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Studying Abroad and the Effect on International Labour Market Mobility

– Evidence from the Introduction of ERASMUS –

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Abstract

We investigate the effect of studying abroad on international labour market mobility later in life for university graduates. We exploit the introduction and expansion of the European ERASMUS student exchange programme as an instrument for studying abroad. We find that studying abroad increases an individual's probability of working in a foreign country by about 15 percentage points. We investigate heterogeneity in returns according to parental education and the student's financial situation. Furthermore, we suggest mechanisms through which the effect of studying abroad may operate.

International labour market migration has risen dramatically in the recent past, especially among university graduates. Lowell (2007), for example, shows an increase in the emigration rate of university graduates from about 4% in 1980 to about 7% in 2000 for developed countries. The increased demand for skilled labour and the importance of highly skilled individuals for innovation has induced many countries to implement policies geared to attracting skilled migrants from abroad (OECD, 2002). Understanding the

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determinants of migration is key to formulating such policies. While attention has traditionally focused on wage differentials, going back to Hicks (1932), it is clear that other factors are important determinants of international mobility.[1] One possible determinant which has received particular attention of policymakers over the past years is student mobility during tertiary education. In particular, it has been hypothesized that student mobility may act as a 'stepping stone' for later labour migration (Guellec & Cervantes, 2001). Numerous countries, including the United States, Japan, and the United Kingdom, attempt to attract highly skilled mobile workers through policies relating to student mobility programmes (Guellec & Cervantes, 2001). These are based on the assumption that student mobility has a genuine effect on later labour market mobility. Despite the widespread belief in the link between studying abroad and international labour market mobility, empirical evidence is very limited. Establishing a causal link between studying abroad and labour market mobility later in life is a challenging task because students who decide to study abroad are in many ways different from students who undertake all of their education in their home country. The unobserved heterogeneity may also affect the decision of working abroad later in life. This may introduce a bias in OLS estimates of the effect of studying abroad on subsequent international labour migration decision.

In this paper, we provide evidence on the *causal* effect of studying abroad on later labour market mobility by exploiting an exogenous change in student mobility: the introduction of the ERASMUS student exchange programme. This programme has been devised by the European Union to foster student exchange in Europe. Introduced in 1987 it offers the possibility of studying in another European country for up to 12 months at very low cost. Different universities and different departments introduced the programme at very different times. We exploit the variation in scholarship availability as a source of exogenous variation in a student's probability to study abroad. In order to ascertain a student's exposure to the ERASMUS programme we construct a unique data set, containing annual information on the number of exchange places for each subject at every German university. In order to assess the effect of studying abroad on international mobility later in life we merge this data to a survey of German university graduates. We first show that the ERASMUS programme has a strong impact on a student's probability of studying abroad. We then use the department level variation in international student exchange programmes to identify the causal effect of studying abroad on the decision of working in a foreign country later in life. We find that studying abroad increases a person's probability of working abroad by about 15 percentage points. This is a large effect given that the difference in means between those who studied abroad and those who did not is about 6.5 percentage points in our OLS specification.[2] The result suggests

[1] For surveys on determinants of migration, see Greenwood (1975, 1985, 1997).

[2] Below we show some evidence that this relatively large effect may be driven by heterogeneity in returns. Expanding the scope or scale of student exchange programmes may therefore produce either smaller or larger returns.

that studying abroad has a strong causal effect on labour market mobility later in life. Qualitative evidence suggests that besides career concerns soft factors such as interest in foreign cultures or living with a foreign partner are important determinants for the decision to work abroad, and we suggest that the effect of studying abroad may work through these channels.

There are some papers analysing the link between labour market mobility and previous mobility. Kodrzycki (2001) provides descriptive evidence on inter-state mobility in the US and links it to the preceding decision of attending college out-of-state.[3] Malamud and Wozniak (2008) study the effect of the decision to go to college on interregional mobility in the US. Using an instrumental variables approach to control for selection effects they find that attending college increases the probability of residing out-of-state later in life by about 35 percentage points. Using individual-level data from the US, Groen (2004) documents that studying in a given state increases the probability of later working in that state, accounting for selection by exploiting information on the set of states individuals applied for. Bound *et al.* (2004) estimate that increasing production of college graduates at the state level leads to moderate increases in the stock of college-educated workers in that state.

The link between *international* student mobility and the decision to work abroad after graduation has rarely been studied to date. One reason is data availability: Most surveys do not contain information on study abroad spells during a student's undergraduate career, and graduates who work abroad are generally not sampled in national surveys of the sending countries. The paper which is most closely related to ours is a study by Oosterbeek and Webbink (2009). They employ a regression discontinuity design to control for unobserved heterogeneity between internationally mobile and non-mobile students. Using data on talented Dutch university students they find that studying abroad increases the probability of living in a foreign country by about 50 percentage points. A key difference to our work is that they look at a small sample of particularly talented students, while we use a nationally representative survey of German university graduates. Another important difference is that Oosterbeek and Webbink investigate the effect of *postgraduate* studies abroad. Students pursuing a postgraduate degree abroad may remain in the receiving country while looking for work. Part of the effect they find may also be driven by the fact that some of the respondents abroad are still enrolled in higher education at the time of the survey. In contrast, in our work, the intervention is international mobility during the undergraduate career, after which students return to complete their degree in Germany. Thus, our research design allows us – and in fact forces us – to separate the two mobility investments (studying abroad and working abroad). The effect we find is therefore informative about the dynamic effects of earlier

[3]She finds that individuals who attended college out-of-state are 54% more likely to live out-of-state five years after graduation. These results, however, cannot be interpreted as causal effects as she does not address the selection issues affecting mobility decisions.

mobility investments.[4]

This paper presents evidence that previous educational mobility is a very important determinant of mobility later in life. We thus establish a causal link of previous mobility decision to mobility later in life.[5] This highlights the importance of taking earlier mobility into account in economic modelling but also for policy decisions. The European Union, for example, tries to foster labour market mobility in the EU (see "Commission's Action Plan for skills and mobility" (2002)). Our research suggests that supporting international student mobility is a very successful policy instrument to foster labour market mobility later in life. Our results on the effect of the ERASMUS programme on the probability of studying abroad also show that exchange programmes are indeed effective in promoting student mobility. This will be important to policymakers as they spend large public funds on these programmes.

We emphasize that our primary interest lies in understanding the role of studying abroad as a determinant of individual international labour migration decisions, and the use of the ERASMUS programme is motivated by the variation it induces in students' decision to study abroad. Our data does not allow us to investigate the role of the ERASMUS programme on immigration of skilled graduates from other countries to Germany, or the overall effect of studying abroad on the international distribution of human capital, although these are potentially interesting and important questions.

The paper proceeds as follows: The next sections provide institutional detail on the ERASMUS programme and describe our data. Section 3 outlines our identification strategy. In the following section we report our first stage results and provide evidence that our instruments are both powerful and operate very precisely in the way we claim they do. Section 5 presents the main results and a number of sensitivity checks. We present descriptive evidence into the channels which lead students who studied abroad to work abroad later on. The last section concludes.

1 The ERASMUS Programme

Our identification strategy relies on the large scale introduction and expansion of the ERASMUS programme. In 1987, the Council of Ministers of the European Community passed the *European Community Action Scheme for the Mobility of University Students* (ERASMUS). The main objective of ERASMUS is "to achieve a significant increase in the number of students [...] spending an integrated period of study in another Member State" (Council of the European Communities, 1987). Student mobility was to be increased through the creation of a European university network, individual scholarships, and

[4]See Jahr and Teichler (2000) and Dreher and Poutvaara (2005) for more descriptive accounts of the effects of studying abroad. They find very similar magnitudes to the ones estimated in this paper.

[5]This finding is consistent with the descriptive literature on the determinants of migration.

mutual recognition of academic credits.

Since then, ERASMUS has continually expanded. Looking across all participating countries, 1.37 million students have taken part in ERASMUS in the period of the academic years 1987/88 to 2004/05, with 15.7% of those outgoings coming from Germany.[6] Figure 1 shows the number of German outgoing students for each year since the introduction of the programme.

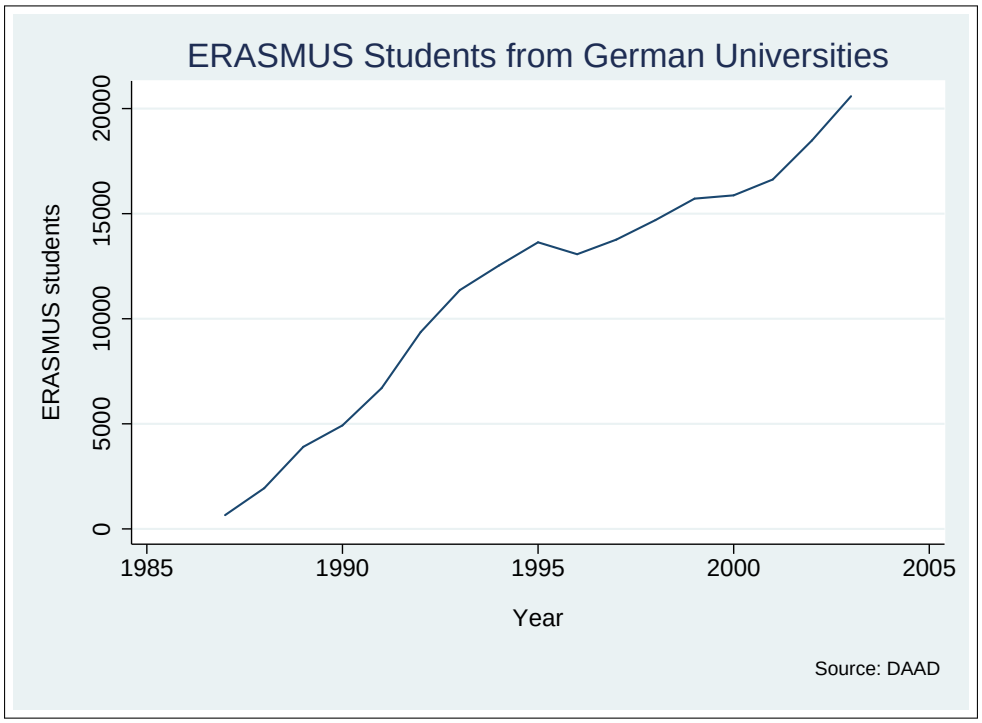

Fig. 1. *ERASMUS in Germany*

The expansion of ERASMUS has significantly contributed to the overall incidence of studying abroad. Our data shows that about 15% of the students in the 2005 graduate cohort have studied abroad as part of their undergraduate degree. We calculate that about 6.7% of the cohort has studied abroad with an ERASMUS scholarship. This amounts to 45% of all students in this cohort who studied abroad.[7] The ERASMUS programme therefore accounts for about half of international undergraduate mobility in Germany.

Students participating in the ERASMUS programme apply for an exchange scholarship at their home university usually one year before they intend to study abroad.

[6]The share of German students as a percentage of all ERASMUS students in Europe has remained relatively constant over time, always ranging between 14 and 20%.

[7]This number is obtained as follows: In the 2005 graduate cohort, the median student started her tertiary studies in the academic year 1999/2000. In that year, about 246782 students entered university. The typical exchange student in that cohort studied abroad in the third year of her studies. In that year 16626 students from German universities participated in the ERASMUS programme. This corresponds to about 6.7% of the entire cohort. The corresponding percentages for the other cohorts are: 6.3% (2001), 4.2% (1997), 2.2% (1993), and 0% (1989).

The department then decides who is awarded an ERASMUS scholarship. The criteria for obtaining an award are mostly based on academic achievement and motivation (as demonstrated in a written statement of interest and/or an interview). In very rare cases the places are allocated on a first come first serve basis.[8] The award of the scholarship not only secures them a place at a certain partner university abroad but also provides them with a small mobility grant. In the academic year 2001/2002 (the year a typical student from the 2005 graduation cohort went abroad) an outgoing student from Germany received about 146 Euros per month for her stay abroad. In addition to receiving the mobility grant the ERASMUS student receives a tuition fee waiver at the foreign university. Another important benefit of ERASMUS is that it significantly reduces the student's application costs and the time the student needs to apply in advance to be able to organize a stay at a foreign university.

University participation in ERASMUS operated through Inter-University Cooperation Programmes (ICP), in which groups of university departments from different countries formed a network covered by an ICP agreement, typically initiated through an active professor who happens to have contacts with professors at foreign universities. If new universities join the ICP additional places may become available. Many departments would at some point enter ERASMUS with a few links to departments at foreign universities. Over time other foreign departments would be taken into the network, increasing the number of exchange places for German students. Similarly the German department itself would enter other (possibly new) cooperation networks. One way to interpret the evolution in ERASMUS scholarships is to think of the cooperations as an emerging network.

The professors involved in the organization of the ERASMUS student exchange programme agree on the number of incoming and outgoing ERASMUS places for each participating university. These agreements are usually longer-term contracts covering a number of years. Thus, the number of exchange places with a certain foreign university stays constant for some years. Sometimes not all admitted students take up their place because they receive another scholarship or because they change their mind about wanting to study abroad. As the ICP agreements are long term agreements this does not affect the number of slots in the following year.

In order to give an insight into the variation, which is exploited in our identification strategy, we show the raw data on the number of ERASMUS students at four departments at the two large universities in Munich in the following Figure 2.[9]

The introduction of the ERASMUS programme at a certain department occurred at different points in time at the two universities even though the universities are of very similar quality. This indicates that a large degree of the variation in ERASMUS

[8] For more information on the allocation process see Maiworm *et al.* (1993).

[9] We choose the Ludwig-Maximilians University Munich and the Technical University Munich for this descriptive analysis because they are located in the same city and are of similar quality and reputation.

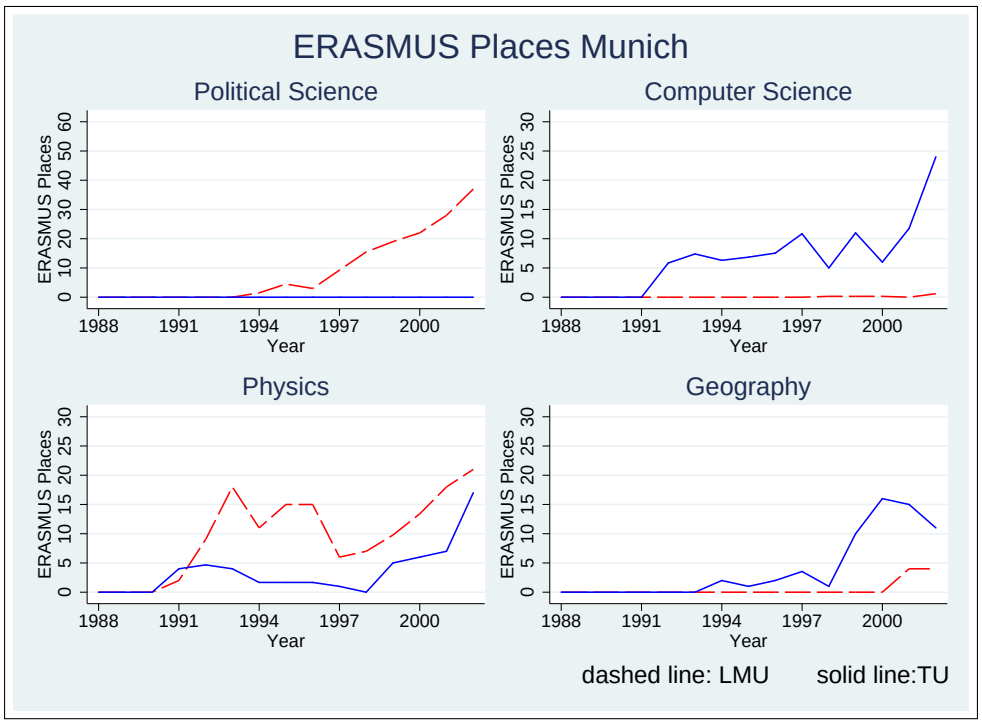

Fig. 2. *ERASMUS in Munich*

places is due to idiosyncratic shocks triggered by the contacts of some active professors. Furthermore note that the number of exchange places may decline in certain years if a particular partner university drops out of the network.

2 Data

We use data on German university graduates, which has been collected by the Higher Education Information System (HIS) institute. This survey is conducted to provide a nationally representative longitudinal sample of individuals who complete their undergraduate education in Germany. A sample of university graduates has been drawn from cohorts graduating in the academic years 1988-89, 1992-93, 1996-97, 2000-01, and 2004-05. In the following, we will refer to these five cross-sections as graduate cohorts 1989, 1993, 1997, 2001, and 2005. Graduates in each cohort are surveyed twice. The first survey takes place about 12 months after graduation (the *Initial Survey*). The same individuals participate in a follow-up survey about 5 years after entering the labour market (*Follow-Up Survey*).[10] The response rate to the survey was around 25%.[11] One key advantage of the data is that the population of interest includes all university graduates

[10]For the 2005 cohort, only the initial survey is available so far. See Briedis and Minks (2004) for more information on the data and the sampling process.

[11]An analysis conducted by the HIS has found that the characteristics of the survey respondents are close to those of the target population.

who completed their undergraduate studies during a given academic year at any institution of higher education in Germany. The data contains no information on nationality of respondents. We know, however, where the students obtain their high school degree. We limit our sample to all those individuals who obtain their high school degree in Germany.

The data contains detailed information on the students' background, study history, and labour market characteristics. This allows us to relate study decisions, in particular international educational mobility, to later labour market outcomes. A large advantage of this data set lies in the fact that individuals graduating from a university in Germany are followed even if they move to a foreign country. This feature makes the data set particularly valuable to investigate questions concerning international mobility.

The key information for our purposes is whether the student has studied abroad during her undergraduate studies, and whether the graduate works abroad at the time of the survey. We infer undergraduate mobility from the first question of the questionnaire, which asks the student to report her complete enrolment history. Respondents are instructed to report each change of degree programme or university.[12] We use this information to construct an indicator of whether the student studied abroad during her undergraduate career. In order to exclude university mobility after finishing the first degree (e.g. to obtain a Master's degree abroad), we only look at international mobility before the graduation date of the first degree. It is important to note that only students who obtain their degree in Germany are surveyed. We are, therefore, not able to observe students who first enrol in Germany and subsequently move to a foreign university and obtain their degree abroad. Also Germans who complete all of their higher education abroad are not included in our sample. These individuals may be different to students who study abroad as part of their degree in Germany. It is quite likely that those who complete their higher education abroad are even more likely to work in a foreign country after graduation than students who obtain their degree in Germany. We would underestimate the effect of studying abroad in this case. Unfortunately, our data is not suitable to test this hypothesis.

For all students who have ever participated in the labour market, both the initial and the follow-up surveys contain questions about the current (or the most recent) employment, including the location of work. We infer from this question whether a former student now works in Germany or abroad, and create an indicator accordingly.

The following Figure 3 shows the percentages of studying abroad and working abroad (from the initial survey, one year after graduation) for the five graduation cohorts. Both studying abroad and working abroad occurs more frequently among students of later graduation cohorts.

These percentages can be compared to information on international mobility from

[12]The questionnaire makes explicit reference to study abroad as one form of change in status in the 2001 and 2005 surveys. For the earlier cohorts respondents were instructed to report every university they attended during the course of their studies.

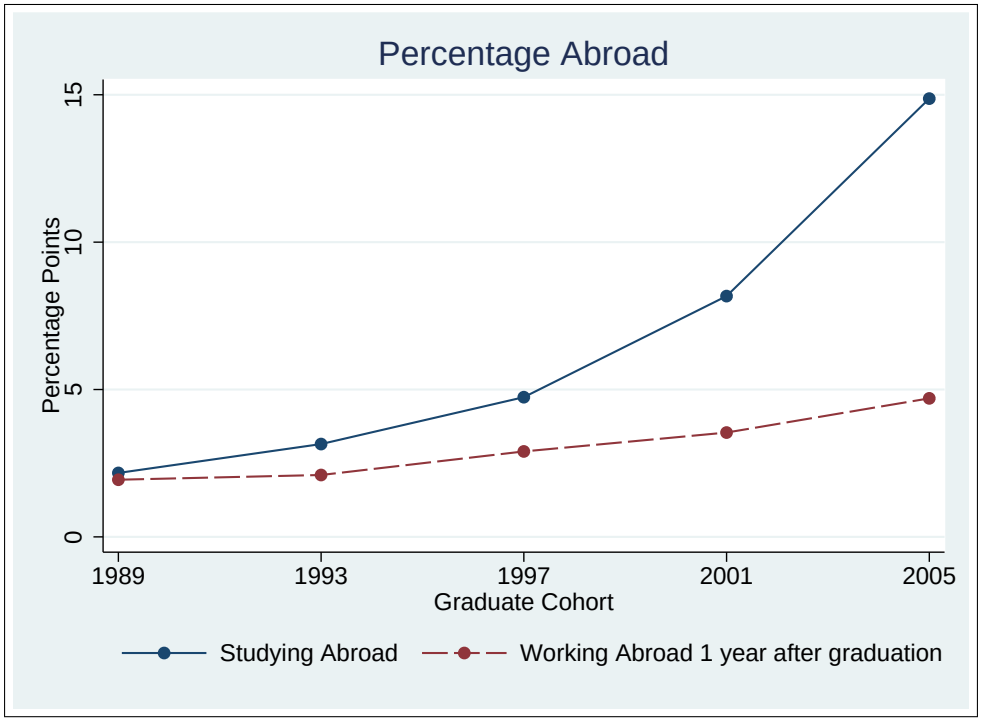

Fig. 3. *International Mobility in HIS Data*

other data sources. We compare the incidence of international educational mobility in our data to data from the 16th Social Survey (*Sozialerhebung*), a large-scale survey of German students in 2000. Of all students surveyed in the Social Survey, about 13% of advanced students indicate that they spent part of their studies at a foreign university. The students surveyed in 2000 will mostly graduate before 2005. In the 2005 graduate cohort data about 15% have studied abroad (see Isserstedt and Schnitzer, 2002). This is very similar to the fraction in the Social Survey. The figures from the Social Survey also replicate the strong over-time increase in the fraction of students who study abroad.

We use data from the OECD Factbook 2006 to investigate the reliability of our data with respect to international labour market mobility. The OECD estimates that about 7.1% of Germans holding a university degree worked as expatriates in a foreign country in the year 2005. This number is higher than the percentage of people working abroad for the 2005 cohort in our data set. This is due to the fact that the OECD figure measures stocks of expatriates while we consider the flow of university graduates to foreign countries. We conclude that both the percentage of people studying abroad and the percentage of people working abroad in our data are comparable to estimates from other data sources.

In addition to the international mobility variables we also use a number of other control variables measured at the individual level. Some of the students in the 2005 cohort received a Bachelor's degree instead of the traditional German degrees (*Diplom*

or *Staatsexamen*).[13] We therefore include an indicator for obtaining a Bachelor's degree in our regressions.

Furthermore, we create a measure of potential experience since graduation, defined as the number of months from graduation to the time of answering the questionnaire.[14] Other controls include a female indicator, age at beginning of university studies, and an indicator for whether the student completed an apprenticeship before starting university. We also use variables which control for a student's earlier mobility decisions. In particular we include a variable which controls for whether the student's first university enrolment occurs in the state *(Bundesland)* where she obtained her final high school degree. Furthermore, we include the distance between the state of her university enrolment and the state where she obtained her high school degree.

We use a number of variables to control for a student's parental background. To control for parental education we use a variable that indicates the highest grade completed by either parent, where we split parental education into three categories to account for the characteristics of the education system in Germany.[15] We also construct indicator variables in five categories for each parent to control for parental occupation. As a proxy for credit constraints we use a variable measuring the proportion of expenses which the student covers by federal financial aid (BAFOEG). Students are eligible for this assistance if parental income is below a certain threshold. This threshold varies according to the number of children who are enrolled in a formal education programme.

In order to implement our Instrumental Variables strategy we combine the HIS graduate survey data with a unique data set of ERASMUS participation. There is no readily available data on the ERASMUS exchange programme for our time period of interest. We obtained data on the number of ERASMUS scholarship holders for each year and each participating institution on a subject-by-subject basis from 1993/94 to 2004/2005 from the German Academic Exchange Service (DAAD). To obtain the data for the earlier years we proceeded as follows: The DAAD provided us with the number of scholarships

[13]Traditionally there was no distinction between Bachelor's and Master's degrees in the German higher education system. Students would enrol in university after high school and study for about four to seven years obtaining one degree at the very end of their studies. This system has been gradually replaced in recent years. Most German universities have switched to a system with Bachelor's and Master's degrees. In the 2005 cohort most students had still been enrolled in a traditional German degree programme. A small fraction already graduated with a bachelor degree.

[14]There is some variation in experience because students were sampled according to whether their graduation fell in a particular academic year. We take this measure of potential experience rather than actual labour market experience, because actual labour market experience could be affected by a study period abroad and might then be endogenous to our outcome.

[15]The omitted category contains students with parents who obtained up to 13 years of education. This group consists of students with parents who did not receive a school degree (very few), parents with lower types of secondary schooling *(Hauptschule or Realschule)* usually followed by an apprenticeship, and parents who obtained a high school degree but no further education (very few). The second group is comprised of students where the better educated parent either obtained an advanced craftsmanship degree *(Meister)* or some higher education, such as a degree from a university of applied science *(Fachhochschule)* but not a degree from a university. The third group includes students who have at least one parent holding a university degree.

allocated to each ERASMUS Inter-University Cooperation Programme (ICP). We combined this information with published listings of all ICPs, which give details about the participating universities and the subjects covered for each inter-university agreement (see for example DAAD, 1992). This allows us to construct a panel data set at the university-subject-year level that covers the entire history of the ERASMUS programme in Germany. The typical (median) student goes abroad three years prior to his graduation, and we assign to each student the exposure to the ERASMUS programme in that corresponding academic year.[16]

We restrict our sample to those observations for which all variables of interest are observed. As mentioned before, students from the graduate cohorts 1989, 1993, 1997, and 2001 have been surveyed twice, the first time one year after graduating from university and a second time five years after graduation. We thus have two observations for the location of work for most individuals from those cohorts. In the estimation below, we pool the observations from the initial and the follow-up survey for efficiency reasons.[17] This allows us to use the information provided in both questionnaires. Means and standard deviations of our estimation sample are reported in Table 1. It is evident from comparing columns (2) and (3) that individuals who studied abroad are also more likely to work abroad later in life. One can also see that individuals with more exposure to ERASMUS (as measured by ERASMUS ratio or ERASMUS indicator, which are described in further detail below) are more likely to study abroad. In the following section we explain how we use the ERASMUS programme to identify the causal link between studying abroad and international labour market mobility later in life.

3 Identification Strategy

To provide a simple conceptual framework, we start from the description of the individual migration decision from Borjas (1987). A university graduate, deciding to work abroad or at home, faces wages at home (w_0) and wages abroad (w_1) as follows:

$$\begin{aligned} \log(w_1) &= \alpha_1 + u_1, \\ \log(w_0) &= \alpha_0 + u_0. \end{aligned} \tag{1}$$

where (u_1, u_0) denote idiosyncratic error terms around means (α_1, α_0). The individual decides to work abroad if the return to migration exceeds the cost of migration (C).

[16]This approach is preferable to simply assigning ERASMUS characteristics at a fixed point in the student's study period (say the second or third year): since our graduates are sampled when they exit university, and since there is substantial variation in length of studies, there might be a systematic relationship between individual study duration and other unobservable factors.

[17]By clustering the standard errors at the university or, in some specifications, at the subject level, we fully account for the resulting dependence in the error terms.

Thus, the resulting decision rule is

$$\begin{aligned} \text{Work abroad} &= 1\{\log(w_1) - \log(w_0 + C) > 0\} && (2) \\ &\approx 1\{u_1 - u_0 > -(\alpha_1 - \alpha_0 - C/w_0)\}. && (3) \end{aligned}$$

The key prediction of this Roy model in this context is that the probability of working abroad decreases with cost of migration C. Our focus lies in understanding the role of studying abroad as one important determinant lowering the cost for later labour market migration. There are a number of channels how studying abroad may reduce the cost for later migration decisions. Studying abroad allows the students to improve their foreign language skills. This would greatly reduce their costs of finding work in the foreign country. Furthermore, they will acquire a better knowledge of the foreign labour market and maybe get in contact with potential employers. Also personal contacts through friends in the foreign country may facilitate finding a job in a foreign country. We show below that individuals often return to work in the very same country where they have studied abroad. This supports the hypothesis that these channels are indeed important. Other channels how studying abroad may lower the cost of migration are more subtle. The study abroad spell may act as a trial period of whether one likes to live in a foreign country and thus increase the interest in foreign cultures. Furthermore, studying abroad may foster private relationships abroad which draw the student to working abroad later on. Below we provide some suggestive evidence that these channels may indeed be affected by studying abroad.

In order to investigate the relationship between studying abroad and later labour market mobility we therefore estimate the following equation.

$$\begin{aligned} \text{Work Abroad} &= \beta_1 + \beta_2 \text{Study Abroad} + \beta_3 X + \beta_4 \text{Cohort FE} \\ &\quad + \beta_5 \text{Subject FE} + \beta_6 \text{University FE} + u, \end{aligned} \tag{4}$$

where *Work Abroad* and *Study Abroad* are dummy variables indicating whether an individual worked abroad or studied abroad, respectively. X is a vector of personal characteristics, which may affect the decision to work abroad, such as gender, age, work experience or an individual's family background. We also include a full set of dummies for each graduate cohort, a student's subject, and university. Our main interest lies in obtaining consistent estimates of β_2.

The summary statistics presented above clearly indicate that students who study abroad differ systematically in their observable characteristics from those who remain in Germany throughout their undergraduate studies. Although our data set is rich in observed characteristics of the student, many dimensions which are likely to affect the students' mobility decision remain unobserved. A possible factor could be, for example,

the students' unobserved motivation. If these unobserved factors are correlated with the outcome, estimating equation (4) using OLS yields biased estimates, because we would mistakenly attribute the effect of the unobserved covariates to the stay abroad. It is therefore not clear what at all can be learned from a comparison of means of those who study abroad versus those who do not. This underlines that this context requires a credible identification strategy to learn about the causal impact of the study period abroad. We use the ERASMUS programme as an instrumental variable to identify the causal effect of studying abroad. As our first stage we estimate the following equation:

$$\begin{aligned} \text{Study Abroad } = \gamma_1 + \gamma_2 \text{ERASMUS} + \gamma_3 X + \gamma_4 \text{Cohort FE} \\ + \gamma_5 \text{Subject FE} + \gamma_6 \text{University FE} + \epsilon. \end{aligned} \tag{5}$$

ERASMUS is a variable measuring a student's exposure to the ERASMUS programme. In addition to the main variables of interest we include the same control variables as in equation (4).

It is important to be precise about the variation we exploit to identify the effect of studying abroad. We account for systematic differences between universities by including university fixed effects. Our empirical strategy thus relies on over-time changes in scholarship availability. At the same time, we include dummies for our five graduate cohorts, so that any difference that is common to all students in a cohort is taken out as well. This ensures that we are not relying on any long-term trends (which may possibly affect both the instrument and the outcome). In addition to that we include subject fixed effects in our estimation. This accounts for any systematic difference in international mobility of students in different subjects. We therefore rely on over-time changes in programme intensity at a given subject and university combination.

We construct different measures of a student's exposure to the ERASMUS programme. The first ERASMUS measure is an indicator, which takes the value 1 if the student's department offered an ERASMUS scholarship in the relevant year. In most cases this variable is 0 until a certain department joins the ERASMUS programme and 1 thereafter, because very few departments leave the programme after they have joined. We denote this variable *ERASMUS indicator,* which varies in the dimensions university, subject, and year. Using the ERASMUS indicator as an instrument amounts to a classical difference-in-differences estimator comparing students before and after the introduction of an exchange programme for their subject at their university.

The second variable measures the exact number of ERASMUS scholarships, offered by each department at every university in a given year. In order to account for differences in size of different departments, we normalize the number of scholarships with the number of students enrolled in the respective department. We use the department level number of first year students in the fall semester of the academic year 1992/93 for this normalization.

In the following we refer to this variable as *ERASMUS ratio*. This measure for a student's exposure to the scholarship programme varies at the university, subject, year level as well.

The ERASMUS indicator is less powerful than the ratio because it does not capture changes in the number of ERASMUS scholarships, which certainly affect a student's probability of studying abroad. On the other hand, however, this disadvantage may be an advantage if student demand at a department affects the number of ERASMUS places. This would affect the credibility of any instrument using the actual number of ERASMUS scholarships. Even though we believe that this is not an important concern in practice the ERASMUS indicator is a way of dealing with this concern. The only way in which student demand may affect this instrument is through triggering the introduction of ERASMUS in the relevant department, which we believe is extremely unlikely. Administrative hurdles when setting up the programme stand in the way of any short term responses to student demand. If a certain department wants to join the ERASMUS programme, the university has to apply for a certification at the European Commission. Moreover, the department has to find partner universities, which are willing to exchange students with the given department. Clearing these administrative hurdles takes time. Another time lag is introduced by the fact that students have to apply for a certain ERASMUS slot almost one year before they actually study abroad. It is therefore very unlikely that departments are able to set up a new ERASMUS programme in time for a certain cohort to be able to benefit from that introduction.

In the following, we address a number of possible concerns regarding the exclusion restriction. In particular, we consider the '*university quality*' argument, the '*big push*' argument, and the '*student selection*' argument.

One concern may be that university quality affects both scholarship availability and the outcome: If good universities offered more ERASMUS scholarships, and if at the same time good universities produced higher skilled graduates who are more likely to find a job in a different country, the exclusion restriction would be violated. We take care of this problem by including university fixed effects (FE) in all our regressions, which control for any permanent university attribute. A closely related criticism is that even within a given university some faculties, such as sciences, may be better than other faculties. We show that our results also hold if we include faculty times university fixed effects, which control for any permanent difference between faculties even within a given university.

A common concern in IV estimation is that using a particular policy may carry the risk of not accounting for other policies which were implemented at the same time. For example, the university could engage in more active exchange activities also outside Europe and possibly implement other measures which increase the employability abroad at the same time. We show below that ERASMUS had a very narrow effect and does not seem to be correlated with other policies. To check for the correlation with other

programmes we use information of where students went to study abroad, grouped into three categories (Europe, United States, and other areas). We show below that the ERASMUS programme only affected the exchange to Europe but not to other areas.

Similarly, one may be worried that active professors who play an important role in expanding a department's exchange network may also be more involved in placing their students internationally once they graduate, having a direct effect on the outcome. We can assess this directly since our data contains information on whether students obtained their first position through intermediation of a professor. We find no evidence that there is any systematic relation between this job finding channel and ERASMUS scholarship availability.[18]

Another concern is that students may choose a particular university-subject combination because of scholarship availability. Particularly mobile students might choose universities and departments offering a large number of ERASMUS scholarships. This would again bias our IV results. We do not think that this is likely to occur, however. Since most of our sampled individuals started their university career long before the widespread availability of the internet, information about exchange programmes was extremely difficult to obtain. Even nowadays it is hard to obtain information on the availability of ERASMUS scholarships on departmental web sites of German universities. It is much more likely that enrolment decisions are based on factors such as reputation of the university or closeness to home. We also address the student selection argument by controlling for distance between the state of a student's high school degree and her university. Controlling for earlier mobility does not affect our results.

Another way of addressing these concerns more directly is to define our measure of ERASMUS exposure without exploiting the specific choice of university the student made.[19] For this purpose, we define a third measure (*ERASMUS subject ratio*) as the ratio of ERASMUS scholarships in the student's subject across all universities, relative to the overall number of students in that subject (again across all universities). This measure does not depend on the specific university a student chooses. As a variant we use the subject ratio measure but subtract the ERASMUS slots in the student's own department.[20] In the tables this measure is denoted as *ERASMUS subject ratio, excluding*

[18] In a simple Pearson's χ^2 test, we cannot reject the hypothesis that this job finding channel and the ERASMUS indicator are independent (p=0.62). When we regress an indicator for obtaining the first position through intermediation of a university professor on our ERASMUS measures in a full specification corresponding to our main model, we find no significant effects of the ERASMUS measures.

[19] This approach is based on our understanding that a school leaver's decision process can be thought of as first deciding on a subject, and then selecting between different universities given the subject. This is reflected, for example, in the subjects where university admissions are centrally administered: students can apply for one subject only, but in their application give a preference ranking for a number of different universities in this subject (ZVS, 2009). The German university system is therefore closer to the UK system in that students apply for a particular subject-university combination and not a university alone as in the US.

[20] This way of defining exposure is related to the instrument of Bartik (1991) for local labour demand conditions.

own department. As this measure does not include the student's own ERASMUS slots it will be unaffected by a possibly endogenous selection of a certain department with more ERASMUS places. We show below that our results are very similar when we use these alternative measures of ERASMUS.

A related worry is that students may change university or department after they figured out that their university and/or department offer little opportunity to study abroad.[21] Using the ERASMUS measures from a student's *first* enrolment enables us to avoid any problems of selective mobility after university entry of the student.

In summary, we believe that in our empirical framework ERASMUS scholarship availability provides us with exogenous variation in the student's decision to study abroad. In all regressions reported below we account for any dependence between observations by clustering the standard errors at the university level. In the specifications exploiting the subject level variation in ERASMUS we cluster the standard errors at the subject level. This leaves the error correlation within clusters completely unrestricted and allows for arbitrary with-in cluster dependence. The clustering, therefore, also allows the errors to be serially correlated. An alternative way of addressing the possible serial correlation of error terms is to collapse the data into a pre and post period as suggested by Bertrand *et al.* (2004). We show in column (5) of Table A1 that this alternative way of obtaining standard errors yields very similar results to clustering at the university level.

In order to visualize how students are affected by the shock of being faced with more or less exchange opportunity, we perform the following event study: For each student's initial university and subject choice, we observe whether there was at any point an ERASMUS cooperation in the time period we observe. We group students by whether they entered the university before or after the introduction of the ERASMUS scheme, and by how many years. In the following figure we plot the time difference between the introduction of ERASMUS and university entry against the probability of studying abroad. Keeping in mind that students usually start two or three years before going abroad, we get the following prediction: According to our hypothesis, the probability of studying abroad should be flat for the cohorts starting more than three years before the introduction. The cohorts starting three or two years before the introduction of ERASMUS would then be the first ones to be affected, and we expect an increase in the proportion of students studying abroad from then on. The results can be seen in Figure 4.

This figure provides evidence that the ERASMUS scheme affects the different cohorts in a very precise way. Closely following our prediction, the probability of studying abroad is low and flat before the introduction of ERASMUS, and goes up steeply afterwards. Furthermore, our data provides evidence that institutions which have *not yet* introduced

[21] Partly owing to the comparatively long duration of studies, it is more common for students to transfer between universities during the undergraduate studies than e.g. in the US or the UK.

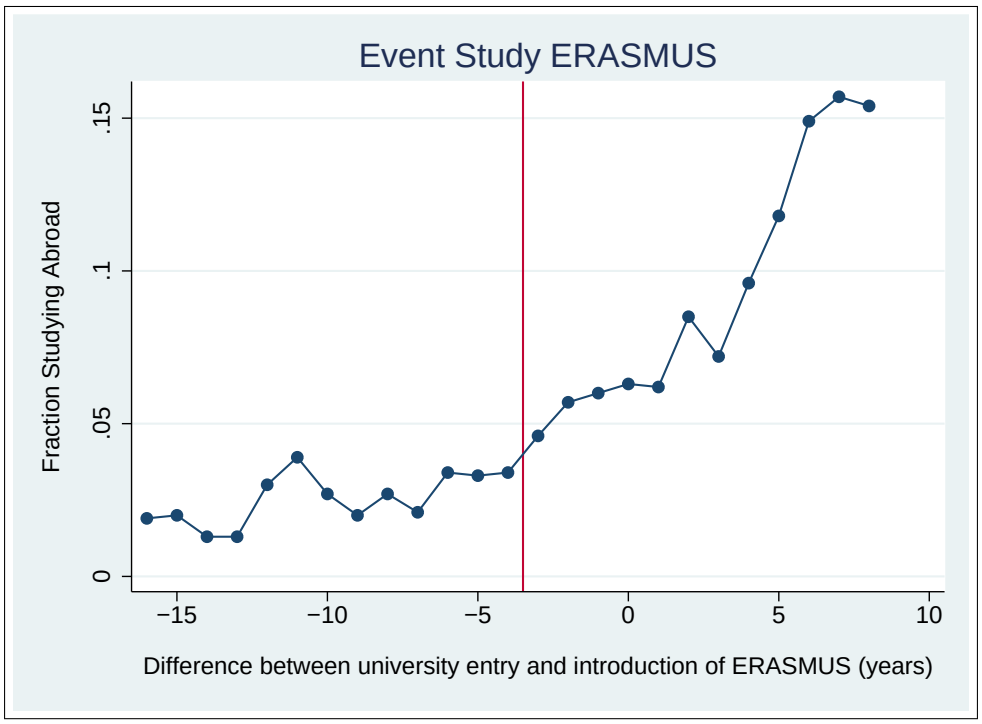

Fig. 4. *Event Study ERASMUS*

ERASMUS are similar to those which *never* introduce ERASMUS: Students at institutions which never introduce ERASMUS have a probability of studying abroad of 2.2%, which closely matches the average for the not-yet-affected students in Figure 4. In the following section we provide estimates of the effect of ERASMUS on the probability of studying abroad.

4 First Stage Results

Table 2 presents the results from our first stage estimates. In this context the first stage regressions are interesting in their own right as one can learn about the factors affecting an individual's decision to study abroad. We regress an indicator for studying abroad on our measure for exposure to the ERASMUS programme and other control variables. In column (1) we use the ERASMUS indicator as our measure for a student's exposure to the programme. The coefficient on ERASMUS is highly significant with an F-statistic of 40.5. The coefficient indicates that a student's probability of studying abroad increases by about 2.5 percentage points if her department participates in the ERASMUS programme. Analysing the effect of our control variables one can see that a student's gender does not seem to affect her probability of studying abroad. The quadratic in age indicates that students who begin their studies at a higher age are much less likely to study abroad (in the relevant age range).

In column (2) we use the ratio of ERASMUS places to the number of students in the relevant cohort as our measure for exposure to the ERASMUS programme. Once again the coefficient on the ERASMUS measure is highly significant with an F-statistic of 49.4. The coefficient indicates that an increase in the ratio of ERASMUS places from say 5% to 10% increases an individual's probability of studying abroad by about 2.2 percentage points. The coefficients for the control variables are very similar to the ones reported in column (1).

In columns (3) and (4) we report the first stage for the ERASMUS subject ratio and the subject ratio, excluding own department. As we would expect, the strength of the instrument in column (4) is somewhat lower, but the F-statistic is still above 30.[22]

In the following we show that the ERASMUS programme has a very specific effect on studying abroad, as it only affects the probability of studying abroad in a European country but not in countries outside Europe. This is a clear indication that the introduction of ERASMUS was not one of many policies to improve university quality, which in turn could affect the outcome as well. In order to demonstrate the precise effect of studying abroad we create three indicator variables, which take the value 1 if an individual studied abroad in Europe, the USA, or in any other foreign country respectively. We expect that our instrument only affects the probability of studying abroad in Europe as the ERASMUS programme only offers scholarships for studying abroad in European partner universities. In columns (1) and (4) of Table 3 we replace the dependent variable of our usual first stage regression (studying abroad in any country) with an indicator for studying abroad *in Europe*.[23] ERASMUS is a strong and highly significant determinant of studying abroad in Europe. The magnitudes of the ERASMUS coefficients is similar to the one obtained when we use the general definition of studying abroad.

The regressions reported in columns (2) and (5) use an indicator for studying abroad in the US as the dependent variable. The coefficients on the ERASMUS measures are not significantly different from 0. Furthermore, the point estimates of the ERASMUS measures are very close to 0. In columns (3) and (6) we report specifications where we use an indicator for studying abroad in any country outside Europe or the US as the dependent variable. Again the coefficients on ERASMUS are small and not significantly different from 0. The evidence from Table 3 strongly suggests that the introduction of the ERASMUS programme was not correlated with the introduction of a broader set of policies, which might themselves affect later labour market outcomes. These results increase our confidence for using the ERASMUS programme as an instrumental variable for studying abroad. In the following section we use this IV to obtain estimates of the

[22] One common concern in IV estimation is a potential bias due to weak instruments (see Bound *et al.*, 1995; and Stock *et al.*, 2002). The F-statistics from the first stage, reported at the bottom of Table 2, show that weak instruments are not likely to pose a problem in our analysis.

[23] We do not observe study abroad destinations in the 1989 cohort, so that our sample in this analysis is correspondingly smaller.

effect of studying abroad on the probability of working in a foreign country later in life.

5 Main Results and Sensitivity Analysis

The OLS results reported in column (1) of Table 4 confirm that graduates who spent some time at a foreign university are more likely to work abroad later in life. Our OLS result indicates that the effect of studying abroad is about 6.5 percentage points. As discussed before we do not want to attribute causality to the OLS results. This is because the factors affecting an individual's decision to study abroad are likely to affect her decision to work abroad later on as well. Therefore, we now turn to our IV results.[24]

In column (2) of Table 4 we present the first set of IV results using the ERASMUS indicator as an instrument. We find that studying abroad increases an individual's probability to work in a foreign country by about 24 percentage points. The effect is significant at the 5% level. We find no significant difference in terms of gender. Furthermore, we find that individuals who completed an apprenticeship before they enrolled at university are about 0.5 percentage points less likely to work abroad. People who complete an apprenticeship may be more likely to go back to work at the same firm where they completed their apprenticeship, which will usually be located in Germany. We also find that labour market experience has an effect on the probability of working abroad. The coefficient indicates that individuals with one more year of experience in the labour market are about 0.7 percentage points more likely to work abroad. Within a survey wave, there is relatively little variation in potential experience, and this estimate also captures the increased probability of working abroad from the initial to the follow-up survey. Over and above this annual measure of potential experience, the indicator variable for the follow-up survey does not show up significantly.

In column (3) we present the results from using the ERASMUS ratio as instrument. Making use of the additional variation in number of scholarships increases precision significantly. The point estimate goes down as well compared to column (2), but is still substantially higher than the OLS estimate. The effect is statistically significant at the 1% level. It is important to note that the point estimate is highest when we use the ERASMUS indicator. Given these results we are confident to say that our results reflect a supply-side increase in scholarship availability, rather than students' demand. If the number of ERASMUS places was driven by the demand of very motivated students we would expect higher coefficients on ERASMUS when using the ERASMUS ratio

[24]In Table A1 in the Appendix, we also present the reduced form estimates corresponding to the main results. Column (5) of Table A1 shows the results from collapsing the data into a pre and a post period as suggested by Bertrand *et al.* (2004) using the ERASMUS dummy measure. The corresponding uncollapsed reduced form is presented in column (1) of Table A1. The results are very similar.

instrument.

We further probe our results by using the ERASMUS measures which exploit subject level variation rather than conditions at the actual department (columns (4) and (5)). It is reassuring to find that the estimates are similar to the ones reported in the previous columns. In the following, we show that our results are robust to a number of specification checks.[25]

We first include a number of important control variables in our regression. To control for differences in parental background that may be correlated with the choice of university and thus the number of ERASMUS places we include controls for parental education and occupation. Because students with a taste for mobility may choose departments with a lot of ERASMUS scholarships we include two powerful controls for previous mobility. The first variable indicates whether the student enrols in university in the state *(Bundesland)* where she obtained her high school diploma *(Abitur)*. The second early mobility variable measures the distance from her high school state to the state of her first university enrolment. A further concern may be that individuals are more likely to work abroad if they know more foreigners. We therefore control for the university wide ratio of foreign students over the total number of students in a student's cohort. The specification including all additional controls is reported in the second panel of Table 5. Reassuringly the coefficient on studying abroad hardly changes when we add these powerful controls.

In the following we check whether our results are driven by time trends in our variables of interest. Including graduate cohort FE (as in all specifications) guarantees that we do not identify the effect of studying abroad on working abroad from overall time trends. There may be a worry, however, that students studying certain subjects exhibit time trends in both studying abroad and working abroad. To address this issue we include linear subject specific time trends. The results of this exercise are reported in the third panel of Table 5. A related worry may be that groups of departments within a university differ in quality or in their ability to foster international exchange. To address this concern we include a full set of department group times university fixed effects. We thus use separate fixed effects for say sciences or languages at a certain university. These results are reported at the bottom of Table 5. It is reassuring that the inclusion of time trends or a finer set of fixed effects does not have a large impact on our estimates.

One defining feature of our results is that the IV results are substantially higher than the corresponding OLS result. We have tested whether the IV estimates are significantly different from the OLS estimates. The results indicate that the IV estimates are not

[25]We have explored whether the returns to studying abroad differ between the to survey rounds (one and five years after graduation) by including an interaction term of studying abroad and the five year survey round. In most specifications there is no evidence that the effect of studying abroad varies across the survey rounds.

statistically different at a 5% level, which reflects the lower precision of the IV estimates.[26] Although the difference in the estimates needs to interpreted in the light of this test, we are nonetheless interested in understanding why our point estimates are consistently higher than the OLS estimates, and we interpret this finding in terms of heterogeneity in returns: It is unlikely that all students will be affected in the same way by the intervention of studying abroad. It is much more plausible that the effect of studying abroad itself varies across the student population. We follow Imbens & Angrist (1994) and interpret our estimates as a Local Average Treatment Effect (LATE): The IV results show the average effect for the subgroup which has been affected by the instrument. In the context of our instrument, this group is well-defined: It is the group of students who would not have studied abroad without the ERASMUS programme, but study abroad when the ERASMUS is implemented. Since these are students who have been affected by the ERASMUS programme, our estimates are of immediate interest to policymakers.

We investigate heterogeneity in returns along two important dimensions: parental education and whether the student was credit constrained during her studies. Parental education may be important because students with better educated parents may be better informed about the benefits from studying abroad. Furthermore, we investigate heterogeneity according to the financial situation of the student. In the absence of credit constraints, all students for whom the cost of studying abroad is above the returns from studying abroad will not study in a foreign country. Some credit constrained students, however, will not be able to invest in studying abroad even though this investment offers a positive return. The introduction of ERASMUS can be understood as a price change which makes the investment into studying abroad worthwhile for these marginal students.

To investigate heterogeneity along these dimensions we split our sample into four different subgroups: students with high parental education who have not been credit constrained, students with high parental education who have been credit constrained, students with low parental education who have not been credit constrained, and lastly the most disadvantaged group: students with low parental education who have been credit constrained. We classify students to being from a high parental education background as those whose parents have at least 16 years of education, i.e. both parents have at least a university degree. Credit constraints are proxied with an indicator variable which takes the value 1 if the student covers 50% or more of his expenses with federal financial assistance (BAFOEG).[27] We then follow Kling (2001) in interpreting the IV estimate

[26] In our main specification, the IV dummy specification is statistically different from the OLS estimate at 10%.

[27] Unfortunately, we do not have any information on the student's financial situation for the 2005 wave. In 1989 the question on BAFOEG was not administered but the students were asked to evaluate their financial situation on a 1 to 5 scale. We classify all those who answered 5 (unsatisfactory financial situation) as being credit constrained. This corresponds almost exactly to the sample proportion who indicate that they financed 50% of their expenses with BAFOEG in the later cohorts.

as a weighted average of the causal effect of studying abroad, where the weight of each subgroup j is given by the following formula:

$$weight_j = \frac{w_j \lambda_j \Delta(StudyAbroad)_j}{\sum_j w_j \lambda_j \Delta(StudyAbroad)_j}. \quad (6)$$

Here w_j is the sample fraction of each subgroup j, λ_j is the variance of the instrumental variable for subgroup j conditional on all other controls, and $\Delta(StudyAbroad)_j$ is the impact of the ERASMUS instrument on the probability of studying abroad for subgroup j. The last term is obtained from estimating the first stage regression separately for each subgroup.[28] We use this decomposition to compute the corresponding weight for our four subgroups.

In our sample about 39% of all students come from the most advantaged background (see column (1) in Table 6), and this group is found to respond strongest to the introduction of ERASMUS (see column (2)). Even though the conditional variance of ERASMUS is lowest for them (column (3)) they contribute about 46% to the final IV estimate which is more than their sample proportion. The other group that contributes more than proportionately to the IV estimates is the group of students with the most disadvantaged background. Column (5) reports the corresponding IV estimates if the regression is estimated separately for the four subgroups. The much smaller samples lead to a loss in precision; comparisons of the point estimates for the four subgroups should therefore be made with caution. With this caveat in mind it is evident that the least advantaged group of students seems to have the highest return from studying abroad. This suggests that credit constraints and information asymmetries may indeed prevent some students from realizing the return from studying abroad.

6 How Studying Abroad Affects International Labour Market Mobility

The results presented in the previous sections indicate that individuals who study abroad are more likely to work in a foreign country. It is interesting to understand how studying abroad affects an individual's decision to migrate to a foreign country later in life. We address this in two ways: First, we make use of observed location choices to study the type of skills acquired during the stay abroad. Second, the survey provides us with direct qualitative evidence on why graduates move abroad, and we show how this varies depending on whether the student studied abroad earlier.

We can think of the effect of studying abroad as affecting the set of skills the student acquires during her studies. One important question is whether these skills have a strong

[28] See Kling (2001) for further details.

location-specific component. We can shed some light on this question by investigating whether individuals who have studied abroad return to work in the same country when they decide to work in a foreign country. There are a number of reasons why mobile graduates may be more likely to work abroad in the countries where they studied abroad before: While they were studying abroad they may have obtained skills that are of particular relevance in that specific labour market, e.g. language skills, knowledge about the local labour market, or personal contacts which facilitate a match. On the other hand, it is possible that studying abroad affects the probability of working abroad equally for different work destinations. This would be the case, for example, if studying abroad widens the horizon of the student generally and leads her to search for a job internationally, independent of where she studied before. This question is also highly relevant from a policy perspective: The ability of the ERASMUS scheme or other student mobility programmes to achieve an integrated European labour market depends on the assumption that students who went abroad to study in Europe are internationally mobile after graduation, but remain in Europe.

Here we present descriptive evidence to address this question from the 2005 cohort.[29] For each study abroad treatment and study abroad location, Table 7 shows the conditional probability of being in each work location. The table provides evidence that choices about study abroad locations are sticky, that is that students tend to return to work to the country or region where they studied abroad. A χ^2-test of independence between the study abroad location and the work abroad location is rejected at the 0.01% level with a test statistic of 768.7.

We now turn to qualitative evidence from the survey on why graduates moved abroad. As these qualitative questions were only administered to the 1997 cohort we cannot apply our instrumental variable strategy here. We therefore provide a descriptive analysis, which – if only suggestive – may shed light on the way studying abroad affects later labour market mobility.

Graduates who had worked in a foreign country for at least one month in the five years since graduation were asked to identify the reasons for their decision to work abroad. In Table 8 we present the percentage of the people who indicated that a certain reason had been important in their decision to work abroad. The table shows that the main reasons for working abroad are interest in foreign cultures, interesting offers from abroad, and the initiative of the employer. We split the sample into those who complete all their university education in Germany and those who study abroad for some time during their undergraduate education. While the means are similar in some categories, there are a number of noteworthy differences. Those who have studied abroad are more likely to indicate that their interest in foreign cultures has led them to seek employment

[29] We only observe country by country locations for the studying abroad and the work abroad spell for the latest cohort.

abroad. It may be the case that studying in a foreign country increased the individual's taste for living abroad, which may in turn increase her probability of migrating later in life. Students who have studied abroad are also significantly more likely to indicate that they have chosen to work abroad to be with their partner. The answers to this question may suggest that people who studied abroad may have met their partner while studying abroad and therefore consider to work abroad later in life. Of course, this difference may also be driven by assortative mating with more mobile people having more mobile partners, and the way this question was asked makes it impossible to distinguish between these alternatives. Meeting a partner abroad may, nonetheless, be a possible channel of the effect of studying abroad. The summary statistics also indicate that those who have studied abroad are somewhat more likely to say that they work abroad because of better employment opportunities in the foreign labour market, where we obtain a p-value of 0.06 when we test for a difference in the means of the two groups for this response. It is possible that a stay at a foreign university makes it easier to realize opportunities in foreign labour markets, either because those who studied abroad have better information on the foreign labour market or because employers are more willing to offer employment to those individuals. Interestingly, rather than the employment outlook, it is the career prospects abroad where the means are significantly different at the 1% level, suggesting that those with international study experience seem to be more likely to consider a career abroad.

The statistics presented here provide some suggestive evidence of how studying abroad may alter later international labour market mobility. Further research is necessary to get a better insight into the channels of the effect of studying abroad on working abroad later on.

7 Conclusion

Using exogenous variation in scholarship availability, we are able to identify a causal effect of undergraduate student mobility on later international labour migration. Our strategy exploits the introduction and expansion of the ERASMUS scholarship programme. The extent to which students were exposed to the scholarship scheme varied widely. We exploit cross-sectional and over-time changes in scholarship availability. Accounting for permanent differences between different institutions, different subjects, and different graduate cohorts, our identification relies only on differential over-time change, and can be interpreted as a Diff-in-Diff estimator. Our first-stage shows that the ERASMUS scheme has indeed a strong effect on the students' decision to go abroad, which is not surprising given its scale. We show that the instrument is precise in that it only affects the decision to study in Europe, but not in other locations. Our event study adds further credibility to our instrument, by showing that the probability of studying abroad

is low and flat before ERASMUS is introduced, and increases strongly for those students affected by the scholarship.

Our OLS results indicate that the group of students who studied abroad are about 6 percentage points more likely to work abroad later on. Our IV results are substantially higher than that, and indicate that the effect of study abroad is about 15 percentage points. We interpret the difference between OLS and IV as an indication of heterogeneity in effects: The population which is affected by our instruments reacts particularly strongly to the incentives of the mobility programme. This Local Average Treatment Effect (LATE) interpretation is of particular interest to policymakers, since it evaluates the effect for the affected subgroup. We show that the most disadvantaged students have the highest returns from studying abroad, suggesting that credit constraints and information asymmetries play a role in this setting.

Our results show that educational mobility programmes may have a potentially large role in affecting students' behaviour in their labour market mobility decision. These results imply that an opportunity to attract talented graduates is to provide student exchange opportunities. Attractive universities and scholarship programmes may yield a return through attracting students, part of whom will remain as skilled workers later on. In the context of the policy change under consideration, ERASMUS is successful in that this student mobility scheme appears to contribute to the development of an integrated European labour market. This is especially so if we take into account the descriptive evidence from the previous section that location choices are sticky, i.e. that mobile students tend to return to the country where they studied before.

More generally, our work allows insights into the dynamic implications of educational mobility decisions. Our results indicate that the effects of educational mobility programmes go far beyond affecting the decision to study abroad for some time period, but rather reach far into the labour market, and it will be interesting to follow the sample of graduates as their careers unfold. But already at this early stage our results indicate that even short-term mobility investments can lead to significant further mobility investments later on.

References

Bartik, T. J. (1991). *Who benefits from state and local economic development policies?,* Kalamazoo: W.E. Upjohn Institute for Employment Research.

Bertrand, M., Dulfo, E., and Mullainathan, S. (2004). 'How much should we trust differences-in-differences estimates?', *The Quarterly Journal of Economics*, vol. 119(1), pp. 249-275.

Bound, J., Groen, J., Kézdi, G., and Turner, S. (2004). 'Trade in university training: cross-state variation in the production and stock of college-educated labor', *Journal of Econometrics*, vol. 121(1-2), pp. 143-173.

Bound, J., Jaeger, D. A., and Baker, R. M. (1995). 'Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak', *Journal of the American Statistical Association*, vol. 90(430), pp. 443-450.

Borjas, G. (1987). 'Self-selection and the earnings of immigrants', *American Economic Review*, vol. 77(4), pp. 531-553.

Briedis, K, and Minks, K.-H. (2004). 'Zwischen Hochschule und Arbeitsmarkt. Eine Befragung der Hochschulabsolventinnen und Hochschulabsolventen des Prüfungsjahres 2001', *HIS Projektbericht*, March.

Commission of the European Communities (2002). 'Commission's action plan for skills and mobility', *Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions*, COM(2002)72.

Council of the European Communities (1987). 'Council decision of 15 June 1987 adopting the European Community Action Scheme for the Mobility of University Students (ERASMUS)', *Official Journal*, L166, pp. 20-24, cited after http://eurlex.europa.eu.

DAAD (1992). *Studienland EG. Geförderte Kooperationsprogramme deutscher Hochschulen 1992/93,* Deutscher Akademischer Austauschdienst, Arbeitsstelle ERASMUS.

Dreher, A. and Poutvaara, P. (2005). 'Student flows and migration: an empirical analysis', *IZA Discussion Paper*, no. 1612.

Greenwood, M. J. (1975). 'Research on internal migration in the United States: a survey', *Journal of Economic Literature*, vol. 13(2), pp. 397-433.

Greenwood, M. J. (1985). 'Human migration: theory, models, and empirical studies', *Journal of Regional Science*, vol. 25(4), pp. 521-544.

Greenwood, M. J. (1997). 'Internal migration in developed countries', in (M. R. Rosenzweig and O. Stark, eds.), *Handbook of Population and Family Economics*, vol. 1, Elsevier, pp. 647-720.

Groen, J. A. (2004). 'The effect of college location on migration of college-educated labor', *Journal of Econometrics*, vol. 121(1-2), pp. 125-142.

Guellec, D. and Cervantes, M. (2001). 'International mobility of highly skilled workers:

from statistical analysis to policy analysis', in *International Mobility of the Highly Skilled*, OECD, pp. 71-98.

Hicks, J. R. (1932). *The Theory of Wages*. London: Macmillan.

Imbens, G. W. and Angrist, J. D. (1994). 'Identification and estimation of local average treatment effects', *Econometrica*, vol. 62(2), pp. 467-475.

Isserstedt, W. and Schnitzer, K. (2002). *Internationalisierung des Studiums. Ergebnisse der 16. Sozialerhebung des Deutschen Studentenwerks*, Bundesministerium für Bildung und Forschung.

Jahr, V. und Teichler, U. (2000). 'Employment and work of former ERASMUS students', in (U. Teichler, J. Gordon, and F. Maiworm, eds.), *Socrates 2000 Evaluation Study*, Study for the European Commission, Chapter 5, pp. 358-364.

Kling, J. R. (2001). 'Interpreting instrumental variables estimates of the returns to schooling', *Journal of Business and Economic Statistics*, vol. 19(3), pp. 99-117.

Kodrzycki, Y. K. (2001). 'Migration of recent college graduates: evidence from the National Longitudinal Survey of Youth', *New England Economic Review*, (January / February), pp. 13-34.

Lowell, B. L. (2007). 'Trends in international migration flows and stocks, 1975-2005', *OECD Social, Employment and Migration Working Paper*, no. 58.

Maiworm, F., Steube, W., and Teichler, U. (1993). 'ERASMUS student mobility programmes 1989/90 in the view of their coordinators', *Werkstattberichte, Uni Kassel,* no. 41.

Malamud, O. and Wozniak, A. (2008). 'The impact of college education on geographic mobility: evidence from the Vietnam generation', *Harris School Working Paper*, vol.(8)11.

OECD (2002). *International Mobility of the Highly Skilled*, Paris: OECD Publishing.

OECD (2006). *OECD Factbook - Economic, Environmental and Social Statistics*, cited after http://www.sourceoecd.org/factbook.

Oosterbeek, H. and Webbing, D. (2009). 'Does studying abroad induce a brain drain?', *Economica*, forthcoming.

Stock, J. H., Wright, J. H. and Yogo, M. (2002). 'A survey of weak instruments and weak identification in generalized method of moments', *Journal of Business and Economic Statistics*, vol. 20(4), pp. 518-529.

ZVS (2009). 'ZVS online: FAQ. Zentralstelle für die Vergabe von Studienplätzen', cited after http://www2.zvs.de/index.php?id=24.

8 Tables

Table 1: Summary Statistics

	(1) All	(2) Study Abroad = 0	(3) Study Abroad = 1	(4) Work Abroad = 0	(5) Work Abroad = 1
Working abroad	0.032	0.027	0.102	0.000	1.000
	(0.176)	(0.163)	(0.303)	(0.000)	(0.000)
Undergraduate study abroad	0.062	0.000	1.000	0.057	0.198
	(0.241)	(0.000)	(0.000)	(0.232)	(0.399)
ERASMUS indicator	0.490	0.472	0.767	0.485	0.637
	(0.499)	(0.499)	(0.423)	(0.500)	(0.481)
ERASMUS ratio	0.031	0.028	0.068	0.030	0.044
	(0.056)	(0.053)	(0.081)	(0.055)	(0.064)
Female	0.450	0.445	0.512	0,449	0.474
	(0.500)	(0.497)	(0.500)	(0.497)	(0.499)
Age when starting studies	21.637	21.682	20.959	21.655	21.082
	(2.559)	(2.603)	(1.595)	(2.577)	(1.831)
Experience	2.686	2.700	2.466	2.670	3.160
	(2.074)	(2.074)	(2.066)	(2.067)	(2.231)
Apprenticeship	0.301	0.313	0.194	0.309	0.206
	(0.461)	(0.464)	(0.396)	(0.462)	(0.405)
Mother's Education (years)	12.283	12.168	14.024	12.240	13.582
	(3.322)	(3.288)	(3.356)	(3.315)	(3.282)
Father's Education (years)	13.707	13.597	15.387	13.665	14.992
	(3.554)	(3.544)	(3.275)	(3.557)	(3.200)
Final University Grade[1]	2.041	2.057	1.812	2.048	1.848
	(0.681)	(0.681)	(0.633)	(0.682)	(0.604)
Credit Constrained[2]	0.119	0.120	0.098	0.120	0.099
(High Financial Assistance)	(0.324)	(0.325)	(0.297)	(0.325)	(0.298)
% in respective Industry:[3]					
Agriculture, Energy	2.6	2.6	1.7	2.6	2.9
Manufacturing	21.4	21.8	14.8	21.4	21.2
Services	40.9	40.9	40.9	41.0	37.7
Education, Culture	23.7	23.1	31.7	23.4	32.4
Administration, Organisations	10.7	10.7	10.5	10.8	4.9
Other	0.0	0.0	0.3	0.0	0.3
% in respective Occupation:[4]					
Manager	5.8	5.9	3.5	5.7	6.7
Employee	69.6	69.4	71.4	69.2	81.7
Self-employed	8.8	8.7	9.2	8.8	7.6
Civil servant	11.8	11.9	9.6	12.1	1.7
Other	4.1	4.0	6.3	4.2	2.3
Observations	54079	50741	3338	52355	1724

This table contains sample means and (in brackets) standard deviations. For industries and occupations it contains percentages. [1]The final university degree is only available for 52830 students in our sample (the best grade is 1.0 the worst 4.0). [2]The question on financial assistance has only been administered between 1993 and 2001. In 1989 the students were directly asked about their financial situation. We therefore have the information on credit constraints for 45307 individuals. [3]The industry information is available for 53427 individuals. [4]The information on occupation is available for 53190 individuals.

Table 2: First Stages

Dependent Variable: Indicator for Study Abroad

	(1)	(2)	(3)	(4)
Instrument	Dummy	Ratio	Subject Ratio	Subject Ratio excluding own department
ERASMUS	0.0247	0.4490	0.9121	0.8382
	(0.0039)**	(0.0639)**	(0.1296)**	(0.1445)**
Female	-0.0022	-0.0026	-0.0029	-0.0029
	(0.0034)	(0.0033)	(0.0039)	(0.0040)
Apprenticeship	-0.0013	-0.0012	-0.0012	-0.0012
	(0.0037)	(0.0037)	(0.0032)	(0.0032)
Age (when starting Studies)	-0.0096	-0.0103	-0.0101	-0.0101
	(0.0027)**	(0.0027)**	(0.0034)**	(0.0034)**
Age Squared	0.0001	0.0001	0.0001	0.0001
	(0.0000)*	(0.0000)**	(0.0001)*	(0.0001)*
Experience	0.0001	0.0000	0.0003	0.0001
	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Bachelor	0.0119	0.0123	0.0127	0.0130
	(0.0328)	(0.0318)	(0.0435)	(0.0438)
Follow-up Survey (Dummy)	✓	✓	✓	✓
Graduate Cohort FE	✓	✓	✓	✓
Subject FE	✓	✓	✓	✓
University FE	✓	✓	✓	✓
N	54079	54079	54079	54079
R-squared	0.087	0.092	0.090	0.090
F-stat of Instrument	40.536	49.394	49.494	33.649

**significant at the 1% level *significant at the 5% level

Standard errors are clustered at the university level in regressions reported in columns (1) and (2).
Standard errors are clustered at the subject level in regressions reported in columns (3) and (4).

Table 3: Falsification Exercise: First Stage with Different Destinations

Dependent Variable: Indicator for Study Abroad in a certain area

	(1)	(2)	(3)	(4)	(5)	(6)
Instrument	Dummy	Dummy	Dummy	Ratio	Ratio	Ratio
Study Abroad in	Europe	USA	Rest	Europe	USA	Rest
ERASMUS	0.0200	-0.0016	0.0013	0.3861	0.0102	0.0281
	(0.0036)**	(0.0018)	(0.0012)	(0.0597)**	(0.0156)	(0.0144)
Controls						
Follow-up Survey (Dummy)	✓	✓	✓	✓	✓	✓
Graduate Cohort FE	✓	✓	✓	✓	✓	✓
Subject FE	✓	✓	✓	✓	✓	✓
University FE	✓	✓	✓	✓	✓	✓
N	41065	41065	41065	41065	41065	41065
R-squared	0.075	0.023	0.039	0.080	0.023	0.039
F-stat of Instrument	30.80	0.77	1.18	41.83	0.43	3.79

**significant at the 1% level *significant at the 5% level

All standard errors are clustered at the university level.

Table 4: Main Results

Dependent Variable: Working Abroad

	(1)	(2)	(3)	(4)	(5)
Estimation Method	OLS	IV	IV	IV	IV
Instruments:					
ERASMUS		Dummy	Ratio	Subject Ratio	Subject Ratio excluding own department
Abroad	0.0646	0.2439	0.1224	0.1488	0.1346
	(0.0066)**	(0.1078)*	(0.0450)**	(0.0561)**	(0.0640)*
Female	-0.0002	0.0002	-0.0001	-0.0000	-0.0000
	(0.0020)	(0.0021)	(0.0020)	(0.0027)	(0.0027)
Apprenticeship	-0.0051	-0.0049	-0.0050	-0.0050	-0.0050
	(0.0023)*	(0.0024)*	(0.0023)*	(0.0022)*	(0.0022)*
Age (when starting Studies)	-0.0052	-0.0035	-0.0046	-0.0044	-0.0045
	(0.0018)**	(0.0022)	(0.0018)*	(0.0019)*	(0.0019)*
Age Squared	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0000)*	(0.0000)	(0.0000)*	(0.0000)*	(0.0000)*
Experience	0.0067	0.0067	0.0067	0.0067	0.0067
	(0.0012)**	(0.0012)**	(0.0012)**	(0.0011)**	(0.0011)**
Bachelor	-0.0013	-0.0033	-0.0020	-0.0023	-0.0021
	(0.0097)	(0.0096)	(0.0092)	(0.0101)	(0.0100)
Follow Up Survey (Dummy)	✓	✓	✓	✓	✓
Graduate Cohort FE	✓	✓	✓	✓	✓
Subject FE	✓	✓	✓	✓	✓
University FE	✓	✓	✓	✓	✓
N	54079	54079	54079	54079	54079
R-squared	0.034				
F-stat First Stage		40.537	49.394	49.494	33.649

**significant at the 1% level *significant at the 5% level

Standard errors are clustered at the university level in regressions reported in columns (1) – (3).
Standard errors are clustered at the subject level in regressions reported in columns (4) and (5).
Dependent variable is an indicator for whether the respondent works abroad at the time of the survey. *Study abroad* is an indicator for whether the student spends part of her university career at a foreign university. See text for further details.

Table 5: Sensitivity Analysis (Additional Controls, Time Trends, and Additional FE)

Dependent Variable: Dummy for Working Abroad

		(1)	(2)	(3)	(4)	(5)
		OLS	IV	IV	IV	IV
Main specification	coefficient	0.0646	0.2439	0.1224	0.1488	0.1346
	(st. err.)	(0.0066)**	(0.1078)*	(0.0450)**	(0.0561)**	(0.0640)*
	F-stat 1st stage		*40.537*	*49.394*	*49.494*	*33.649*
Including extended set of individual and university level control variables	coefficient	0.0618	0.2406	0.1176	0.1407	0.1248
	(st. err.)	(0.0066)**	(0.1103)*	(0.0457)**	(0.0575)*	(0.0655)
	F-stat 1st stage		*39.780*	*48.935*	*48.838*	*32.925*
Including Subject-Specific Time Trends	coefficient	0.0639	0.2550	0.1023	0.1447	0.1261
	(st. err.)	(0.0065)**	(0.1288)*	(0.0558)	(0.0869)	(0.1079)
	F-stat 1st stage		*29.915*	*35.184*	*21.724*	*12.424*
Including University * Subject group FE	coefficient	0.0638	0.2231	0.1408	0.1946	0.1805
	(st. err.)	(0.0067)**	(0.1243)	(0.0630)*	(0.0649)**	(0.0727)*
	F-stat 1st stage		*39.155*	*35.220*	*30.130*	*21.452*
Graduate Cohort FE		✓	✓	✓	✓	✓
Subject FE		✓	✓	✓	✓	✓
Instruments: ERASMUS			Dummy	Ratio	Subject Ratio	Subject Ratio excluding own department
N		54079	54079	54079	54079	54079

**significant at the 1% level *significant at the 5% level

Standard errors are clustered at the university level in regressions reported in columns (1) – (3).

Standard errors are clustered at the subject level in regressions reported in columns (4) and (5).

Note: This table only shows results for the coefficient of interest, studying abroad. Regressors not listed include female indicator, apprenticeship, age (when starting studies), age squared, potential experience, Bachelor indicator, follow-up survey dummy. Panel 1 reports the results from Table 4. Panel 2 adds additional controls for parental background (parental education and occupation dummies), for earlier mobility (between high school graduation and starting university), and for the number of foreign students in the home university. Panel 3 adds time trends for each subject to the main specification. In these regressions we also include university FE as before. Panel 4 adds Fixed Effects at the university*subject group level to the main specification. The specifications reported in Panel 4 do not include university FE because we use the finer level of university*subject group FE. See text for details.

Table 6: Heterogeneity in Returns

	(1)	(2)	(3)	(4)	(5)	(6)
	Fraction in Sample w_j	Delta (First Stage) $\Delta(StudyAbroad)_j$	Lambda λ_j	Kling Weight	IV (Ratio)	se(IV)
Not Credit Constrained/ High Parental Education	0.39	0.027	0.083	0.46	0.178	(0.117)
Not Credit Constrained/ Low Parental Education	0.49	0.014	0.119	0.43	0.085	(0.114)
Credit Constrained/ High Parental Education	0.05	0.006	0.118	0.02	0.154	(0.234)
Credit Constrained/ Low Parental Education	0.07	0.019	0.129	0.09	0.341	(0.163)*

Credit constrained = 1 for students who defray 50% or more of their living costs with federal financial aid for the 1993 to 2001 waves. The question was not administered in the other waves. For the 1989 wave credit constrained students are all students who indicate that their financial situation during their studies was unsatisfactory. High parental education = 1 for students whose less educated parent has at least 16 years of schooling (has at least an undergraduate degree). See text for details.

Table 7: Destinations of International Mobility

		Work Abroad Location													
		GB Ireland	France	Spain	Benelux	Scandinavia	Austria Switz.	East. Euro.	Other Euro.	USA	Other Amer.	Asia	Australia NZ	Other	Total	% of total studying abroad
Not Studying Abroad		15	4	5	8	5	41	4	2	7	2	2	3	2	100	
Study Abroad in:	GB/Ireland	**46**	0	0	15	0	31	0	0	8	0	0	0	0	100	8
	France	3	**50**	0	12	0	29	3	0	0	3	0	0	0	100	21
	Spain	5	0	**48**	5	10	29	0	0	0	0	0	0	5	100	13
	Benelux	20	0	20	**60**	0	0	0	0	0	0	0	0	0	100	3
	Scandinavia	9	4	0	9	**52**	17	0	0	9	0	0	0	0	100	14
	Austria/Switzerland	0	0	0	9	0	**82**	0	0	9	0	0	0	0	100	7
	Eastern Europe	0	0	25	25	0	0	**50**	0	0	0	0	0	0	100	2
	Other Europe	0	11	11	11	0	33	0	**33**	0	0	0	0	0	100	6
	USA	10	5	0	5	5	38	0	0	**24**	5	10	0	0	100	13
	Other America	0	0	0	20	20	20	0	0	0	**40**	0	0	0	100	3
	Asia	14	0	0	0	0	29	0	0	0	0	**57**	0	0	100	4
	Australia/ NZ	14	0	0	0	0	43	14	0	0	14	0	**14**	0	100	4
	Other	0	0	0	0	0	0	0	0	0	0	0	100	**0**	100	1
% of total working abroad		13	7	6	9	6	38	3	2	6	3	2	3	2		

Note: For all graduates working abroad, this table shows conditional probabilities of working abroad in the different countries conditional on the study abroad treatment and the destination of the stay abroad. Based on 496 observations from graduate cohort 2005.

Table 8: Reasons for Working Abroad

	All	Study Abroad = 0	Study Abroad = 1	Difference in means (p-value)
Interest in Foreign Cultures	52.95	50.93	67.21	0.000
	(1.59)	(1.71)	(4.27)	
Received Interesting Offer	35.85	35.35	39.34	0.389
	(1.53)	(1.63)	(4.44)	
At Employer's Instance	33.40	34.07	28.69	0.239
	(1.51)	(1.62)	(4.11)	
Better Career Prospects in Germany after Return	25.36	25.81	22.13	0.382
	(1.39)	(1.49)	(3.77)	
Obtain Qualifications Abroad	16.80	16.86	16.39	0.897
	(1.19)	(1.28)	(3.37)	
International Research Project	14.77	14.65	15.57	0.788
	(1.13)	(1.21)	(3.30)	
Partner	10.90	9.77	18.85	0.003
	(0.99)	(1.01)	(3.56)	
Employment Outlook Abroad	8.66	8.02	13.11	0.061
	(0.90)	(0.93)	(3.07)	
Career Prospects Abroad	6.52	5.70	12.30	0.006
	(0.79)	(0.79)	(2.99)	
Number of Observations	982	860	122	

Note: Based on all respondents from the 1997 follow-up survey who have work experience abroad. Table shows percentage of respondents who indicate that a particular reason led them to take up work abroad. Example: 50.93% of respondents without study abroad experience indicate that interest in foreign cultures led them to take up work abroad.

A Appendix

Table A1: Reduced Forms

Dependent Variable: Indicator for Working Abroad

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	OLS	BDM
ERASMUS	0.0060 (0.0027)*	0.0550 (0.0221)*	0.1357 (0.0592)*	0.1128 (0.0613)	0.0065 (0.0030)*
Instruments: ERASMUS	Dummy	Ratio	Subject Ratio	Subject Ratio excluding own department	Dummy
N	54079	54079	54079	54079	

**significant at the 1% level *significant at the 5% level
Standard errors are clustered at the university level in regressions reported in columns (1) and (2).
Standard errors are clustered at the subject level in regressions reported in columns (3) and (4).
In column (5) the data is first collapsed into pre-post subject times university cells as suggested by Bertrand *et al.* (2004).