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Does Studying Abroad Induce a Brain Drain?

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This paper investigates whether studying abroad increases the propensity to live abroad later on. We use an instrumental variable approach based on cut-offs in the ranking of Dutch higher education graduates who applied for a scholarship programme for outstanding students. Applicants ranked above the cut-off received a scholarship to study abroad. Applicants ranked below the cut-off were denied a scholarship. Assignment of a scholarship increases the probability to study abroad and the number of months spent studying abroad. Studying abroad and the number of months spent studying abroad increase the probability of currently living abroad.

Introduction

In June 1999, European Ministers of Education agreed in Bologna to reshape the national systems of higher education to fit into a European higher education area. An important reason for doing so is to stimulate and facilitate students to study abroad. International student mobility is supposed to increase the human capital of the students involved, and also to create international networks that lead to a better understanding of different cultures. In recent decades, international mobility of students has already increased sharply. Two decades ago, studying abroad was very uncommon, whereas in 2003, two million students were studying abroad (*Economist*, 26 February 2005).

Nearly 40% of all Dutch university graduates from recent cohorts have studied for some time at a foreign institute of higher education, often as exchange students (Nuffic 2003). To promote a further increase, the Dutch government has recently decided that Dutch students remain eligible for financial aid from the Dutch government when they are registered as students at a recognized higher education institute in one of the 44 European countries that signed the Bologna agreement. With this decision the Dutch government is ahead of most other Bologna countries.

Despite such initiatives taken by European governments and the alleged advantages of international student mobility, there is a lack of knowledge about its actual effects. This paper focuses on one possible effect in particular, namely that studying abroad for some period may afterwards trigger the decision to stay abroad. If this effect is substantial, a country that stimulates its youth to study abroad may in fact export its high-skilled workers.

The main problem in identifying the effect of studying abroad on subsequent decisions to stay abroad is that students who decided to study abroad are not a random group. A simple comparison of location decisions of students who studied abroad and students who did not study abroad, will therefore fail to provide an unbiased estimate of the effect of interest.

In this paper we exploit exogenous variation in the likelihood to study abroad that is generated by the rules of a scholarship programme. This programme awards scholarships on a competitive basis to outstanding students after their graduation. The scholarship can be used for a year of study in a foreign country. We obtained information on the

assignment of the scholarship by the selection committee. The selection committee ranks all applicants of an annual cohort. Only applicants whose rank is above a certain cut-off rank are assigned a scholarship, thereby creating a regression discontinuity design. We use assignment of a scholarship, conditional on the ranking by the selection committee and other controls, as the instrumental variable (IV) for studying abroad. The data we use cover the applicant cohorts from the period 1997 to 2002. Our main dependent variable, living abroad, is measured in early 2005. Hence we investigate the effect of studying abroad on living abroad in the first period of the career.

Our main findings are that award of a scholarship from the programme increases the probability to study abroad from 72% to 97% and increases the number of months spent studying abroad from 10 to 15 months. Award of the scholarship also lowers the probability that an applicant lives in the Netherlands during the early years of his/her working career by 30 percentage points. The results further imply that studying abroad increases the likelihood to settle abroad with almost 100 percentage points, and that every month of study abroad decreases the probability to live in the Netherlands later on by 4–5 percentage points.

The remainder of this paper is organized as follows. The next section reviews previous studies on the migration of highly educated individuals. Section II describes the scholarship programme. Section III outlines the empirical strategy. Section IV describes the data and the data collection. Section V analyses the determinants of applicants' ranks in the pool of applicants and of the award of scholarships. Sections VI and VII present and discuss the estimation results. Section VIII concludes.

I. Previous Studies

This paper focuses on the effect of studying abroad on the decision to stay abroad. Education policies that stimulate students to study abroad might in fact induce a brain drain. In the economic literature, the interest in the topic of brain drain originates from the issue of migration of highly educated individuals from developing to developed countries. Since the 1960s many studies have investigated the consequences of these international transfers of human capital. The early studies concluded that the welfare of those left behind would fall if the migrants' contributions to the economy were larger than their marginal product (Grubel and Scott 1966; Johnson 1967). In general, the home countries of the migrants bear at least a part of the education costs through the public financing of education, which increases the negative impact on those left behind. In the 1970s the idea of a 'tax on brains' (Bhagwati tax) was put forward, based on the notion that emigrants would gain from migration 'at the sacrifice of those left behind' (Hamada 1977, p. 20). The tax could compensate the sending countries for this (Bhagwati and Hamada 1974).

Several recent studies focus on the gains of migration of highly educated individuals for the home countries. Gains may come from feedback effects such as remittances, return migration after acquiring additional skills, quality of governance, creation of business and trade networks, and diaspora externalities (Rapoport and Docquier 2006; Domingues Dos Santos and Postel-Vinay 2003). Another recent argument is that the possibility of migration might provide incentives for investment in human capital (Mountford 1997; Stark *et al.* 1997; Vidal 1998; Beine *et al.* 2001; Docquier and Rapoport 2007). The returns to education will probably be higher abroad than in the home country. These higher returns to education might increase domestic enrolment in

education. This may lead to an increase of the level of human capital in the sending country because not everyone will actually emigrate. In addition, the possibility of migration might have an impact on the field of study. For instance, there might be a shift of demand towards more general studies (hard sciences, economics) and towards English language programmes.[1] A recent paper estimates that a limited but positive skilled emigration rate (between 5% and 10%) can be beneficial for development (Beine *et al.* 2008).

Dustmann (1996) and Güngör and Tansel (2005) investigate the determinants of the decision *to return to the home country*. Dustmann reports that return propensities of migrants in Germany increase with the age at entry, but decrease with the number of years of residence in the host country. Using a sample of highly educated Turkish migrants, Güngör and Tansel find that work experience in Turkey decreases the probability to return, as do higher offered wages in the host country. Respondents who perceive economic instability in Turkey as an important push factor are also less likely to return.

Brain drain between developed countries might have an effect on the financing of public education. The possibility of migration of highly skilled individuals might yield incentives for governments to finance country-specific skills instead of internationally applicable education (Poutvaara 2008). This could lead to too few engineers, economists and doctors, and too many lawyers. Dreher and Poutvaara (2005) investigate the relationship between student flows and migration to the USA. They find that the stock of foreign students is an important predictor of subsequent migration to the USA. Also related to our analysis is the study by Messer and Wolter (2005), who examine the impact of student exchange programmes on future salaries. Using mother's education as an instrument of participation in such programmes, they find no significant impact on salaries for a sample of Swiss university graduates.

II. The Scholarship Programme

The *Talentenprogramma* is a programme that awards scholarships on a competitive basis to outstanding students after finishing their undergraduate education. A scholarship from the programme can be used for a year of study in a foreign country. The programme started in 1997 and is fully funded by the Dutch government. Each year approximately 40 scholarships are available. The annual number of scholarships that can be awarded depends on the size of that year's budget, the amounts that individual applicants demand, and any remaining budget from the previous year. Columns (1) and (2) of Table 1 show the numbers of applicants and awarded scholarships since the start of the programme. Over the entire period there are 2.5 times more applicants than awarded scholarships. The share of applicants that obtained a scholarship from the programme varies between a low 26% in 1997 and a high 48% in 2003. There appears to be no clear time trend in the numbers of awarded scholarships and applicants, and the share of applicants that obtained a scholarship.

The programme is targeted at outstanding students. To be eligible for a scholarship from the programme, applicants should be younger than 26 years, have above average performance in their study and have to be admitted to a foreign institute of higher education. The maximum size of a scholarship amounts to 18,000 euros. Applicants have to send an application form including a detailed curriculum vitae (CV), extensive information on their studies, a plan for their stay abroad and their motivation, and

TABLE 1
APPLICANTS AND SCHOLARSHIPS 1997–2004

			Ranking by committee		Marginal category	
	Applicants	Scholarships	No. of categories	Cut-off rank	No. below cut-off	No. above cut-off
Year	(1)	(2)	(3)	(4)	(5)	(6)
1997	142	38	5	0.72		
1998	101	41	5	0.58	5	9
1999	113	48	4	0.55	4	8
2000	95	43	7	0.54	7	15
2001	105	39	5	0.61	5	9
2002	84	38	5	0.57	4	10
2003	100	48				
2004	107	40				
Total	847	335			25	51

correspondence that proves that they have been admitted to a foreign institute. In addition, a letter of recommendation by the director of their current education institute proving the student's excellence should be attached. Moreover, two letters of reference on the study skills and personal qualities of the student are part of the file.

A selection committee awards the scholarships. This committee consists of five people: two from university education, two from higher professional education and one from the private sector. Their expertise covers different scientific disciplines. The main factors in the decision are the student's performance in previous education, their motivation and the intended study programme. Also relevant are the letters of recommendation, the reputation of the foreign institute, the matching of previous education with the study abroad, and the CV.

The selection committee uses a two-stage ranking procedure based on their assessment of the quality of the candidates. In the first stage, candidates are assigned to four to seven ordered categories; column (3) in Table 1 shows that the number of categories varies across years. Scholarships are first awarded to students in the top category. If sufficient resources are then left to serve all students in the next highest category, scholarships are awarded to these students. This continues until insufficient funding remains to award scholarships to all students in the next category. The committee then ranks all students in this 'critical' category individually, and scholarships are awarded to the best candidates in this category until funding is exhausted.

It is not exactly clear (to us) how the selection committee determines the number of categories and the number of candidates per category. A potential concern is that the criteria used by the selection committee to assign candidates to categories induce some discontinuities. This could then lead to discontinuities in observable or unobservable characteristics of the candidates at the cut-off rank if the category sizes are chosen endogenously. It is therefore reassuring that for five out of six cohorts the marginal candidate comes from the middle of one of the categories (in which candidates are then individually ranked).

We first translated the two-stage ranking into an annual ranking of students running from 0 to 1, with a higher rank signifying a better position. Students in groups that were not individually ranked were assigned the average rank of the group. Column (4) in Table 1 shows the cut-off ranks for awarding a scholarship by year. This is the rank of the best student who did not receive a scholarship in that year. We then rescaled applicants' ranks relative to the cut-off rank in the year of application. That is, from an applicant's rank we subtract the cut-off rank in the year of application. We will refer to this rescaled rank as relative rank. A positive relative rank therefore indicates a rank above the cut-off rank, while a negative relative rank indicates a rank below the cut-off rank. The numbers of students in the marginal categories just above or just below the cut-off rank are shown in columns (5) and (6).

This scholarship programme is attractive for evaluating the impact of studying abroad because it offers relatively large scholarships that make it possible to study abroad for a substantial period (up to a year). Hence we expect that the assignment of scholarships has a considerable impact on the probability to study abroad and on the length of the period spent studying abroad. In addition, the programme is targeted at a selective group of outstanding students.

III. Empirical Approach

We are interested in the effect (δ) of having studied abroad (S) on the outcome whether the student currently lives in the Netherlands (Y):

$$(1) \qquad Y = \delta S + \beta X + \sum_{k=0}^{K} \alpha_k r^k + \varepsilon,$$

where X is a vector of control variables, r is the applicant's relative rank, K is the degree of the polynomial of the relative rank included in the specification, α_k, δ and β are parameters to be estimated, and ε is a disturbance term. It seems likely that studying abroad will increase the probability of living abroad afterwards. Studying abroad means investing in human capital. If the returns to human capital are higher in the country of studying, a student might decide not to return to the home country. In addition, a student who studies abroad not only invests in human capital but is also likely to meet new people, make new friends, perhaps find a partner, discover new labour market opportunities and probably improve her/his language skills.

OLS (or probit) estimation of δ may be biased due to a correlation between S and ε. Endogeneity bias arises when students who are more inclined to reside abroad after they finish their studies are also more inclined to study abroad. For instance, students with a strong interest in migrating to a foreign country might use study abroad as a first test case. In that case, OLS estimates of δ would be biased upwardly. It is also possible that students view a study abroad only as a necessary step for success in the labour market of their home country. In that case they will soon return to the home country after their study abroad, and the estimate of δ will be downward biased. In a random sample of students, it seems likely that the first type of bias will be more important. However, since our sample consists of applicants for a scholarship for studying abroad, which could mean that they all have some interest in going abroad, this might not be the case here. Hence it is not clear which bias will dominate. To address the potential bias, we use

assignment of a scholarship (Z) as the instrumental variable for studying abroad:

$$S = \lambda Z + \gamma X + \sum_{k=0}^{K} \kappa_k r^k + \eta. \tag{2}$$

The identifying assumption is that conditional on X and the polynomial function in r, actual award of a scholarship is mean independent of ε: $E[Z \cdot \varepsilon | X, r] = 0$.

This approach basically exploits a regression discontinuity design (cf. Campbell 1969; Hahn *et al.* 2001). Having a rank above or below the cut-off rank pertaining in a particular year is decisive for the assignment of a scholarship and through that has an impact on studying abroad. There is no reason, however, to suspect that having a rank below or above the cut-off rank has an independent impact on the decision to live abroad once we condition on a smooth function of rank. In this respect it is important to notice that applicants cannot manipulate their own rank relative to the cut-off rank. First, an applicant's rank depends on how s/he compares to other applicants about whom s/he has no information. Second, the cut-off rank pertaining in a particular year is unknown beforehand and fluctuates from one year to the next.

In addition to instrumental variable estimates of equation (1) we will also present estimates of first-stage relations in which studying abroad is the dependent variable and award of the scholarship is the explanatory variable of interest (equation (2)). Moreover, we will present results from reduced form equations in which the outcome variable (currently living in the Netherlands) is the dependent variable and in which again award of the scholarship (Z) is the explanatory variable of interest:

$$Y = \rho Z + \tau X + \sum_{k=0}^{K} \mu_k r^k + \nu. \tag{3}$$

In the empirical analysis we employ two different measures of studying abroad (S). The first is a dichotomous indicator that takes the value 1 if the applicant studied abroad and 0 otherwise. The second measures studying abroad as the number of months that an applicant studied abroad. We make this distinction because a very large fraction of applicants who were denied a scholarship from the programme nevertheless studied abroad. This is due to having access to other scholarship programmes and other sources of funding (parents, loans). These other sources are not necessarily substitutes for a scholarship from the programme because the applicants who received a scholarship can also have access to the other scholarship programmes and funding sources.

In the empirical analysis we control for the direct effect of rank on future country of residence by including a second-order polynomial of relative rank. Including a cubic in relative rank does not change the findings in any significant way (statistically or qualitatively). The dependent variable in our analysis is a dichotomous indicator for the current country of residence. This variable equals 1 if the respondent currently lives in the Netherlands (NL) and 0 otherwise. To avoid any confusion, it is important to notice that living abroad is measured at the moment of filling out the questionnaire (early 2005) and that studying abroad takes place (if it does) following the year of application (1997 to 2002). Hence respondents are not living abroad because they are still studying abroad, but rather they are living abroad because they did not return to the Netherlands after they finished their study abroad.

IV. Data Collection

The data used in this paper came from three sources. First, we obtained information from the application forms that applicants submitted to the scholarship officials. To obtain a scholarship, students have to send an application form with information on their study performance and evidence showing that they have been accepted at a foreign institute (see Section I). Variables taken from these application forms include gender, age, field and level of study. Second, we received information about the annual ranking of the students by the committee that assigns the scholarships. Third, we conducted a survey among all applicants for the scholarship in the years 1997 to 2002. In this period, 640 students applied for a scholarship from the program (Table 1).

The first step in the project was to track applicants' current addresses. The organization responsible for the payments of the scholarships (Nuffic) could provide approximately 120 addresses of students who received the scholarship in 2000, 2001 and 2002. For the other students (winners in 1997, 1998 and 1999, and losers in all years), we asked the organization executing the Dutch system of student financial aid to track the addresses. They retrieved 430 additional addresses. In a letter to all 550 addresses thus obtained, we invited the former applicants to participate in our survey, which was posted on the internet. We offered a reward of 25 euros on completion of the survey. This invitation letter was sent out in November 2004. After sending a reminder (December 2004) and a telephone round (January 2005), we received 337 completed surveys, which is a response of 61% for the group for which addresses were retrieved, and 54% of the total sample of applicants. The survey includes questions concerning personal characteristics (father's education measured on an 8-point scale), the study (date of graduation, average mark, study duration), the scholarship (did you obtain and use the scholarship), studying abroad, and current country of residence.

A reason for worry is that addresses of winners of the last three cohorts come from a different source than the addresses of these cohorts' losers, and that these addresses are probably more accurate especially for people who moved abroad. This asymmetry potentially stacks the deck in favour of finding a negative effect of receiving a scholarship on currently living in the Netherlands. To investigate how serious this problem is, we redid all our estimations on only the sub-sample of the cohorts of 1997, 1998 and 1999, so that addresses of winners and losers were obtained from the same source. The results are very similar to those obtained using the entire sample but are less precise. For this reason we present the results based on the entire sample in the main text and report those obtained using only the first three cohorts in the Appendix.

Table 2 shows results of a response analysis. We estimated a probit model where the dependent variable takes the value 1 if a person responded to the survey and 0 otherwise. Explanatory variables are year of application, gender and whether a scholarship was awarded. We focus on the response in the total sample of applicants (this differs from the sample of students we could track and were invited to participate). The estimates for the year dummies reveal no clear pattern of a declining or increasing response rate. Gender has no impact on participation. We find a strong effect of the assignment of the scholarship on the participation in the survey. Students who were assigned the scholarship are 17 percentage points more likely to respond.

When we restrict the sample to the first three cohorts, the difference in response rates between winners and losers amounts to 16 percentage points. This implies that the difference in response rates is not caused by differences in the accuracy of participants' addresses. Hence this does not suggest a positive interaction between award of

TABLE 2
DETERMINANTS OF RESPONSE (OLS)

	Coefficient	Standard error
Year of application (1997 = reference)		
1998	− 0.071	(0.065)
1999	0.147**	(0.062)
2000	0.052	(0.066)
2001	0.080	(0.064)
2002	0.133*	(0.068)
Female	0.029	(0.040)
Scholarship assigned	0.174***	(0.040)
R-squared	0.054	

Notes
Robust standard errors in parentheses.
***,**,*Indicate significance at the 1%, 5%, 10% level.
Number of observations is 640.

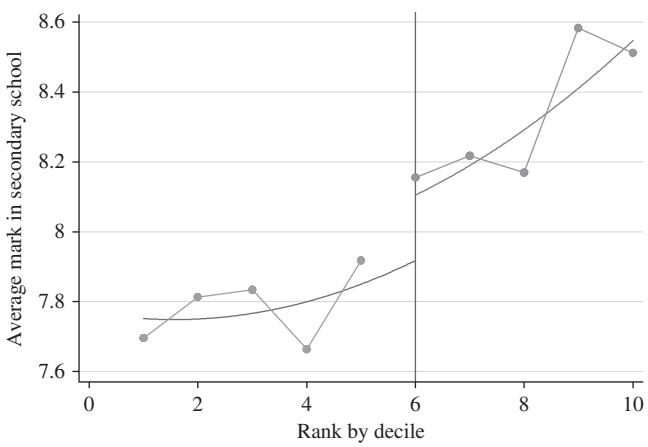
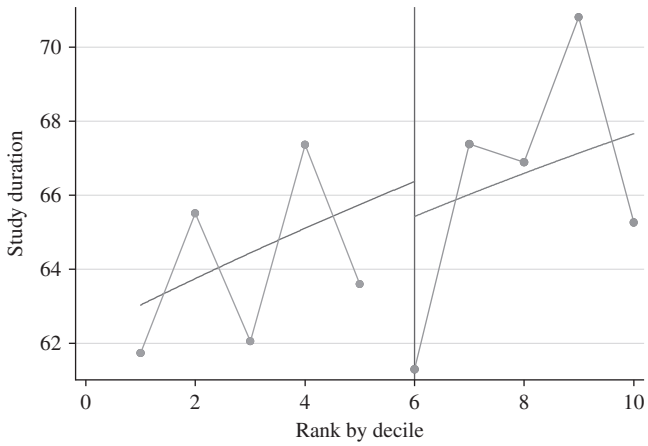


FIGURE 1. Relation between average mark and rank relative to cut-off.

scholarship and currently living abroad (which we know only for respondents) on the response rate, through which the higher response rate among winners could bias our results. In addition, the covariates from our models are quite similar just above and below the cut-off rankings (see Figures 1–4). This also suggests that the higher response rate among winners does not bias our results.

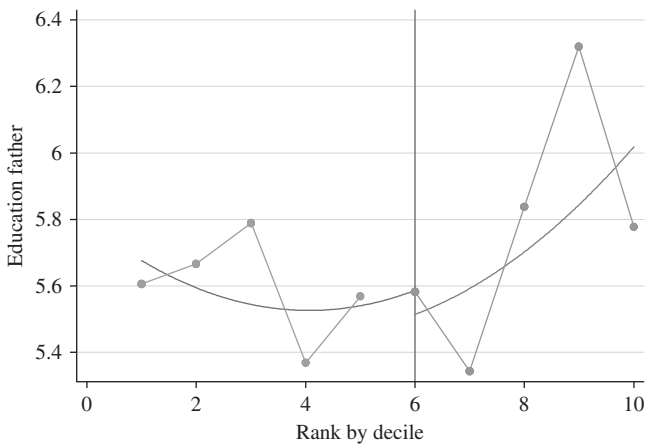
The final sample used in the analysis consists of 325 observations. Of the original response of 337, one observation is lost because scholarship status is unknown, and three observations are lost because the respondents' current country of residence is unknown. Another eight observations are not included in the analysis because their study abroad was still ongoing at the time the invitation letter was sent out.

Descriptive statistics are presented in Table 3, separately for the group that received a scholarship and the group that was denied a scholarship. Among winners of a scholarship, 97% have studied abroad, while among applicants not getting a scholarship



Discontinuity at threshold = –0.942; with s.e. 3.816.

FIGURE 2. Relation between study duration and rank relative to cut-off.



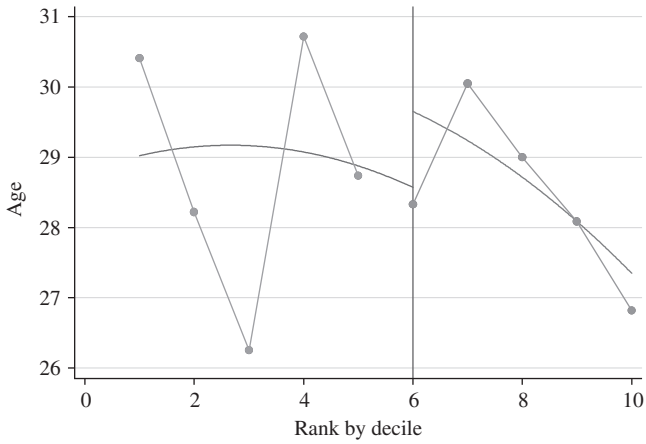
Discontinuity at threshold = –0.072; with s.e. 0.409.

FIGURE 3. Relation between father's education and rank relative to cut-off.

from the programme this number is 72%. The average duration of the study abroad is close to 15 months among winners and 10 months among losers. When restricted to those who studied abroad, the respective figures are 15.5 and 13.8. The average durations reveal that scholarships from the programme are not typically used to partially finance studies of longer duration such as a PhD programme. Only 10 respondents in the group of winners and 3 in the group of losers report that they studied abroad for more than 3 years. (The 75th percentile is equal to 12 months in both groups.)

Table 3 also shows that winners are more likely to live abroad at the moment of the interview. In the group of winners we further observe higher marks, higher relative ranks, more receipt of other scholarships, more men, higher educated fathers, younger graduates, less applicants with cultural education and more applicants with a background in economics, more students with a university degree and a longer duration of their undergraduate study.

Not reported in Table 3 are the destination countries. The most popular countries among all applicants and those who actually study abroad are the UK (41%) and the



Discontinuity at threshold = 1.075; with s.e. 0.538.

FIGURE 4. Relation between age and rank relative to cut-off.

USA (25%). In third and fourth place are Germany (5%) and France (5%). The remaining quarter spreads out over many different countries. Respondents who currently reside in a foreign country have almost always settled in the country where they studied.

The identifying assumption in our approach is that there are no discontinuities in other variables around the cut-off except for the award of the scholarship. Figures 1–3 shows this to be the case for the average mark, study duration and father's education. These figures show the relationship between an applicant's rank relative to the cut-off rank and the various variables. The vertical lines near the middle of the figures resemble the cut-off rank. The dots in the graphs represent the average value per decile of the rank.[2] The lines in each graph come from a regression of the dependent variable on rank, rank squared and a dummy for a rank above the cut-off. Below each graph we report the point estimate of the dummy for a rank above the cut-off along with its standard error using this specification. (We will use similar figures to illustrate the effect of award of a scholarship on (length of) studying abroad and on currently living in the Netherlands.) Figure 4 shows that there is a small but significant difference between people below and above the cut-off in terms of their age.

V. Determinants of Relative Rank and Awarding Scholarships

This section examines the determinants of the ranking by the selection committee and of the award of scholarships. To this end, Table 4 presents estimation results from regressions in which ranking (columns (1) and (2)) and scholarship award (columns (3) to (5)) are the dependent variables.[3] In columns (1) and (3) the only explanatory variable is the average mark applicants received during their undergraduate education. The regressions in columns (2), (4) and (5) also contain the other information available in our dataset.

The results show that the average mark obtained during undergraduate education is a prime determinant of both ranking and subsequent granting of a scholarship. One point more on a scale from 6 to 10 (in our sample—the full scale runs from 1 to 10), which is equivalent to 1.7 of a standard deviation, boosts the rank by around 20 percentile points and increases the probability that a scholarship is awarded by over 38 percentage points.

TABLE 3
SAMPLE MEANS BY SCHOLARSHIP STATUS

	With scholarship	Without scholarship	*p*-value
Study abroad	0.97	0.72	0.000
Months of study abroad	14.95 (11.08)	9.99 (9.74)	0.000
Currently living in NL	0.62	0.81	0.000
Relative rank	0.21 (0.11)	− 0.29 (0.14)	0.000
Average mark	8.31 (0.48)	7.78 (0.56)	0.000
Obtained other scholarships	0.66	0.52	0.008
Months of study at home	66.85 (15.08)	64.20 (17.20)	0.144
Female	0.44	0.64	0.000
Father's education	5.79 (1.82)	5.55 (1.67)	0.105
Age	28.67 (2.24)	29.01 (2.44)	0.200
University	0.83	0.61	0.000
Year			0.225
1997	0.14	0.24	
1998	0.2	0.11	
1999	0.24	0.20	
2000	0.18	0.13	
2001	0.17	0.18	
2002	0.16	0.14	
Type of education			0.367
Culture	0.36	0.40	
Economics	0.12	0.11	
Health	0.04	0.01	
Agriculture	0.00	0.02	
Science	0.06	0.05	
Education	0.01	0.00	
Law	0.17	0.17	
Social	0.15	0.18	
Technical	0.09	0.07	
N	151	174	

Note
Standard deviations in parentheses.

Columns (2) and (4) show that these results are independent of the inclusion of other covariates. For the other covariates we observe that duration of undergraduate education tends to have a positive impact on rank. For given values of the other observed characteristics, women get lower ranks and have lower chances to obtain a scholarship than men. This might indicate discrimination by the selection committee, but may also capture the effect of women having less impressive reference letters or women being less motivated to study abroad than men. Furthermore, applicants with a background in academic higher education rather than in professional higher education have higher ranks and better chances to be awarded a scholarship from the programme. The same is true for applicants with a specialization in economics compared to applicants with specializations in most of the other fields.

In the final column of Table 4, we also included relative rank and relative rank squared as regressors. These two variables absorb the entire effects of average mark,

TABLE 4
DETERMINANTS OF RELATIVE RANK AND AWARD OF SCHOLARSHIP (OLS)

	Relative rank		Scholarship		
	(1)	(2)	(3)	(4)	(5)
Average mark	0.226***	0.190***	0.386***	0.354***	0.040
	(0.024)	(0.025)	(0.043)	(0.045)	(0.025)
Duration of study		0.002*		0.001	− 0.001
		(0.001)		(0.002)	(0.001)
Female		− 0.057**		− 0.118**	− 0.030
		(0.029)		(0.053)	(0.027)
Father's education		− 0.001		0.004	0.004
		(0.008)		(0.014)	(0.007)
Age		0.057		0.120	0.072
		(0.128)		(0.229)	(0.115)
Age squared		− 0.001		− 0.002	− 0.001
		(0.002)		(0.004)	(0.002)
University		0.114***		0.213***	0.042
		(0.034)		(0.061)	(0.031)
Relative rank					1.660***
					(0.059)
Relative rank squared					0.816***
					(0.179)
Type of education					
Culture (reference)					
Economics		0.092*		0.169**	0.014
		(0.048)		(0.085)	(0.043)
Health		0.122		0.160	− 0.045
		(0.089)		(0.160)	(0.081)
Agriculture		− 0.182		− 0.297	− 0.027
		(0.126)		(0.226)	(0.114)
Science		0.009		0.033	0.001
		(0.064)		(0.116)	(0.058)
Education		0.359		0.707	0.175
		(0.250)		(0.449)	(0.226)
Law		0.004		− 0.013	− 0.016
		(0.043)		(0.076)	(0.038)
Social		− 0.008		− 0.031	− 0.013
		(0.043)		(0.076)	(0.038)
Technical		0.049		0.077	0.001
		(0.055)		(0.098)	(0.049)
R-squared	0.215	0.322	0.202	0.295	0.823

Notes
Robust standard errors in parentheses.
***,**,*Indicate significance at the 1%, 5%, 10% level.
Number of observations is 325.

gender and level of higher education that have a significant impact on award of scholarship in column (4). This suggests that relative rank and relative rank squared capture the main differences in underlying characteristics between winners and losers.

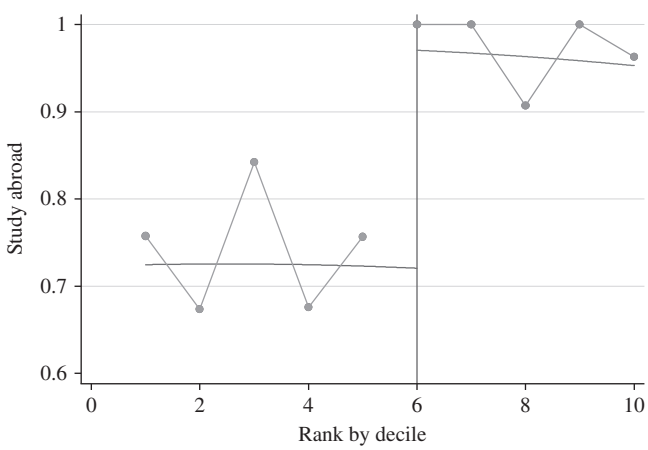
VI. The Effect of a Scholarship on Studying Abroad

This section reports the first-stage relations, that is, the effect of having been awarded the scholarship on the probability of having studied abroad and on the number of months spent studying abroad.

Scholarships were assigned to all applicants with a rank above the cut-off rank. Applicants with a rank below the cut-off did not receive a scholarship from the programme. Figures 5 and 6 show the relationship between an applicant's rank relative to the cut-off rank and the probability of having studied abroad and the number of months spent studying abroad.

Figure 5 shows that passing the cut-off rank, and thereby award of scholarship, boosts the probability of having studied abroad by 25 percentage points. Figure 6 shows that passing the cut-off rank increases the number of months spent studying abroad by around 6 months. The figures also show that there is no systematic relationship between relative rank and studying abroad at either side of the cut-off rank. This suggests that without the scholarship programme there would have been no differences in the probability of studying abroad and the number of months spent studying abroad for students who were assigned different ranks.

To further explore the first-stage relations, Table 5 presents regression results from various specifications. The top panel of Table 5 shows the effect of award of scholarship on the probability to study abroad for four different specifications. The regression reported in column (1) includes no other control variables. For that specification we find an effect of award of the scholarship on the probability to study abroad of 24 percentage points. As it should be, this effect is similar to the raw difference reported in Table 3. The regression in column (2) adds relative rank and relative rank squared as control variables; this is comparable with the graphs in Figure 5. These controls should capture the systematic differences between applicants with a rank above the cut-off for award of the scholarship and applicants with a rank below this cut-off. As already suggested by the graph in Figure 5, neither of these terms has a significant impact on the probability to study abroad; also the joint effect of these terms is insignificant ($p = 0.7916$).[4] More importantly, the effect of the scholarship changes only slightly. The regressions in columns (3) and (4) add other observed characteristics as controls. The estimates of the



Discontinuity at threshold = 0.250; with s.e. 0.082.

FIGURE 5. Relation between studying abroad and rank relative to cut-off.

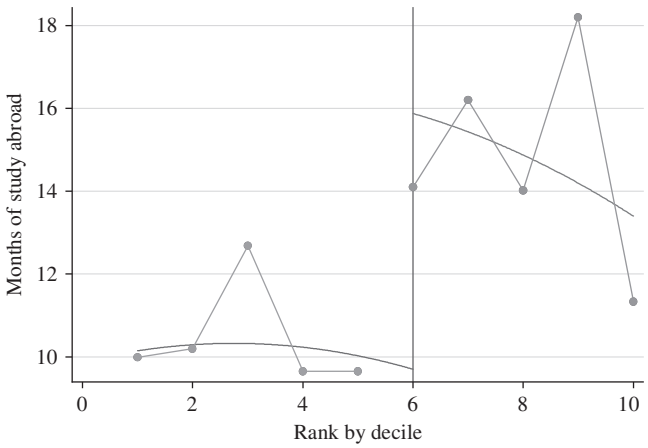


FIGURE 6. Relation between months of study abroad and rank relative to cut-off.

TABLE 5
EFFECT OF SCHOLARSHIP ON (LENGTH OF) STUDYING ABROAD (OLS)

	(1)	(2)	(3)	(4)
Study abroad				
Scholarship	0.243***	0.258***	0.295***	0.277***
	(0.037)	(0.072)	(0.081)	(0.073)
F-test instrument	43.06	12.76	13.17	14.24
Length of study abroad				
Scholarship	4.959***	7.923***	6.683***	5.887**
	(1.166)	(2.370)	(2.406)	(2.295)
F-test instrument	18.10	11.18	7.72	6.58
Controls				
Relative rank, relative rank squared	No	Yes	Yes	Yes
Female, age, age squared, father's education, field, level, year	No	No	Yes	Yes
Mark, study duration, other scholarship	No	No	No	Yes

Notes
Robust standard errors in parentheses.
***,**Indicate significance at the 1%, 5% level.
Number of observations is 325.

effect of the scholarship remain virtually identical. The table also reports the *F*-test statistics of the restriction that scholarship has no impact on the decision to study abroad. In all specifications, this statistic indicates that this instrument is not weak.

The bottom panel of Table 5 repeats the same analysis, but now the dependent variable is measured as the number of months that applicants have studied abroad. The impact size varies only slightly across specifications and indicates that award of a scholarship from the programme increases the length of the study abroad by 5 to 8 months. Also with this dependent variable, relative rank and relative rank squared have no significant (joint) impact. The *F*-test statistics of the restriction that award of the scholarship has no impact on the length of the study period abroad are above 6. While

this indicates significance at the 5% level, it may point to a weak instrument problem. With the relatively small sample size this is not too surprising. This potential problem should be kept in mind when interpreting the IV results presented in the next section.

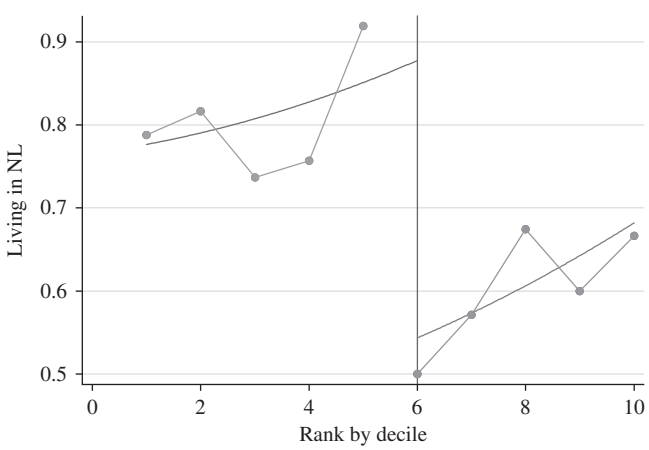
VII. The Effects of Scholarship and Study Time Abroad on Returning

We start this section by presenting the reduced form results, that is, the effect of award of a scholarship from the programme on the probability to live in the Netherlands at the moment of the interview. Recall that award of the scholarship occurs in the period 1997 to 2002 and that current country of residence relates to the situation in 2005, when the study abroad has been finished.

We first give a graphical illustration in Figure 7. This figure shows a substantial gap in the probability to currently live in the Netherlands exactly around the cut-off. Estimation results are presented in Table 6. This table follows the same format as the previous two tables: it presents results from four different specifications that vary in the number of control variables that they contain. The results from all four specifications point in the same direction: applicants who were awarded a scholarship in the period 1997–2002 are more likely to live abroad at the moment of the interview (2005). The estimated effect is close to 20 percentage points when no controls are included. After adding controls for relative rank, the effect increases to 30 percentage points, and this effect is independent of the inclusion of other covariates.

These reduced form results have a clear-cut policy interpretation. The specific programme that awards scholarships to outstanding applicants on the basis of competition results in an almost 30 percentage points increase in the probability that applicants to the programme do not live in the Netherlands when they are in the early years of their working careers.

Before presenting the IV results we first present results from OLS equations in which the dummy for currently living in the Netherlands is regressed on (length of) studying abroad and other covariates without instrumenting. The results are reported in the top panel of Table 7. Clearly (length of) studying abroad and currently living in the Netherlands are negatively related.



Discontinuity at threshold = –0.334; with s.e. 0.102.

FIGURE 7. Relation between living in NL and rank relative to cut-off.

TABLE 6
EFFECT OF SCHOLARSHIP ON CURRENTLY LIVING IN NL (OLS)

	(1)	(2)	(3)	(4)
Scholarship	− 0.194***	− 0.302***	− 0.317***	− 0.302**
	(0.050)	(0.111)	(0.120)	(0.120)
Controls				
Relative rank, relative rank squared	No	Yes	Yes	Yes
Female, age, age squared, father's education, field, level, year	No	No	Yes	Yes
Mark, study duration, other scholarship	No	No	No	Yes

Notes
Robust standard errors in parentheses.
***,**Indicate significance at the 1%, 5% level.
Number of observations is 325. Instrumental variable is award of scholarship.

TABLE 7
EFFECT OF (LENGTH OF) STUDYING ABROAD ON CURRENTLY LIVING IN NL (OLS AND IV)

	(1)	(2)	(3)	(4)
OLS				
Studying abroad	− 0.222***	− 0.179***	− 0.191***	− 0.256***
	(0.049)	(0.053)	(0.057)	(0.076)
Months of study abroad	− 0.013***	− 0.012***	− 0.012***	− 0.014***
	(0.002)	(0.002)	(0.002)	(0.002)
IV				
Studying abroad	− 0.801***	− 1.173**	− 1.075**	− 1.090**
	(0.226)	(0.514)	(0.473)	(0.455)
Months of study abroad	− 0.039***	− 0.038**	− 0.047**	− 0.051**
	(0.012)	(0.016)	(0.022)	(0.024)
p-value endogeneity studying abroad	0.0030	0.0214	0.0275	0.0420
p-value endogeneity months of study abroad	0.0067	0.0568	0.0408	0.0486
Controls				
Relative rank, relative rank squared	No	Yes	Yes	Yes
Female, age, age squared, father's education, field, level, year	No	No	Yes	Yes
Mark, study duration, other scholarship	No	No	No	Yes

Notes
Robust standard errors in parentheses.
***,**Indicate significance at the 1%, 5% level.
Number of observations is 325. Instrumental variable is award of scholarship.

The bottom panel of Table 7 presents the IV estimates of the effect of the dichotomous indicator of having studied abroad on the probability that an applicant currently lives in the Netherlands. As could already be anticipated from the first-stage and reduced form estimates (see also Figure 7), the effect sizes are very large, up to a hundred percentage points, and much larger than the effects obtained without instrumenting. These findings suggest that the OLS estimates are downward biased. In Section II we noted that such a bias may arise from students with a strong focus on success in the labour market of the home country. The most natural interpretation of this

large impact is in terms of a local average treatment effect (cf. Imbens and Angrist 1994). Applicants who would not have studied abroad without a scholarship would currently live in the Netherlands had they not received a scholarship. With a scholarship they will study abroad and currently live abroad. This would, for instance, be the case if compliers—that is, students who study abroad only when they win a scholarship—are credit constrained and face poor prospects in the Netherlands compared to their opportunities abroad (therefore they stay abroad once they leave the Netherlands). In addition, the timing of the study abroad investigated in this paper might be especially important. The students in our sample have just finished their study in Dutch higher education, and maybe are also ending their student life, thus are bound to embark on a new step in life. This step might be decisive for many subsequent steps in life. The last row in Table 7 repeats the analysis but with the number of months spent studying abroad as the instrumented endogenous regressor. The results mean that each month of study time abroad increases the probability of future settlement outside the Netherlands by 4–5 percentage points.

In all but one case we must reject the hypothesis that the OLS estimate is equal to the IV estimate, implying that endogeneity is an issue.

A possible concern regarding the results reported in this section is that the outcome only measures where people reside in the beginning of their labour market career. The fact that someone lived abroad when the data were collected does not necessarily imply that that person will not return to the Netherlands. Perhaps people only expand their stay abroad with a fixed period and then decide to return. The period over which we measure residential choices is too short to completely rule out such a pattern. To examine this we restricted our analysis to cohorts 1997–1999 instead of 1997–2002. The results on this restricted sample are reported in the Appendix. The patterns reported there are very similar; if anything, effects on the restricted sample are somewhat larger than the results reported in Table 7. This suggests that—within the window observed in the data—the amount of time elapsed between receiving the scholarship and the moment of the interview does not bias our findings.

VIII. Conclusions

We investigated whether studying abroad (longer) increases the propensity to live abroad later on during the first period of the career. To correct for the possible endogeneity bias in the study abroad variables, we applied an instrumental variable approach exploiting information from the selection process of a particular scholarship programme. The identifying assumption is that conditional on an applicant's relative rank (squared) in the pool of applicants (and other observable characteristics), award of the scholarship is random and thereby creates exogenous variation in the decision to study abroad and in the number of months of study abroad.

We find that award of a scholarship from the programme increases the probability to study abroad by 25–30 percentage points and the number of months spent studying abroad by 5–8 months. Award of the scholarship lowers the probability that an applicant lives in the Netherlands during the early years of his/her working career by 30 percentage points. Hence the policy of awarding scholarships has a substantial effect on the migration of Dutch top students during the first period of their career.

The results further imply that studying abroad increases the probability to settle abroad by a hundred percentage points and that every month of study abroad decreases the probability to currently live in the Netherlands by 4–5 percentage points. The IV

estimates are much larger than the OLS estimates. The IV estimates are based only on students who studied abroad because of receiving the grant (a local average treatment effect). The estimates suggest that applicants who would not have studied abroad without a scholarship would currently live in the Netherlands had they not received a scholarship. With a scholarship they will study abroad and currently live abroad. This would, for instance, be the case if compliers are credit constrained. In addition, the timing of the study abroad investigated in this paper might be especially important because the sample consists of students at a turning point in their life. They have just finished their study in Dutch higher education and are bound to engage in a new step in life.

The scholarship programme that we evaluated in this paper is targeted at outstanding students. This limits the possibility to generalize our findings to the population at large. At the same time, this limitation makes the programme interesting as the target group probably includes the high potentials that countries and enterprises think important for their success.

Our findings merit consideration of a hitherto neglected side effect of the Bologna agreement. An open higher education market in Europe with international student mobility requires funding schemes that allow students to study abroad. Countries that take the lead in facilitating their young people to go abroad may be confronted with a deficit on their human capital trade balance. The possible negative effects of losing young talented individuals should be weighted against possible positive feedback effects such as remittances, creation of business and trade networks, or return migration after the 7–8 years of the working career observed in this paper.

APPENDIX

This appendix contains estimation results based on the sub-sample of applicants in the years 1997, 1998 and 1999. Tables A1, A2 and A3 correspond to Tables 5, 6 and 7, respectively, in the main text.

TABLE A1
EFFECT OF SCHOLARSHIP ON (LENGTH OF) STUDYING ABROAD (OLS)

	(1)	(2)	(3)	(4)
Study abroad				
Scholarship	0.231***	0.305***	0.346***	0.390***
	(0.051)	(0.094)	(0.105)	(0.099)
F-test instrument	20.50	10.63	10.90	15.47
Length of study abroad				
Scholarship	6.654***	7.392	5.855	5.657
	(1.972)	(4.532)	(4.369)	(4.282)
F-test instrument	11.38	2.66	1.80	1.75
Controls				
Relative rank, relative rank squared	No	Yes	Yes	Yes
Female, age, age squared, father's education, field, level, year	No	No	Yes	Yes
Mark, study duration, other scholarship	No	No	No	Yes

Notes
Robust standard errors in parentheses.
***, ** Indicate significance at the 1%, 5% level.
Number of observations is 171.

TABLE A2
EFFECT OF SCHOLARSHIP ON CURRENTLY LIVING IN NL (OLS)

	(1)	(2)	(3)	(4)
Scholarship	− 0.229***	− 0.531***	− 0.421**	− 0.396**
	(0.071)	(0.162)	(0.177)	(0.182)
Controls				
Relative rank, relative rank squared	No	Yes	Yes	Yes
Female, age, age squared, father's education, field, level, year	No	No	Yes	Yes
Mark, study duration, other scholarship	No	No	No	Yes

Notes
Robust standard errors in parentheses.
***,**Indicate significance at the 1%, 5% level.
Number of observations is 171. Instrumental variable is award of scholarship

TABLE A3
EFFECT OF (LENGTH OF) STUDYING ABROAD ON CURRENTLY LIVING IN NL (OLS AND IV)

	(1)	(2)	(3)	(4)
OLS				
Studying abroad	− 0.276***	− 0.255***	− 0.262***	− 0.347***
	(0.062)	(0.069)	(0.076)	(0.103)
Months of study abroad	− 0.013***	− 0.014***	− 0.013***	− 0.014***
	(0.002)	(0.002)	(0.002)	(0.003)
IV				
Studying abroad	− 0.991***	− 1.739**	− 1.218**	− 1.015**
	(0.350)	(0.690)	(0.585)	(0.441)
Months of study abroad	− 0.034***	− 0.072*	− 0.072	− 0.070
	(0.012)	(0.043)	(0.053)	(0.049)
p-value endogeneity studying abroad	0.0158	0.0071	0.0605	0.1146
p-value endogeneity months of study abroad	0.0395	0.0081	0.0431	0.0542
Controls				
Relative rank, relative rank squared	No	Yes	Yes	Yes
Female, age, age squared, father's education, field, level, year	No	No	Yes	Yes
Mark, study duration, other scholarship	No	No	No	Yes

Notes
Robust standard errors in parentheses.
***,**,*Indicate significance at the 1%, 5%, 10% level.
Number of observations is 171. Instrumental variable is award of scholarship.

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NOTES

1. In this paper we cannot explore these issues empirically because of the design and size of our sample.

2. Observations have been divided into deciles of their rank, so that each average is based on roughly 10% of the observations (due to clustering, the deciles vary a little in size). We have chosen the threshold between the fifth and sixth 'decile' such that it corresponds to the cut-off of the programme.
3. Throughout the paper we present results based on OLS and 2SLS. This follows the recommendation by Angrist and Krueger (2001, p. 80): 'In two-stage least squares, consistency of the second-stage estimates does not turn on getting the first-stage functional form right ... Nonlinear second-stage estimates with continuous or multivalued regressors are similarly tricky, requiring a correctly specified functional form in order to interpret the estimates easily.' Given the relatively small size of our sample, we have not much scope to assess functional form issues.
4. Adding higher-order terms of rank does not change the results.

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