distance to university	0.0134**	0.0124**	0.0146***
	(0.00549)	(0.00529)	(0.00561)
county FE	X	X	X
parental controls	X		X
further controls			X
Observations	358	366	345
r2	0.039	0.032	0.082

Note: Dependent variable: Moved for job. Instrument: Distance to the closest university. Robust standard errors. All results contain fixed effects for the county. Parental Control: father's education. Further controls: gender, age, children, partnership, high school grade, university subject, internship, and lived abroad. Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01

university by 2 percentage points.[19] The reduced form (intention to treat) is presented as well, showing significant and robust effects at a point estimate of around .013 (Table 1b). It can be seen that the distance to the closest university is correlated with the decision to move when taking the first job.

7.2 Threats to identification

The results stay robust against observable controls (last column). In the next tables, we will challenge the exclusion restriction by changing the instrumented variable. We present the same instrument against all observable controls and show that for none of them the p-value is close to significance. To make this more visible, the p-values will be shown in parentheses instead of the standard errors in the following tables (Table A.7 & A.8).

As in any instrumental variable approach the exclusion restriction is key. One could think of a selection problem in the data as only high school graduates who finished university are considered. For instance, one might expect that with higher distance to the university also intellectual capacity decreases. On the other side, only very good high school graduates from further away might study whereas students from closer located high schools might study even with they were less able. However, if we take the high school diploma (average) grade as a proxy for intellectual capacity and regress the distance variable on that outcome, the estimate is not significant.

Last, looking at the map in Figure A.1 the LMR of Munich gets relatively close to the cities of Augsburg for instance. However, this should not effect our results as we look only at the direct suburban region of Munich. Even the high schools close to the outer border of our group of interest are much closer to Munich than to Augsburg. Also, public transport in this region is constructed to connect to Munich and is rather bad to connect to other cities.

7.3 Robustness

In our main specification, we only control for the father's education, arguing that job category and mother's characteristics are correlated. Figure A.3 shows that the results stay robust when adding more parental controls. Additionally, we estimate the model applying the logarithm of the instrument and show that results stay unchanged. This controls that the results are not driven by observations with high distances.

[19] The first stage is also working for other cities and universities in other LMRs than Munich (with other radius for the borders as these cities are smaller than Munich). However, the second stage does not show significant results. This might be due to higher attachment to these regions, and therefore, higher returning rates after graduating from university, due to a high job-mobility of "stayers" due to weaker labor markets, or due to many "movers" moving to Munich, where it is easier to find a job.

Though we have good arguments for the cutoff-points to define the suburban region, we present robustness checks with different distances showing significant results as well. However, again the estimates might be biased as the exclusion restriction might not hold anymore. First, we vary the inner and outer distance. The inner border takes the values 10, 12.5, 15, and 17.5 km, where as the outer border takes the values 30, 32.5, and 35 km. Figure A.4 shows all donuts of these inner and outer borders. Then, we only vary the inner border and do not cut at the outer border. Here, the inner border takes the following values: 5, 7.5, 10, 12.5, 15, and 17.5 km (Figure A.5). Moreover, we follow an administrative approach by taking all observations in the LMR Munich but not in the city-county Munich (Table A.10). Dropping the city-county Munich and varying the distances also shows robust results (Figure A.6).

Next robustness check changes the street distance. We show that our approach still works if the linear distance (Figure A.7 and A.8) or travel time (by car; Figure A.9 and A.10) is taken instead of street distance. The linear distance is of course shorter than street distances. Therefore, the distances are set to 5, 7.5, 10, 12.5 and 15 km for the inner border and to 27.5, 30 km and no outer border for the outer border, both with and without the Munich city-county. For the travel time the borders are set to 20 and 25 minutes and 35 and 40 minutes and no outer border.

Concerns might be that the results are driven by a certain course of study that is not offered in Munich. Of course each university might have slightly different study regulations for popular subjects. These might not effect the enrollment decision. Most probably, one will notice these differences only when already studying there as they are not easily to find when informing about the future university. Then, there are mostly universities of applied sciences which can have a special focus, like the Rosenheim Technical University of Applied Sciences which offers some courses of study with a focus on timber. Also universities offer specific courses of study. For instance, the University of Bayreuth offers to study economics and philosophy in a joint program. The University of Passau allows students studying European Studies to take many language courses and combine it with legal studies and political science. Therefore, we show that the results are also robust when leaving out each county of all universities one by one (Figure A.11).

Also, as all students graduated in Bavaria, one might want check whether the results hold for job mobility within Bavaria. The results are shown in Table A.11. Finally, we show that the change when adding more controls comes from the controls and not from the reduced number of observations. In Table A.12, only observations without missings in all covariates are taken for the analysis. The results stay robust.

8 Conclusion

In this paper, we add to the existing literature on determinants of spatial mobility of university graduates. We show that the likelihood to move when entering the labor market for the first time is highly determined by previous mobility, i.e. the decision whether to study in the home area or somewhere else. We set up an identification strategy which is able to control for direct and indirect channels which influence the decision to move for university studies and therefore models this decision exogenously.

It seems that it is no solution to attract students to move to a LMR with the purpose to get new workers for that LMR. As students then seem to move again to another LMR. Therefore, it might be more effective to set financial incentives by the state or the country to not enroll at the home university, if job mobility is a general aim. Then, high potentials might get generally more willing to move and could therefore help the labor market where workers are needed but applicants are missing. On the other hand, if a city like Munich wants to keep all high potential graduates in the city, it should preserve financial aid to those high school graduates willing to study that lives further away from the city center. One way might be to reduce costs for the public transport system (a thing that was established recently) or support these new student with students accommodations. Student dormitories are at the moment limited to students from outside the suburban train system. It seems that also students outside the metro system but inside the suburban train system could be kept in the city with better accommodation possibilities.

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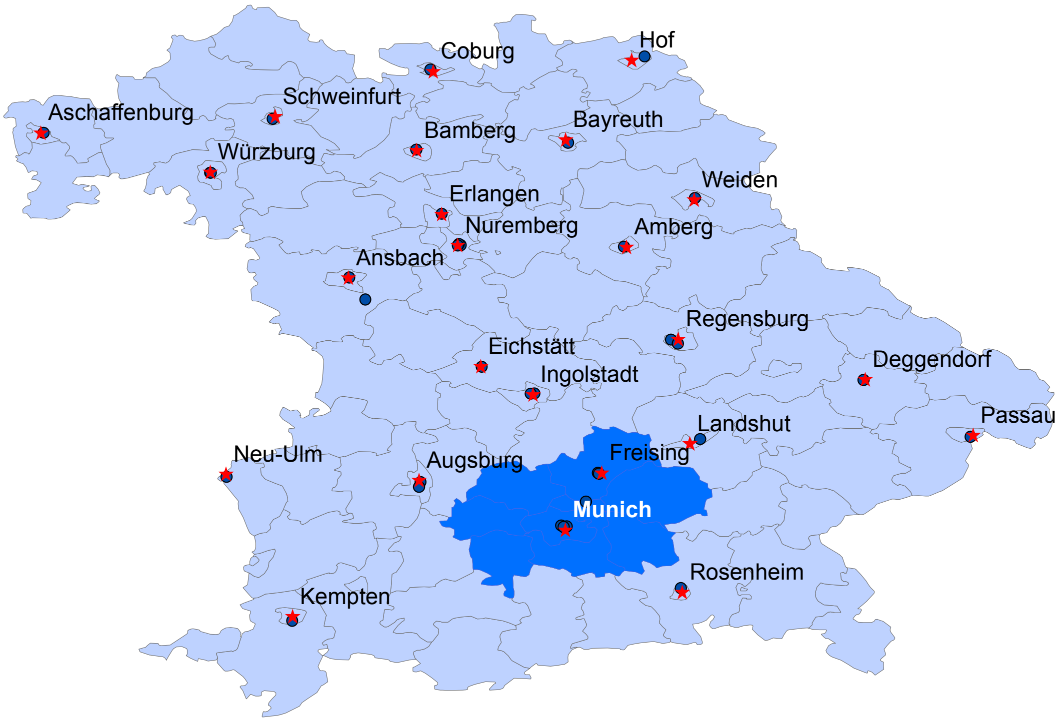
A Appendix

Figure A.1: Overview of all Bavarian cities with a university (of applied science)



Note: In this map of Bavaria with county boundaries, all cities with an university (of applied sciences) are named and marked with a red star. Each university (of applied sciences) is shown with a blue dot. The LMR of Munich is made more visible with a different blue tone.

Figure A.2: Distribution over distance to closed university (LMR Munich)

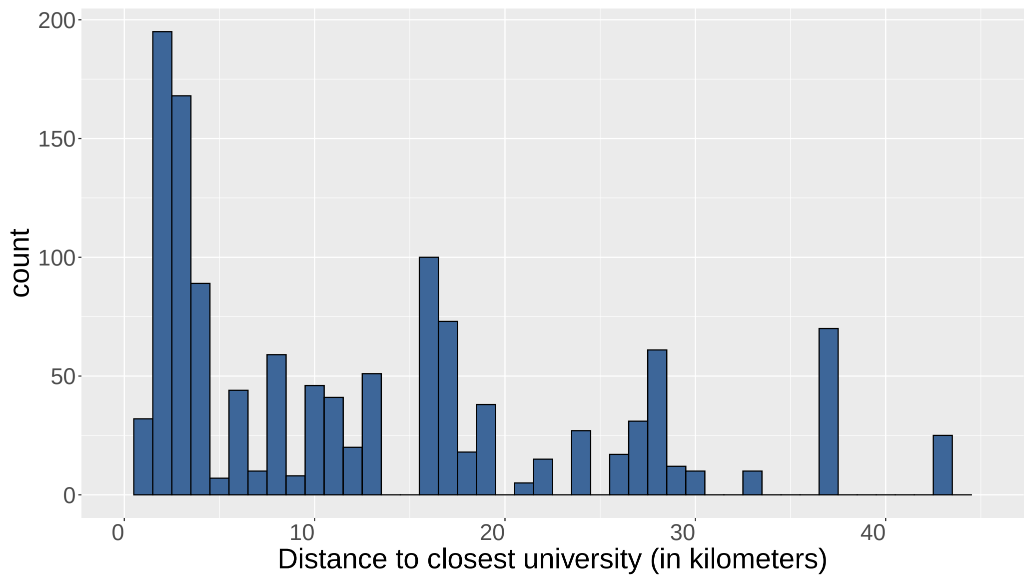
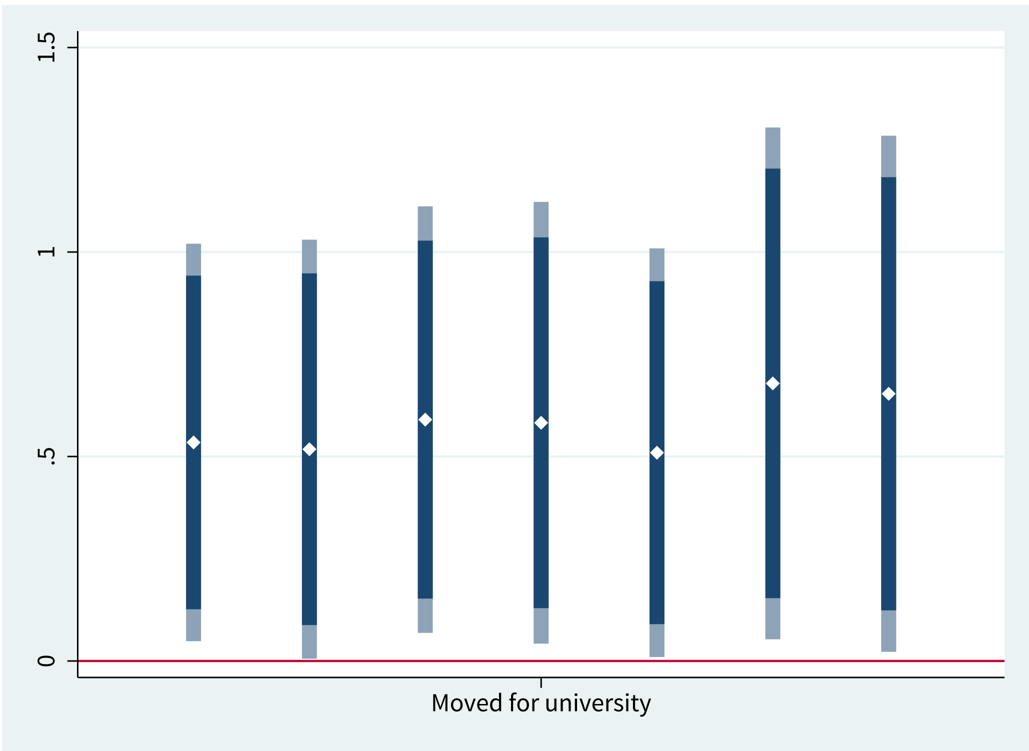
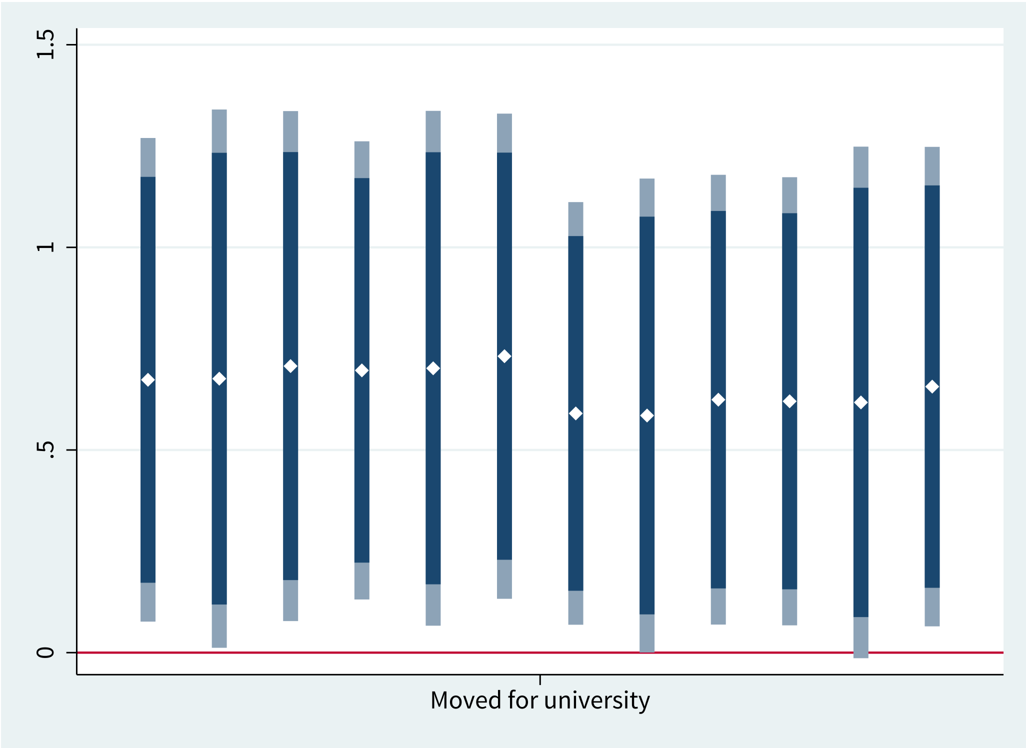


Figure A.3: Robustness of estimates when controlling for different parental characteristics



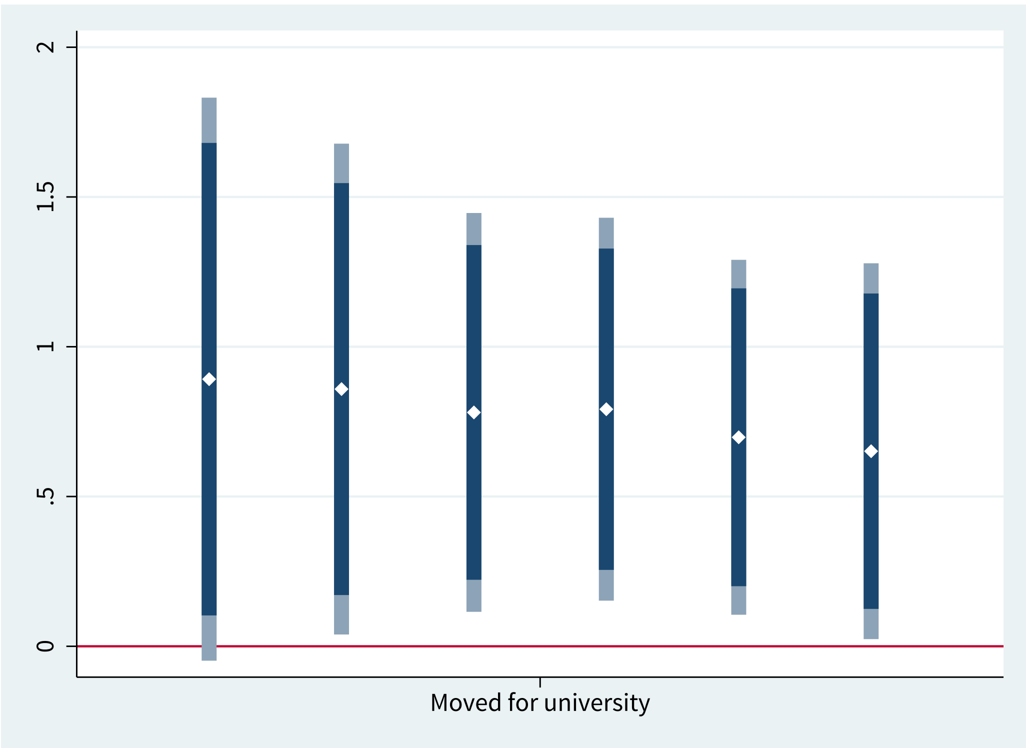
Note: All results contain fixed effects for the county and controls for the father's occupational status.

Figure A.4: Robustness of estimates when changing distances of the borders



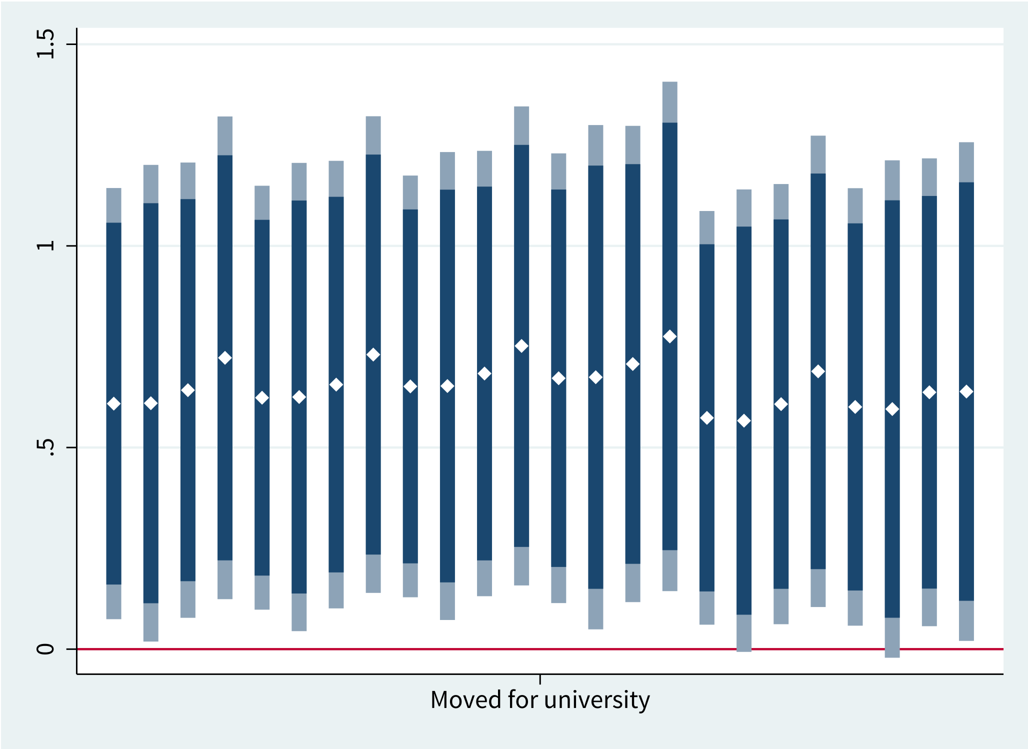
Note: All results contain fixed effects for the county and controls for the father's occupational status.

Figure A.5: Robustness of estimates when changing distances of the borders and having no outer cut-off point



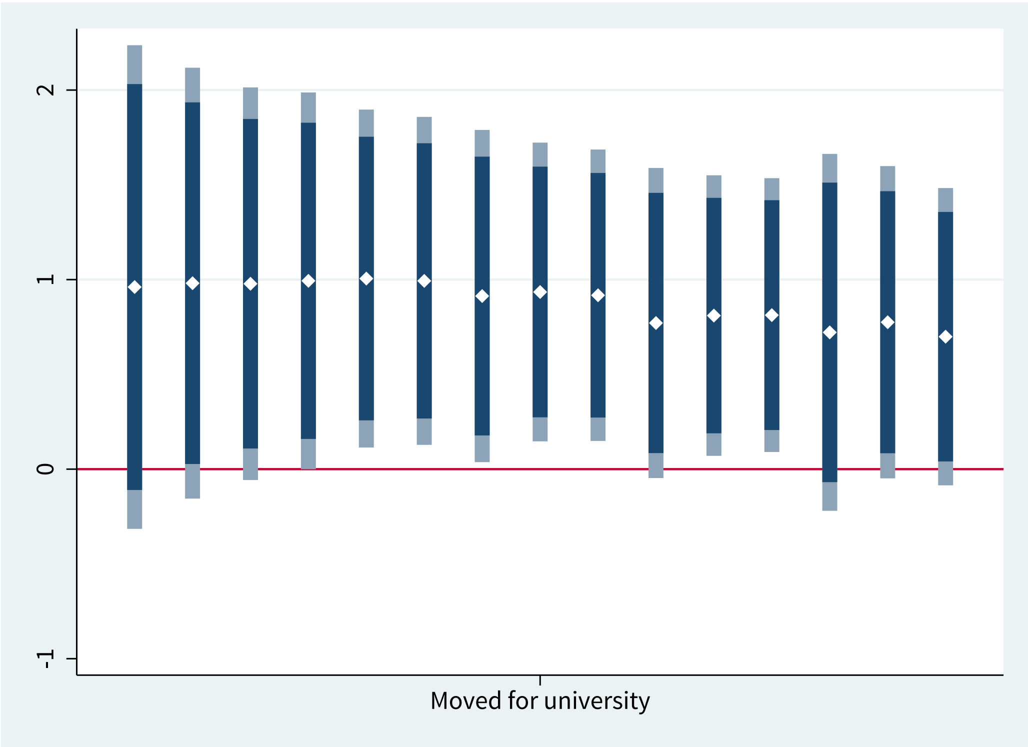
Note: All results contain fixed effects for the county and controls for the father's occupational status.

Figure A.6: Robustness of estimates when changing distances of the borders and leaving the city-county of Munich out



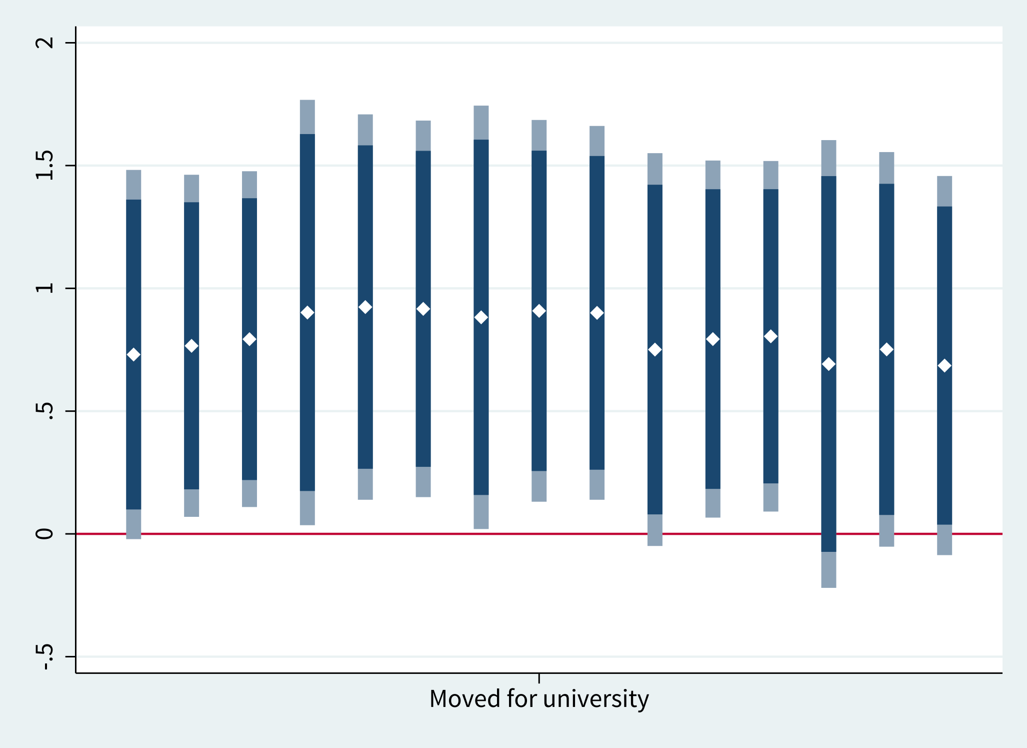
Note: All results contain fixed effects for the county and controls for the father's occupational status.

Figure A.7: Robustness of estimates when using linear distance and varying its borders



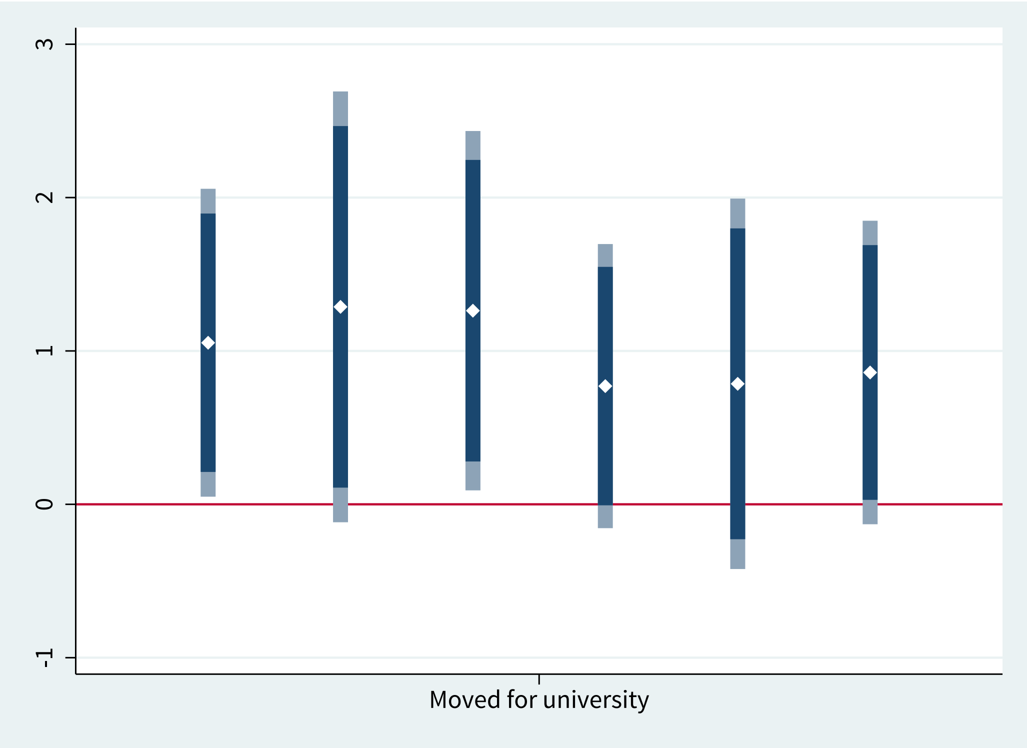
Note: All results contain fixed effects for the county and controls for the father's occupational status.

Figure A.8: Robustness of estimates when using linear distance, varying its borders, and leaving the city-county of Munich out



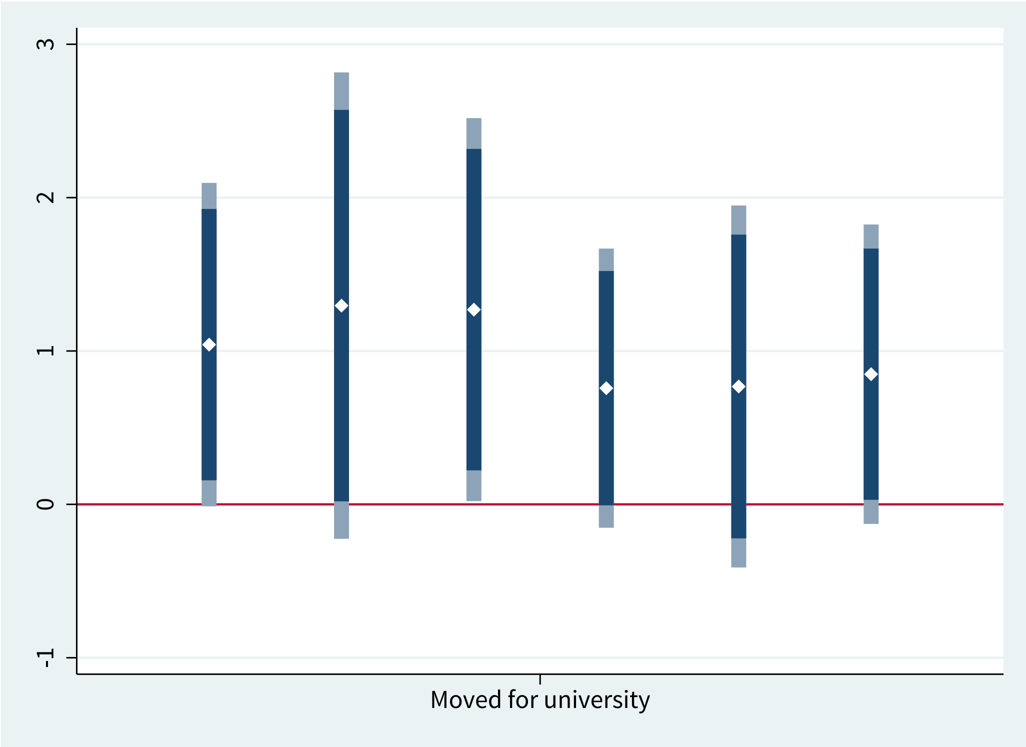
Note: All results contain fixed effects for the county and controls for the father's occupational status.

Figure A.9: Robustness of estimates when using travel time and varying its borders



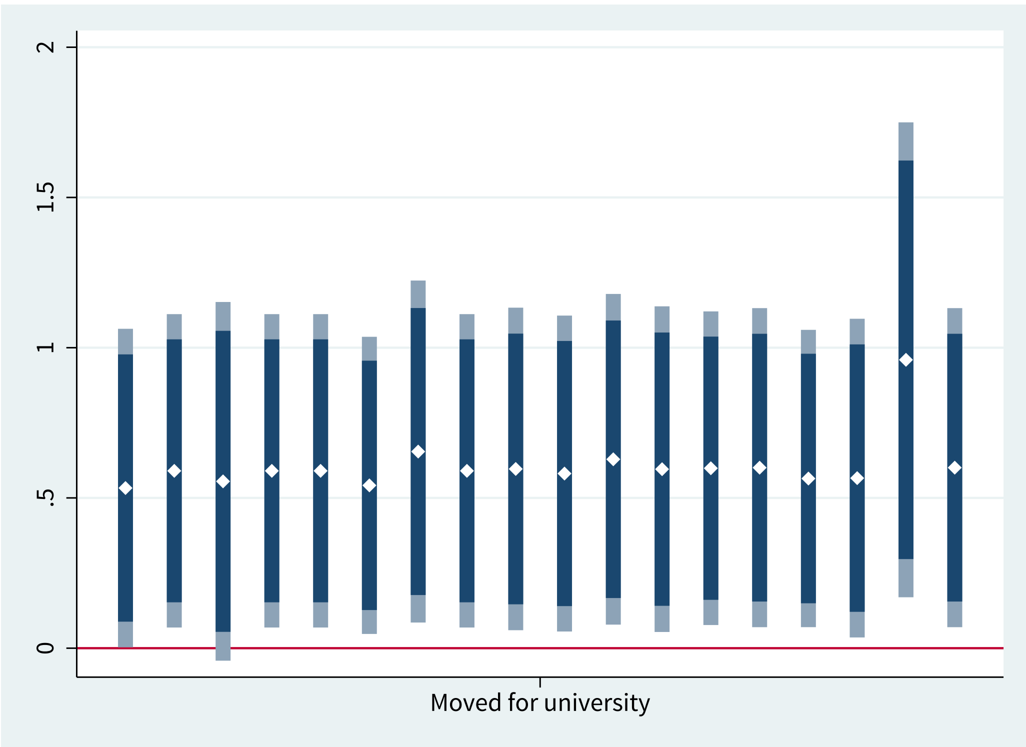
Note: All results contain fixed effects for the county and controls for the father's occupational status.

Figure A.10: Robustness of estimates when using travel time and varying its borders, and leaving the city-county of Munich out



Note: All results contain fixed effects for the county and controls for the father's occupational status.

Figure A.11: Robustness of estimates when leaving out one university county



Note: All results contain fixed effects for the county and controls for the father's occupational status.

Table A.1: Overview of movers in each stage for each home LMR and for the LMR of the university graduates

	university mover	job mover	returnee
Amberg	0.75	0.50	0.16
Ansbach	0.84	0.46	0.15
Aschaffenburg	0.50	0.47	0.21
Augsburg	0.40	0.33	0.22
Bamberg	0.80	0.48	0.23
Bayreuth	0.76	0.42	0.24
Coburg	0.42	0.52	0.22
Deggendorf	0.60	0.48	0.14
Erlangen	0.66	0.41	0.28
Hof	0.47	0.57	0.20
Ingolstadt	0.64	0.26	0.23
Kempten	0.55	0.36	0.21
Landshut	0.65	0.47	0.16
München	0.22	0.13	0.58
Nürnberg	0.61	0.31	0.36
Passau	0.61	0.45	0.28
Regensburg	0.23	0.40	0.25
Rosenheim	0.70	0.34	0.14
Schweinfurt	0.69	0.49	0.17
Ulm	0.85	0.52	0.17
Weiden	0.71	0.43	0.12
Würzburg	0.37	0.47	0.14

Note: Data from Bayerische Staatsinstitut für Hochschulforschung und Hochschulplanung (IHF)

Table A.2: Overview of movers in each stage for each home LMR and for the LMR of the university graduates

	job mover (stayer)	job mover (mover)	returnee
Amberg	0.56	0.46	0.26
Ansbach	0.33	0.50	0.44
Aschaffenburg	0.58	0.71	0.12
Augsburg	0.34	0.30	0.43
Bamberg	0.65	0.49	0.25
Bayreuth	0.29	0.35	0.26
Coburg	0.57	0.48	0.37
Deggendorf	0.58	0.44	0.46
Erlangen	0.62	0.32	0.28
Hof	0.65	0.59	0.28
Ingolstadt	0.25	0.44	0.36
Kempten	0.33	0.33	0.54
Landshut	0.56	0.32	0.56
München	0.11	0.17	0.10
Nürnberg	0.35	0.31	0.28
Passau	0.60	0.36	0.27
Regensburg	0.41	0.37	0.22
Rosenheim	0.46	0.33	0.37
Schweinfurt	0.63	0.63	0.27
Ulm	0.75	0.62	0.23
Weiden	0.42	0.49	0.32
Würzburg	0.44	0.42	0.24

Note: Data from Bayerische Staatsinstitut für Hochschulforschung und Hochschulplanung (IHF)

Table A.3: Where do high school graduates go to?

amr_name	No.
Amberg	1
Augsburg	20
Bamberg	3
Bayreuth	3
Deggendorf	1
Erlangen	1
Ingolstadt	9
Kempten	2
Landshut	9
Nürnberg	1
Passau	20
Regensburg	11
Rosenheim	6
Würzburg	3
Total	90

Note: Data from Bayerische Staatsinstitut für Hochschulforschung und Hochschulplanung (IHF)

Table A.4: Where do university graduates that stem from go to?

amr_name	No.
Aachen	1
Augsburg	5
Bad Tölz	3
Berlin	2
Bielefeld	1
Bonn	1
Braunschweig	1
Donauwörth-Nördlingen	1
Düsseldorf	4
Erlangen	1
Frankfurt/Main	2
Freiburg	1
Hamburg	2
Ingolstadt	6
Karlsruhe	1
Kempten	1
Landsberg	2
Landshut	2
Mainz	1
Münster	1
Nürnberg	2
Ravensburg	1
Regensburg	2
Rosenheim	1
Stuttgart	2
Ulm	1
Weilheim	2
Wiesbaden	1
Wolfsburg	1
Total	52

Note: Data from Bayerische Staatsinstitut für Hochschulforschung und Hochschulplanung (IHF)

Table A.5: Difference between movers and stayers

	non mover Mean/SD	**mover** Mean/SD
Female	0.4	0.4
	(0.5)	(0.5)
Age	26.4	26.5
	(2.4)	(2.7)
German	1.0	1.0
	(0.09)	(0.1)
Family Status	1.1	1.1
	(0.3)	(0.3)
Partnership	2.2	2.2
	(0.8)	(0.9)
Children	0.04	0.05
	(0.2)	(0.2)
UAS	0.4	0.4
	(0.5)	(0.5)
Subject	2.4	2.4
	(1.1)	(1.0)
Grade University	1.8	1.8
	(0.5)	(0.5)
Intern Experience	0.7	0.8
	(0.4)	(0.4)
Experience Abroad	0.4	0.4
	(0.5)	(0.5)
Work Experience	1.0	1.0
	(0.3)	(0.4)
Type High School	1.2	1.3
	(0.7)	(0.7)
Grade High School	2.3	2.4
	(0.6)	(0.6)
Job Mother	1.2	1.1
	(0.8)	(0.8)
Job Father	2.0	2.0
	(0.9)	(0.9)
Education Mother	2.4	2.6
	(0.8)	(0.8)
Education Father	2.0	2.2
	(0.9)	(0.9)
Observations	4811	4811

Note: Data from Bayerische Staatsinstitut für Hochschulforschung und Hochschulplanung (IHF)

Table A.6: Probit estimation

	(1) probit	(2) probit	(3) probit	(4) probitIV	(5) probitIV	(6) probitIV
Moved for first job						
Moved for university	0.395^{**}	0.389^{**}	0.287	1.931^{***}	1.802^{***}	2.057^{***}
	(0.181)	(0.179)	(0.193)	(0.361)	(0.413)	(0.340)
county FE	X	X	X	X	X	X
parental controls	X		X	X		X
further controls			X			X
Observations	358	366	345	358	366	345

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Dependent variable: Moved for job. Instrument: Distance to the closest university. Robust standard errors. All results contain fixed effects for the county. Parental Control: father's education. Further controls: gender, age, children, partnership, high school grade, university subject, internship, and lived abroad. The sample contains all graduates which went to a high school in the Munich LMR but those who went to a high school in the city-county of Munich.

Table A.7: Robustness: Exclusion restriction (raw regressions)

	(1) survey year	(2) female	(3) age	(4) UAS	(5) grad (university)	(6) internship
Minimal distance to university	-1.935	0.000568	0.00898	0.000955	-0.00483	0.00267
	(0.478)	(0.933)	(0.723)	(0.878)	(0.457)	(0.636)
county FE	X	X	X	X	X	X
parental controls						
further controls						
Observations	366	366	363	331	333	359
r2	0.046	0.013	0.024	0.066	0.017	0.021

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) living abroad	(2) working student	(3) high school type	(4) grad (high school)	(5) marital status	(6) partnership
Minimal distance to university	-0.00153	0.00125	0.00585	-0.0119	-0.00315	-0.00701
	(0.823)	(0.805)	(0.184)	(0.138)	(0.492)	(0.557)
county FE	X	X	X	X	X	X
parental controls						
further controls						
Observations	364	360	365	366	359	358
r2	0.022	0.018	0.093	0.011	0.013	0.023

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) working student (dummy)	(2) high school type (dummy)	(3) partnership: alone	(4) partnership: living separated	(5) partnership: joint household
Minimal distance to university	-0.00190	-0.00411	0.00345	0.00109	-0.00350
	(0.697)	(0.105)	(0.587)	(0.849)	(0.606)
county FE	X	X	X	X	X
parental controls					
further controls					
Observations	366	366	366	366	366
r2	0.014	0.120	0.020	0.020	0.023

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Robust standard errors. All results contain fixed effects for the county. The instrument, distance to the closest university, is regressed on control variables. This indicates that the exclusion restriction might hold as the instrument is not correlated with observable characteristics.

Table A.8: Robustness: Exclusion restriction (with parental controls)

	(1) survey year	(2) female	(3) age	(4) UAS	(5) grad (university)	(6) internship
Minimal distance to university	-2.683	-0.000825	0.0222	0.00132	-0.00462	0.00451
	(0.326)	(0.904)	(0.386)	(0.835)	(0.487)	(0.434)
county FE	X	X	X	X	X	X
parental controls	X	X	X	X	X	X
further controls						
Observations	358	358	357	323	325	351
r2	0.060	0.029	0.042	0.072	0.037	0.049

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) living abroad	(2) working student	(3) high school type	(4) grad (high school)	(5) marital status	(6) partnership
Minimal distance to university	-0.00116	0.00103	0.00544	-0.0110	-0.00139	-0.00657
	(0.867)	(0.837)	(0.222)	(0.184)	(0.763)	(0.586)
county FE	X	X	X	X	X	X
parental controls	X	X	X	X	X	X
further controls						
Observations	356	352	357	358	354	353
r2	0.032	0.015	0.093	0.028	0.022	0.024

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) working student (dummy)	(2) high school type (dummy)	(3) partnership: alone	(4) partnership: living separated	(5) partnership: joint household
Minimal distance to university	-0.00301	-0.00346	0.00313	0.000568	-0.00355
	(0.529)	(0.184)	(0.631)	(0.924)	(0.607)
county FE	X	X	X	X	X
parental controls	X	X	X	X	X
further controls					
Observations	358	358	358	358	358
r2	0.026	0.117	0.020	0.024	0.026

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Robust standard errors. All results contain fixed effects for the county. Parental Control: father's education. The instrument, distance to the closest university, is regressed on control variables. This indicates that the exclusion restriction might hold as the instrument is not correlated with observable characteristics.

Table A.9: Robustness: Logarithm

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
Moved for university	0.0837*	0.0849*	0.0605	0.590**	0.527**	0.661**
	(0.0487)	(0.0476)	(0.0510)	(0.268)	(0.246)	(0.281)
county FE	X	X	X	X	X	X
parental controls	X		X	X		X
further controls			X			X
Observations	359	367	346	359	367	346
$F-stat$				14.255	15.822	14.276

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Dependent variable: Moved for job. Instrument: Logarithm of distance to the closest university. Robust standard errors. All results contain fixed effects for the county. Parental Control: father's education. Further controls: gender, age, children, partnership, high school grade, university subject, internship, and lived abroad. The sample contains all graduates which went to a high school in the Munich LMR but those who went to a high school in the city-county of Munich.

Table A.10: Robustness: Remove only city-county of Munich

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
Moved for university	0.103***	0.105***	0.0771**	0.713**	0.686**	0.716**
	(0.0372)	(0.0367)	(0.0382)	(0.306)	(0.305)	(0.315)
county FE	X	X	X	X	X	X
parental controls	X		X	X		X
further controls			X			X
Observations	590	602	566	590	602	566
F				8.652	8.367	8.403

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Dependent variable: Moved for job. Instrument: Distance to the closest university. Robust standard errors. All results contain fixed effects for the county. Parental Control: father's education. Further controls: gender, age, children, partnership, high school grade, university subject, internship, and lived abroad. The sample contains all graduates which went to a high school in the Munich LMR but those who went to a high school in the city-county of Munich.

Table A.11: Robustness: only observations with a job within Bavaria included

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
Moved for university	0.0287	0.0268	0.0182	0.539**	0.487**	0.536**
	(0.0391)	(0.0380)	(0.0416)	(0.234)	(0.223)	(0.216)
county FE	X	X	X	X	X	X
parental controls	X		X	X		X
further controls			X			X
Observations	334	342	321	334	342	321
F				13.542	14.571	13.987

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Dependent variable: Moved for job. Instrument: Distance to the closest university. Robust standard errors. All results contain fixed effects for the county. Parental Control: father's education. Further controls: gender, age, children, partnership, high school grade, university subject, internship, and lived abroad. The sample is reduced to graduates who had their first job in Bavaria.

Table A.12: Robustness: for all columns only observations with no missings included

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
Moved for university	0.0858*	0.0856*	0.0605	0.555**	0.503**	0.651**
	(0.0494)	(0.0489)	(0.0510)	(0.261)	(0.248)	(0.275)
county FE	X	X	X	X	X	X
parental controls	X		X	X		X
further controls			X			X
Observations	346	346	346	346	346	346
F				13.989	14.857	14.701

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Dependent variable: Moved for job. Instrument: Distance to the closest university. Robust standard errors. All results contain fixed effects for the county. Parental Control: father's education. Further controls: gender, age, children, partnership, high school grade, university subject, internship, and lived abroad. Observations are only taken into account if they do not have missings for any control variable.