The Selection of High-Skilled Migrants

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Abstract

We investigate international migration choices of high-skilled individuals and measure migrant selection using predicted earnings. High-skilled migrants select to destinations as predicted by Borjas' (1987) model of migration choices. Migrants to less equal countries are positively selected, while migrants to more equal countries are negatively selected, relative to non-migrants. For our analysis, we use a survey of university graduates, including detailed information on background characteristics, university studies, and labor market choices, combined with measures of earnings inequality for high-skilled individuals in destination countries. Our rich data allow us to decompose the observed selection patterns. Positive selection to less equal countries is driven by university quality and grades. Negative selection to more equal countries is driven by university subject and gender. Our results highlight the relevance of the Roy/Borjas model for high-skilled individuals in a setting where credit constraints and other barriers to migration are unlikely to be binding.

JEL-Code: F22, J24, J61
Keywords: Migrant selection, high skilled, international migration, earnings inequality.

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Introduction

International migration of high-skilled individuals has become more important in recent decades. In the year 2000, high-skilled migrants represented about 11 percent of the tertiary educated population in OECD countries (Brücker et al., 2012, p. 17). Between 2000 and 2006, the United States attracted 1.9 million and European OECD countries attracted 2.2. million tertiary educated migrants. Emigration rates of the highly educated have risen to 5.2% in upper-middle income countries and 5.4% in low income countries (Widmaier and Dumont, 2011).[1]

Access to talent is central to firms' success in the marketplace and has become more important in economies where ideas drive technological progress and innovation (Chambers et al., 1998). With a limited pool of home-grown talent the ability to attract high-skilled migrants is crucial for improving the quality of a country's workforce and its innovative capacity. Understanding the drivers of high-skilled migrant selection is therefore important for sending and receiving countries. While the selection of migrants has been studied extensively since Borjas' (1987) outlined theoretical predictions for migrant selection, we are not aware of other papers that have studied migrant selection within the group of high-skilled individuals.[2]

In this paper we use rich survey data on German university graduates to investigate how the selection of high skilled migrants depends on relative inequality in home and receiving countries. As German university attendance rates are relatively low, reflecting the traditionally selective entry into higher education, we can study selection within the top 11 percent of the educational distribution.[3] The university graduates in our data

[1] Data are for 2000-2005 or 2000-2006, depending on the country.

[2] See section 1.2 for a review of empirical papers investigating migrant selection. While the selection of high-skilled migrants has not previously been studied, some papers have investigated the effects of high-skilled migrants on the receiving economy and in particular on innovation. High-skilled migrants from China and India increase overall patenting in U.S. cities but do not increase patenting of natives (Kerr and Lincoln, 2010). Soviet mathematicians who migrated to the United States after the collapse of the Soviet Union lowered publication output of U.S. mathematicians (Borjas and Doran, 2012). German Jewish chemists who migrated to the United States after being dismissed from Nazi Germany increased patenting in research fields of émigrés by attracting new patentees to their research fields rather than increasing patenting by established patentees (Moser et al., 2014). Another recent strand of the literature has shown that U.S. firms that hire high-skilled migrants also expand employment of natives (Pekkala Kerr et al., 2014).

[3] The German statistical office reports that in 2012, 575,000 out of 4,744,000 people between age 35 and 39, and 633,000 out of 6,260,000 people between age 40 and 44, have graduated from university

are followed into the labor market until five years after graduation, even if they move abroad. We therefore observe whether they have decided to stay and work in Germany, migrate to a less equal country, or migrate to a more equal country.

As shown in Section 1.1, a basic version of the Roy/Borjas (1997, 1991) model predicts that migrants to less equal countries, such as the United States, should be positively selected but migrants to more equal countries, such as Sweden, should be negatively selected.

We investigate the selection of migrants using predicted earnings as a summary measure of observable skills. We first estimate an augmented Mincer regression for graduates who work in Germany. We then use the estimated returns and each graduate's personal characteristics to obtain a measure of predicted earnings for all graduates, independently of whether they stay in Germany or migrate abroad. Our data contain a rich set of personal characteristics including family background, education before university, including final high school degree (*Abitur*), information about their studies, including university, subject, and final grade, and information on mobility before enrolling at university. This rich set of characteristics allows us to obtain a useful measure for earnings potential that can successfully identify high versus low productivity university graduates.

For our baseline results we compare cumulative density functions of predicted earnings for three groups of graduates: graduates who stay in Germany, graduates who migrate to less equal countries, and graduates who migrate to more equal countries. To classify destinations into more or less equal countries, we construct new inequality measures, based on individual-level income surveys from 20 countries. The inequality measures capture earnings inequality for university graduates in each destination.

We find that selection of university graduates is consistent with the predictions of the basic Roy/Borjas model. Migrants to less equal countries have significantly higher predicted earnings than non-migrants. Migrants to more equal countries, on the other hand, have significantly lower predicted earnings than non-migrants. These findings hold along the whole probability distribution of predicted earnings.

(Destatis, 2013, p. 27). This corresponds to a university graduation rate of 10.97 percent for the age groups studied in this paper.

Our baseline results analyze selection using predicted earnings from an augmented Mincer regression that we estimate for non-migrants to obtain a measure of earnings potential in Germany. The Borjas/Roy model predicts that migrants should be non-randomly selected from the population of graduates and our baseline results indicate they are indeed non-randomly selected. This suggests that the coefficients of the augmented Mincer regression would suffer from selection bias and our measure of predicted earnings could therefore be biased.

We address selection in the augmented Mincer regression using a sample selection correction as suggested by Heckman (1979). In the selection equation we predict whether individuals work in Germany using the availability of study abroad programs as the instrumental variable. Prior research has shown that studying abroad is an important predictor for subsequent international migration (Parey and Waldinger, 2011, Oosterbeek and Webbink, 2011). We use the number of places in the ERASMUS study abroad program in a student's university and subject as the instrument in our selection equation. Graduates who have studied in universities and subjects with larger increases in the number of ERASMUS places are significantly more likely to migrate than graduates in universities and subjects with smaller increases (Parey and Waldinger, 2011).[4] Changes in the number of ERASMUS places are therefore a good predictor for migration and allow us to correct for selection in the augmented Mincer regression. In our context sample selection bias is small because only 5 percent of graduates migrate, and because migrants are selected from both the top and the bottom of the predicted earnings distribution. The coefficients in the selection corrected Mincer regression are therefore very similar to coefficients in the uncorrected Mincer regression.

When we use the selection corrected coefficients to construct predicted earnings, we confirm our baseline results. Migrants to less equal countries have significantly higher predicted earnings than non-migrants. Migrants to more equal countries have significantly lower predicted earnings than non-migrants.

Our main results investigate selection of migrants to more equal and selection of

[4]See Parey and Waldinger (2011) for a more detailed description of the ERASMUS program. As we discuss below we use variation over time in the number of ERASMUS places in a students' subject and university. This variation is arguably exogenous to students' preferences (see Parey and Waldinger for a thorough discussion of this assumption).

migrants to less equal countries. In an additional analysis, we analyze selection into each of 19 major destination countries. In particular, we investigate how average predicted earnings of migrants to each of the 19 destinations correlates with inequality in those destinations. On average migrants to destinations with higher levels of inequality have higher predicted earnings than migrants to destinations with lower levels of inequality, again confirming the predictions of the basic Roy/Borjas model.

We also investigate the robustness of these findings and investigate selection in a number of different sub-samples. We confirm the baseline findings in a sample of male graduates. For female graduates the results are similar apart from the very top of the predicted earnings distribution. We also show that our findings for less equal countries are not solely driven by the positive selection of migrants to the United States. Lastly, we confirm that our results hold for migration to European countries where migration restrictions are basically absent.

Predicted earnings can be considered a summary measure of different skills. In additional results we decompose predicted earnings, to investigate which characteristics in the earnings regression are driving the observed selection patterns. The positive selection to less equal countries is mostly driven by the graduates' university career and parental background. Graduates who migrate to less equal countries have higher predicted earnings than non-migrants because they have better university grades, attend better universities, and come from families with a higher socioeconomic background. The negative selection to more equal countries is mostly driven by university subject, gender, and university quality. Graduates who migrate to more equal countries have lower predicted earnings than non-migrants because they have studied subjects with lower earnings, are more likely to be female, and have attended worse universities. Interestingly, migrants to more equal destinations are also positively selected in terms of university grade and family background. The decomposition suggests that selection does not need to be uniform across all characteristics. As a result, papers that investigate selection with a measure that is based on only one characteristic, such as education, may come to different conclusions than papers that measure skills based on different characteristics. Using predicted earnings as we do in the subsequent analysis

provides a natural summary measure of expected productivity.

The remainder of the paper is organized as follows. Section 1 sets out the main predictions from the Roy/Borjas model and gives an overview of existing studies. Section 2 describes the data. Section 3 covers the method and the baseline results. Section 4 discusses further results and robustness checks. Section 5 concludes.

1 A Model of Migrant Selection and Existing Empirical Tests

1.1 Borjas/Roy Model of Migrant Selection

In his seminal work Borjas (1987, 1991) has proposed a useful theoretical framework to understand the selection of international migrants. To motivate our empirical analysis, we use important insights of the Roy/Borjas model to highlight the predictions for selection in terms of observable characteristics.

Researchers typically do not have information on an individual's earnings at home and abroad, but observe a set of relevant covariates, which can be used to form a prediction on selection. An individual is considering to migrate based on earnings opportunities abroad (w_1) and at home (w_0), and a cost of migration. In our framework, we think of potential log earnings as consisting of an observed component (θ_j, where $j = 0, 1$ indicates home versus abroad) and an unobserved component (ϵ_j):

$$\begin{aligned} \log w_0 =& \theta_0 + \epsilon_0 \\ \log w_1 =& \theta_1 + \epsilon_1 \end{aligned}$$

θ_0 denotes the earnings potential at home based on a set of covariates observed by the researcher, and ϵ_0 denotes the unobserved component. Taking into account a cost of migration (c), the individual's migration decision is:

$$\text{Migrate if } \theta_1 + \epsilon_1 > \theta_0 + \epsilon_0 + c$$

The vector of potential outcomes is $(\theta_0, \theta_1, \epsilon_0, \epsilon_1)$. For tractability, we assume that

this vector is jointly normally distributed. Furthermore, we assume that each type of skill (observables and unobservables, respectively) are correlated across countries, but not across types. μ_j reflects differences in means between home and abroad. $\sigma^2_{\theta_j}$ represents the variance of the observed component in each location. $\sigma_{\theta_0,\theta_1}$ is the covariance in the observed component across locations, and we refer to the corresponding correlation as ρ_θ . While our framework incorporates observed and the unobserved earnings, this does not affect the underlying economic mechanism developed by Borjas (1987, 1991).[5]

We now consider how earnings potential at home, θ_0, differs between migrants and non-migrants. Let $v = \theta_1 + \epsilon_1 - \theta_0 - \epsilon_0$ be the wage difference between abroad and home, with $var(v) = \sigma^2_v$. Individuals will move abroad if the wage gain is larger than the moving cost c. From the normality assumption we obtain

$$\begin{aligned} E(\theta_0|\text{Migrate=1}) &= E(\theta_0|\theta_1 + \epsilon_1 > \theta_0 + \epsilon_0 + c) \\ &= \mu_0 + \left(\rho_\theta - \frac{\sigma_{\theta_0}}{\sigma_{\theta_1}}\right) \frac{\sigma_{\theta_0}\sigma_{\theta_1}}{\sigma_v} \frac{\phi(z)}{1-\Phi(z)}, \end{aligned}$$

where $z = \frac{\mu_0 + c - \mu_1}{\sigma_v}$ is a constant reflecting differences in means across locations, adjusted for migration costs and normalized by the variance of earnings. Our main interest is in understanding how selection on observables relates to relative inequality between the two destinations, as measured by the ratio $\frac{\sigma_{\theta_0}}{\sigma_{\theta_1}}$. As leading case, we focus on a situation where the correlation in the observed component ρ_θ is sufficiently high. Given that most migration flows in our analysis are between industrialized countries, this is a natural benchmark case.[6] When the potential destination country is more unequal than home ($\sigma_{\theta_1} > \sigma_{\theta_0}$) then migrants are positively selected: $E(\theta_0|\text{Migrate=1}) > \mu_0$. Intuitively, the positively selected migrants benefit from the upside opportunities offered by more unequal countries. Considering a more equal destination country ($\sigma_{\theta_1} < \sigma_{\theta_0}$), migrants will be negatively selected, and in fact have lower expected earnings potential than the stayers, so that $E(\theta_0|\text{Migrate=1}) < \mu_0$. These migrants benefit from the insurance offered by a compressed wage distribution.

[5]Borjas (1987) develops the original model focusing on the role of unobservables. In the formulation here this corresponds to the case of $\sigma_{\theta_0} = \sigma_{\theta_1} = 0$. Borjas (1991) introduces the distinction between returns to observables and unobservables, focusing on the case where observable skills are perfectly correlated across countries ($corr(\theta_0, \theta_1) = 1$).

[6]This rules out the case of 'refugee sorting' (Borjas 1987).

Clearly, while the model is a stylized description of migration choices, this allows us to emphasize the role of inequality in driving selection patterns. Differences in means across home and abroad have strong effects on the migration probabilities (and appear in the term z above), but have no effect on the direction of the selection pattern. Borjas (1991) has extended the model to include stochastic migration costs, which leads to very similar results as long as the migration costs are unrelated to potential earnings; Chiquiar and Hanson (2005) emphasize how selection patterns can change substantially when migration costs vary systematically with earnings potential. Since we are focusing on the population of high-skilled individuals, the nature and extent of moving cost is likely to be very different.

In our empirical analysis, we focus on comparing the earnings potential of migrants, separately between more equal and more unequal countries, with that of stayers. We also investigate whether migrants to unequal countries become more positively selected as inequality increases, and whether migrants to equal destinations become more negatively selected as inequality decreases.

1.2 Empirical Evidence on the Borjas/Roy Model from International Migration

While we are not aware of other papers that have analyzed migrant selection within the group of high-skilled individuals, a large number of papers have analyzed migrant selection in general. The existing empirical evidence on the predictions of the basic Borjas/Roy model is mixed (see Table 1).

Existing papers have used different skill measures to analyze the selection of migrants. Starting with Borjas (1987) some papers have analyzed selection using earnings, either at the destination or in the home country. The pattern of earnings is mostly consistent with the prediction of the basic model. In the US, migrants from more equal home countries have lower earnings than migrants from less equal countries (Borjas, 1987, Borjas, 2014). Migrants from Mexico (less equal) to the US (more equal) have lower earnings than non-migrants (Fernández-Huertas Moraga, 2011, Kaestner and Malamud, 2014). While actual earnings are a good proxy of both observed and

Table 1: Empirical papers on selection of international migrants

Paper	Journal/ Publisher	Skill measure	Home and destination countries	Consistent with basic Roy/Borjas Model
Skill measure: actual earnings				
Borjas (1987)	AER	Entry w in destination (US)	Many countries -> US	partly
Fernandez-Huertas Moraga (2011)	ReStat	w in home country (Mexico)	Mexico -> US	yes
		Education		partly
Kaestner and Malamud (2014)	ReStat	w in home country (Mexico)	Mexico -> US	yes
		Education		no
		Cognitive ability		no
Borjas (2014)	Harvard	Entry w in destination (US)	Many countries -> US	yes
Skill measure: predicted earnings				
Ramos (1992)	NBER Book	$\hat{w}$(edu, exp, marital status, occ)	Puerto Rico -> US	yes
Chiquiar and Hanson (2005)	JPE	$\hat{w}$(edu, age, marital status)	Mexico -> US	no
		Education		no
Other skill measures:				
Orrenius and Zavodny (2005)	JDE	Education	Mexico -> US	no
Feliciano (2005)	Demography	Education	32 countries -> US	no
Ibarraran and Lubotsky (2007)	NBER Book	Predicted education	Mexico -> US	yes
Borjas (2008)	JHC	Education	Puerto Rico -> US	partly
Grogger and Hanson (2011)	JDE	Education	Cross country	no
Abramitzky, Platt Boustan, Eriksson (2012)	AER	Father's occupation	Norway -> US	yes
		Own occupation		partly
Stolz and Baten (2012)	EEH	Age heaping	52 countries -> 5 countries	yes
Belot and Hatton (2012)	ScJE	Education	80 countries -> 29 countries	partly
Gould and Moav (2014)	EJ	Education	Israel-> US	yes
		Residual wages		partly

Notes: Table shows empirical tests of the Roy/Borjas model ordered by skill measures. Papers that report selection for different skill measures are reported only once

unobserved skills, the decision to migrate may be affected by wage shocks. If wage shocks and the decision to migrate are correlated, the use of observed earnings as a measure for skills may be problematic.

Another set of papers have used predicted earnings to measure skills. While predicted earnings indicate that the selection of migrants from Puerto Rico (less equal) to the United States (more equal) is consistent with the basic Borjas/Roy model, the selection of migrants from Mexico (less equal) to the United States (more equal) is not consistent with the basic model (Ramos, 1992, Chiquiar and Hanson, 2005). In their seminal paper on the migration of Mexicans to the United States, Chiquiar and Hanson show that a model with skill-varying migration costs is a better description of the migration from Mexico to the United States.[7]

Lastly, a number of papers have used one skill (e.g. education, or occupation) to measure migrant selection. Of the papers that use single skill measures, some find evidence that the patterns of migrant selection are consistent with the predictions of the basic Borjas/Roy model (e.g. Ibarraran and Lubotsky, 2007, Abramitzky et al., 2012, Stolz and Baten, 2012), others papers find evidence that is only partly consistent with the basic model (Borjas, 2008, Belot and Hatton, 2012), and yet others find evidence that is not consistent with the basic model (Chiquiar and Hanson, 2005, Orrenius and Zavodny, 2005, Feliciano, 2005, Grogger and Hanson, 2011, Kaestner and Malamud, 2014). Table 1 gives more details on skill measures and findings of existing papers. Papers are ordered by skill measures and publication date.

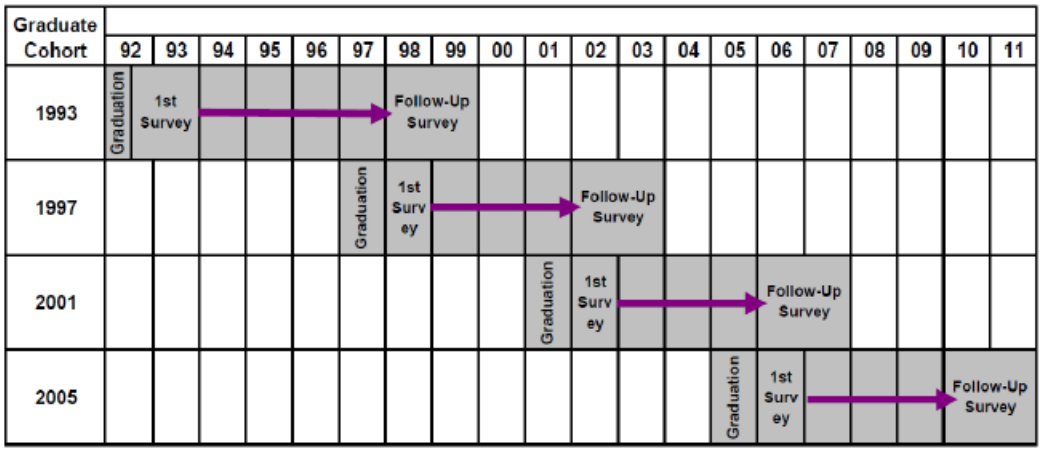
2 Data

2.1 University Graduates

We analyze the selection of high-skilled migrants using data on German university graduates. The data on migration decisions and skill measures come from graduate surveys

[7]The selection of Mexican migrants to the United States is hotly disputed in the literature. While some papers find evidence for negative selection that is consistent with the basic Borjas/Roy model (e.g. Ibarraran and Lubotsky, 2007, Fernández-Huertas Moraga, 2011) other papers find intermediate selection that suggests that migration costs vary with skills, perhaps driven by poverty constraints (Chiquiar and Hanson, 2005, Orrenius and Zavodny, 2005).

Figure 1: Graduate Surveys



*Notes:*The figure shows timing of baseline and 5 year follow-up surveys of university graduates.

conducted by the German Centre for Research on Higher Education and Science Studies (DZHW). The graduate surveys are designed to provide nationally representative longitudinal samples of individuals who complete their university education in Germany (Briedis and Minks, 2004).[8] The DZHW sampled university graduates from cohorts graduating in the academic years 1992-93, 1996-97, 2000-01, and 2004-05. We refer to these four cross-sections as graduate cohorts 1993, 1997, 2001, and 2005. Graduates in each cohort are surveyed twice. The initial survey takes place about 12 months after graduation. The same individuals participate in a follow-up survey about 5 years after graduation (Figure 1).[9]

The survey is ideal for our purposes because graduates are surveyed even if they move abroad. We focus our analysis on migrations decisions that are measured five years after graduation.[10] Five years after graduation the total number of respondents was 6,737 (1993 cohort), 6,220 (1997 cohort), 5,426 (2001 cohort), and 6.459 (2005 cohort). To analyze selection of high-skilled migrants we focus on graduates from traditional

[8]Between 1993 and 2005 the majority of German university graduates completed Diplom, Magister, or Staatsexamen degrees. These degrees usually last between 4 and 6 years and are considered comparable to a masters degree in other countries

[9]The response rate to the initial survey is around 25%. While a higher response rate would be desirable an analysis conducted by the HIS concludes that the characteristics of survey respondents are close to the characteristics of the target population.

[10]After graduation many university graduates enroll in additional training such as legal or teacher traineeships (Referendariat) or PhD programs. As a result, earnings in the initial survey are a noisy measure of earning potentials.

universities.[11] Furthermore, we restrict the sample to full time workers without missing information on key characteristics.

The graduate data contain detailed information on graduates' family background, study history, and labor market experience. Five years after graduation about 5.2 percent of graduates work abroad (Table 3). The main destinations are Switzerland (152 graduates), the United States (87 graduates), the UK (68 graduates), Austria (42 graduates), and France (41 graduates) (Table 2). Five years after graduation average earnings were 43,487 Euros (in 2001 prices)[12] 19.1 percent have completed a PhD and 7.3 percent have completed further non-PhD level studies (such as MBAs).

University graduates have completed university with an average grade of 2.02 (the top grade is 1.0, the worst passing grade is 4.0). During their studies about 7.8 percent have studied abroad but have returned to graduate in Germany.[13] 66 percent have studied in the federal state where they graduated from high school. Their average high school grade (Abitur) was 2.1. About 22 percent had completed an apprenticeship before starting their degree.

The data also contain detailed personal characteristics. 45 percent are female, 78 percent are living with a partner, 42 percent are married, and 29 percent have children. Mothers of German university graduates have about 13.5 years of education, while fathers have 14.8. Most parents work as salaried employees.

2.2 Earnings Inequality Data

We classify destination countries as more or less equal using newly constructed measures of earnings inequality for university graduates. Existing inequality measures, such as Gini coefficients, typically measure inequality for the whole population while the decisions of high-skilled migrants will likely depend on earnings inequality of university graduates.

[11]The German higher education sector consists of traditional universities, universities of applied science (Fachhochschulen), specialized universities focusing on arts, music, or theology, and a very small number of private universities. The best students usually enroll in traditional universities, but universities of applied science have improved in repuation and quality in recent decades.

[12]This corresponds to around 70,000 US $ in today's prices.

[13]This survey does not include individuals who complete their studies outside Germany.

Table 2: Destinations of German University Graduates

Country	Number of Graduates	Wage Inequality Data
Germany	10,510	Yes
Switzerland	152	Yes
USA	87	Yes
UK	68	Yes
Austria	42	Yes
France	41	Yes
Luxembourg	25	Yes
Netherlands	25	Yes
Spain	20	Yes
Belgium	20	Yes
Norway	20	Yes
Sweden	15	Yes
Italy	13	Yes
Denmark	13	Yes
Ireland	11	Yes
China	8	
Australia	7	Yes
Canada	7	Yes
Japan	5	Yes
Finland	5	Yes
Poland	5	Yes
Brazil	5	
New Zealand	5	
Other	56	

Table shows the most important destinations for German university graduates in the graduate survey data and the availibility of inequality data for university graduates in the augmented LIS data. All destinations in the "Other" category receive fewer than 5 graduates.

Our main data source is the Luxembourg Income Study (LIS) (2013).[14] The LIS provides access to individual-level earnings surveys from several countries and years. We use all available surveys for the main destinations of German university graduates. Two important destinations of German university graduates, Austria and Switzerland, are poorly covered in the LIS. We therefore use additional data for both countries. For Austria, we use the *Microcensus* (1999) and the *European Union Statistics on Income and Living Conditions* (EU-SILC, 2007 and 2008). For Switzerland, we use the Swiss Labour Force Survey (*Schweizerische Arbeitskräfteerhebung* (SAKE, 1998-2005).

[14]Grogger and Hanson (2011) have previously used these data to measure inequality in the context of migration decisions. Since then the LIS data has been revised including changes in the concept of income and earnings.

Table 3: Summary statistics German university raduates

	Full Sample	Working in Germany	Abroad more equal	Abroad less equal
Job characteristics (5 years)				
Working Abroad	0.052	0	1	1
Earnings in Euro (2001 prices)	43,491	43,265	39,458	49,231
Education after first degree				
PhD completed	0.191	0.182	0.313	0.371
Further studies completed	0.073	0.071	0.125	0.122
Education first degree				
Final university grade	2.018	2.032	1.698	1.787
Studying abroad	0.078	0.072	0.240	0.169
ERASMUS/Total students in subject	0.040	0.039	0.052	0.050
Education before first degree				
Studying in same state as high school	0.659	0.663	0.583	0.581
Final school grade	2.110	2.119	1.951	1.959
Apprenticeship	0.220	0.225	0.094	0.138
Personal characteristics				
Female	0.445	0.444	0.594	0.445
Partner	0.780	0.782	0.740	0.736
Married	0.416	0.421	0.281	0.344
Any children	0.291	0.297	0.156	0.184
Parental Background				
Mother's education (years)	13.459	13.423	14.458	14.035
Father's education (years)	14.852	14.816	15.458	15.493
Mother self-employed	0.092	0.093	0.063	0.091
Mother salaried employee	0.597	0.596	0.677	0.619
Mother civil servant	0.108	0.105	0.177	0.148
Mother worker	0.100	0.103	0.042	0.049
Mother did not work	0.103	0.104	0.041	0.093
Father self-employed	0.194	0.191	0.188	0.262
Father salaried employee	0.447	0.448	0.479	0.406
Father civil servant	0.223	0.221	0.271	0.258
Father worker	0.113	0.116	0.063	0.062
Father did not work	0.023	0.024	0.000	0.012
Observations	11,091	10,510	96	485

Table shows summary statistics of German university graduates 5 year after graduation. Sample includes graduates with non-missing values for all characteristics apart from earnings. To predict earnings in our analysis below we do not need to observe earnings.

To measure earnings inequality for high-skilled individuals, we restrict the samples in the individual-level surveys to university graduates. We further restrict the samples to full-time employees between 30 and 60 years. We exclude individuals who are self-employed, who are enrolled in school, and who report negative earnings.

Based on the individual level surveys, we construct earnings percentiles for each country and available year using the survey sampling weights (see data appendix for available survey years in each country). Some surveys in the augmented LIS data report gross earnings while others report net earnings. As we want to measure cross-country inequality of net earnings, we convert gross earnings into net earnings using the *net personal* average tax rate of single persons without children from the OECD (2013).[15] The OECD reports three different taxes rates along the income distribution: the average tax rate at 67 percent, at 100 percent, and at 167 percent of average earnings. We apply the tax rate at 67 percent of average earnings to the 25^{th} percentile and below, the tax rate at 167 percent of average earnings to the 75^{th} percentile and above, and the tax rate at 100 percent of average earnings to the remaining percentiles.[16]

In our main analysis we use the 75/25 ratio for university graduates to measure earnings inequality across countries. Table 4 and Figure 2 shows the ranking of countries according to the 75/25 ratio that we average between 1998 and 2010 because migration decisions of university graduates are observed during this time span. Inequality is highest in the United States, followed by France, and Poland. The Scandinavian countries and Australia are at the bottom of the ranking. Germany is ranked in the middle. We can therefore investigate selection of German university graduates into less and more equal countries.

Inequality based on the 75/25 ratio for university graduates is highly correlated with other measures of inequality. The correlation between the 75/25 percentile ratio and the OECD Gini index is 0.75. As the Gini is computed for the total population and based on family income instead of personal income we do not expect a perfect correlation of the two measures.[17]

[15]The net personal average tax rate is defined as the personal income tax and employee social security contributions net of cash benefits, expressed as a percentage of gross wage earnings.

[16]The data appendix provides more detail on the construction of the inequality measures.

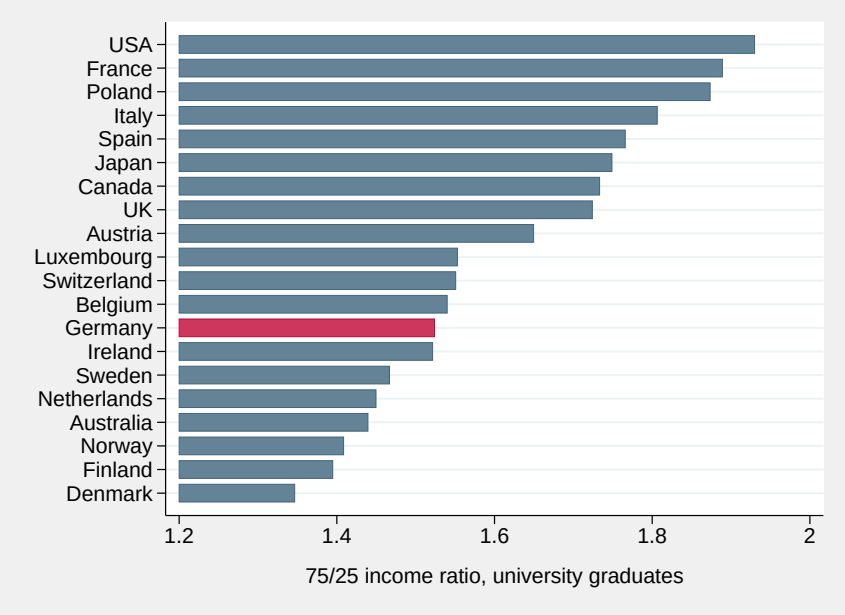
[17]A number of recent papers have documented the rise in German earnings inequality during the

Table 4: Inequality measures

	(1)	(2)	(3)	(4)
Country	75/25 ratio	90/10 ratio	Gini, OECD	Inequality of predicted wages, REFLEX
USA	1.930	4.213	0.362	
France	1.889	3.436	0.288	1.904
Poland	1.873	3.364	0.322	2.978
Italy	1.806	2.986	0.317	2.319
Spain	1.766	3.225	0.316	1.981
Japan	1.749	3.876	0.326	1.677
Canada	1.733	3.822	0.323	
UK	1.724	3.578	0.340	2.409
Austria	1.650	3.227	0.263	1.688
Luxembourg	1.553	2.699	0.275	
Switzerland	1.551	2.358	0.290	
Belgium	1.540	2.569	0.261	2.035
Germany	1.524	2.893	0.276	1.769
Ireland	1.521	2.695	0.307	
Sweden	1.467	3.431	0.255	
Netherlands	1.450	2.475	0.290	1.540
Australia	1.439	2.696	0.310	
Norway	1.409	2.964	0.262	
Finland	1.395	2.330	0.256	1.745
Denmark	1.347	2.437	0.230	
Correlation with 75/25 ratio	1.000	0.758	0.748	0.592

Notes: Measures in columns (1) – (3) are averages, computed for the time period 1998-2010. The inequality measures in column (1) (75/25 income ratio) and (2) (90/10 income ratio) are computed from a sample of university graduates, working full-time, 30-60 years old, males and females based on net wages. Data comes from the Luxembourg Income Study (LIS) for most countries, from the Microcensus and EU-SILC for Austria, and from SAKE for Switzerland. For comparison, column (3) provides average Gini coefficients from the OECD. The inequality measure in column (4) is computed as predicted wages based on German high and low quality characteristics and foreign returns. Data come from REFLEX.

Figure 2: 75/25 inequality ratios



Notes: The figure shows 75/25 earnings inequality ratio for university graduates. The 75/25 ratios are averaged over the period between 1998 to 2010.

The 75/25 ratio measures earnings inequality based on observed and unobserved skills. Our analysis investigates selection using predicted earnings based on returns to observed skills. To investigate whether countries with higher 75/25 ratios also exhibit higher returns to observed skills alone, we use additional data from REFLEX and HEGESCO to construct alternative inequality measures that capture returns to observed skills alone.[18] The REFLEX and HEGESCO data include surveys of university graduates from different countries who graduated from university in the academic year 1999/2000 (REFLEX) and 2003 (HEGESCO) and were surveyed five years after graduation. The data include similar, but less detailed, information than our main graduate cohort survey data. To measure earnings inequality based on observed skills we estimate augmented Mincer regressions for each country using the REFLEX/HEGESCO data. Using the estimated returns in each country we then construct an inequality mea-

last decades (Dustmann et al., 2009, Card et al., 2013). These papers have used large administrative datasets analyzing earnings inequality of the whole population. In these datasets earnings are censored at the maximum of social security contributions. Between 1998 and 2008 about 26 percent of observations are top coded for individuals with a university education or an education in a university of applied science. As we want to measure inequality for university graduates, we cannot use the administrative data for our analysis.

[18]See data appendix for a detailed description of these data and the construction of an inequality measure that is solely based on returns to observed skill.

sure that is based on differences in returns to observed characteristics. The correlation between this measure and the 75/25 ratio that we use in our main analysis is 0.62. This indicates that total earnings inequality is correlated with inequality measures that are solely based on observed skills.We use the 75/25 ratio as our main inequality measure because the REFLEX/HEGESCO data do not include information for eight of the most important destinations that receive close to 60 percent of German university graduates in our data.

2.3 Data on ERASMUS places

We use data on the number of ERASMUS places to correct for selection in the augmented Mincer regression. ERASMUS is the largest student exchange program in Europe and facilitates study abroad spells of one or two semesters at another European university. The program started in 1987 and has expanded massively since then. Overall, 3 million European students have studied abroad using the ERASMUS program. In Germany, about 4,925 students participated in ERASMUS in 1990 (the year when the typical student of the 1993 cohort studied abroad) and participation rose to 18,482 in 2002 (the year when the typical student of the 2005 graduate cohort studied abroad). Over time, more and more universities and departments started to offer an increasing number of places in the ERASMUS program. The expansion of the program increased study abroad opportunities for German students depending on the year their department joined the program and how much departments expanded the number of places over time. As discussed in more detail in Parey and Waldinger (2011), students only had very limited knowledge about the number of ERASMUS places at the time of enrollment and it is unlikely that they chose to study in a particular university to benefit from larger increases in the number of ERASMUS places. Better universities usually offer more ERASMUS places. As we rely on the variation in the number of ERASMUS places over time and control for university fixed effects this will not affect the estimation of our selection equation.

Prior literature has shown that studying abroad is a strong predictor for international migration (Parey and Waldinger, 2011, Oosterbeek and Webbink, 2011). As

studying abroad is an endogenous decision, we use the availability of the ERASMUS study abroad program in a student's university and subject as the excluded variable in our selection equation. We obtain the number of study abroad places in the ERASMUS program in each university, subject, and year from the German Academic Exchange Service (DAAD). The median student studies abroad about three year before graduation. We assign the number of ERASMUS places in the corresponding academic year, subject and university to each student. To account for differences in cohort size that affect students' study abroad opportunities we normalize the number of ERASMUS places with the number of students in the corresponding university and subject.[19]

3 Method and Results

3.1 The Selection of Migrants to More and Less Equal Destinations

In this section, we describe our empirical strategy and our results. We begin by constructing a measure of skill based on predicted earnings, using the sample of non-migrants only. This measure of earnings potential at home represents θ_0 in the model outlined above. We then use the skill prices estimated in the first step to compare the distribution of skills seen across migrants to unequal locations, equal locations, and stayers.

In the first step, we estimate an augmented Mincer regression for non-migrants, only.

$$ln\, w_i = X_i\beta + \varepsilon_i$$

This allows us to recover skill prices β in the home location. Our data allow us to include a large number of variables X_i to obtain a good prediction of earnings potential for each graduate. Variables that measure personal characteristics are gender, marital/partnership status, and an indicator for having children. Variables that measure parental background are mother's and father's education in years, and indicators

[19] We use the number of first year students in each university and subject in the academic year 1992/1993 for this normalization. The data come from the German Statistical Office (Statistisches Bundesamt).

for mother's and father's occupation. Variables that measure additional education after graduation are indicators for completing a PhD, or a non-PhD graduate degree. Variables that capture the graduates university experience are final university grade (and its square), age at graduation (and its square), and an indicator for completing university with a Bachelor degree (instead of a pre-Bologna degree). We also include 24 subject and 74 university fixed effects. Variables that measure education before graduates enrolled in university are final high-school grade (and its square) and an indicator for whether the graduate completed an apprenticeship before studying. We also include a variable that measures previous mobility using an indicator for studying in the same regional state as completing high-school, potential experience[20] in months and its square and graduate cohort fixed effects. Estimated regression coefficients are reported in column (1) of Table 5.

Next, we predict earnings for migrants and non-migrants based on the coefficients of the Mincer regression.[21] This measure of earnings potential at home represents θ_0 in the model outlined above.[22] Given the high R^2 in the underlying regression of about 0.28, our measure of predicted earnings is correspondingly informative. Subsequently, we use this measure of skills to compare the three groups of interest: Migrants to less equal countries, migrants to more equal countries, and non-migrants.

Table 6 summarizes the predicted earnings for these three groups. Our sample for this comparison consists of 10,524 graduates who stayed in Germany and 485 graduates who work abroad. Stayers have average log predicted earnings of 10.599 (column (2)). Migrants to less equal destinations have average predicted log earnings of 10.624, that is 2.5 log points above the non-migrants. When we look at migrants to more equal destinations, however, the pattern is reversed. Average predicted log earnings are 10.54, that is 5.9 log points less than the migrants, and 8.3 log points less than migrants to unequal destinations. Thus, the migrants to more equal countries are negatively selected

[20] As all graduates are surveyed around 5 years after graduation the variation in potential experience is small and estimated coefficients are different from the typical pattern observed in Mincer regressions.

[21] We include all graduates with non-missing characteristics in the prediction stage, including a small number who do not report earnings. Excluding individuals who do not report earnings from our analysis does not affect our findings.

[22] Thus our measure of skill is similar to the one used in Dustmann et al. (2013).

Table 5: Augmented Mincer Regression University Graduates in Germany

	(1)		(2)		(3)	
Dependent Variable:	Labor Earnings		Labor Earnings		Working in Germany	
	OLS		Heckman Sel. Model		Selection Equation	
	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.
Personal						
Female	-0.131	(0.008)***	-0.131	(0.008)***	-0.002	(0.051)
Partner	0.066	(0.009)***	0.066	(0.010)***	0.070	(0.056)
Married (additionally)	0.028	(0.009)***	0.028	(0.009)***	0.014	(0.055)
Children	-0.039	(0.009)***	-0.041	(0.010)***	0.246	(0.061)***
Postgraduate education						
PhD completed	-0.003	(0.011)	-0.001	(0.013)	-0.361	(0.063)***
Further degree (non-PhD)	-0.024	(0.015)	-0.022	(0.016)	-0.290	(0.079)***
University career						
Final grade	0.048	(0.027)*	0.046	(0.027)*	0.202	(0.187)
Final grade square	-0.023	(0.006)***	-0.023	(0.006)***	-0.035	(0.044)
Bachelor	-0.131	(0.028)***	-0.131	(0.028)***	0.026	(0.151)
Age at end of studies	-0.026	(0.011)**	-0.026	(0.011)**	-0.014	(0.088)
Age square	0.000	(0.000)*	0.000	(0.000)*	0.000	(0.001)
Pre-university education						
School grade	-0.041	(0.034)	-0.042	(0.034)	0.035	(0.213)
School grade square	0.010	(0.008)	0.010	(0.008)	0.000	(0.049)
Apprenticeship	0.038	(0.010)***	0.037	(0.010)***	0.054	(0.066)
Previous mobility						
Same state school and uni.	-0.010	(0.008)	-0.011	(0.008)	0.153	(0.047)***
Parental background						
Mother's education (years)	0.003	(0.002)*	0.003	(0.002)*	-0.002	(0.010)
Father's education (years)	0.003	(0.002)*	0.003	(0.002)*	-0.020	(0.010)**
Mother self-employed	-0.008	(0.017)	-0.008	(0.017)	0.059	(0.106)
Mother salaried empl.	-0.012	(0.013)	-0.012	(0.013)	-0.020	(0.083)
Mother civil servant	-0.019	(0.018)	-0.018	(0.017)	-0.062	(0.107)
Mother worker	-0.001	(0.016)	-0.002	(0.016)	0.240	(0.118)**
Father self-employed	0.054	(0.025)**	0.055	(0.025)**	-0.312	(0.194)
Father salaried empl.	0.041	(0.024)*	0.041	(0.024)*	-0.143	(0.191)
Father civil servant	0.027	(0.025)	0.028	(0.025)	-0.189	(0.194)
Father worker	0.003	(0.026)	0.003	(0.026)	-0.103	(0.205)
Experience						
Experience in months	-0.058	(0.022)***	-0.058	(0.022)***	0.048	(0.133)
Experience square	0.000	(0.000)***	0.000	(0.000)***	0.000	(0.001)
ERASMUS places/students					-0.891	(0.413)**
Mills ratio			-0.025	(0.099)		
Graduate cohort FE	YES		YES		YES	
Subject FE	YES		YES		YES	
University FE	YES		YES		YES	
R-sq./Pseudo R-sq.	0.28				0.122	
Observations	9,778		9,778		10,388	

in terms of predicted earnings, and the average gap is sizeable.[23] This is a first piece of evidence supporting the selection of migrants as predicted by the Borjas/Roy model. Rather than looking at average predicted earnings, we can compare the selectivity of migrants a different quantiles of the earnings distribution, and this is what we turn to next.

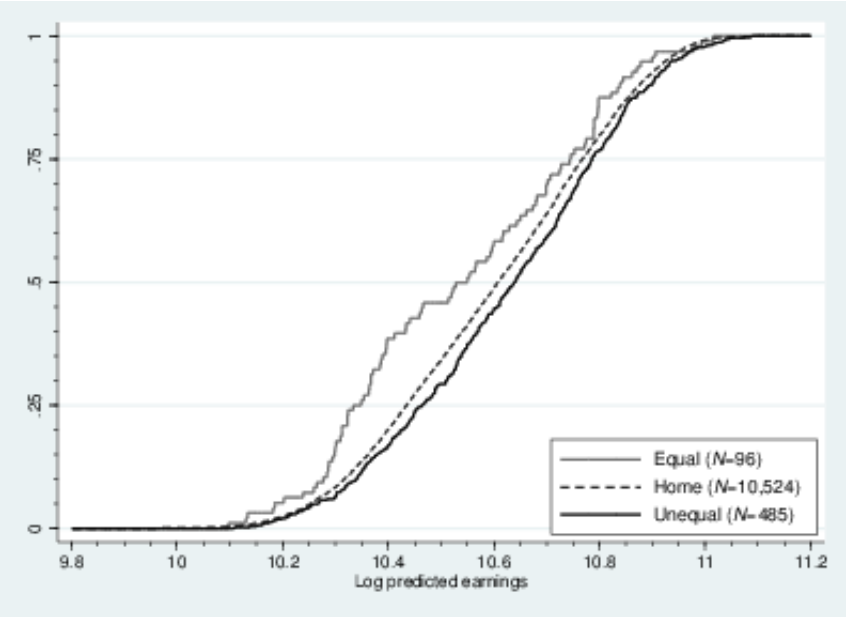
The focus of our analysis compares the Cumulative Distribution Function (CDF) of predicted earnings, by migration group:

$$F(\theta_0 \mid \text{Migration status})$$

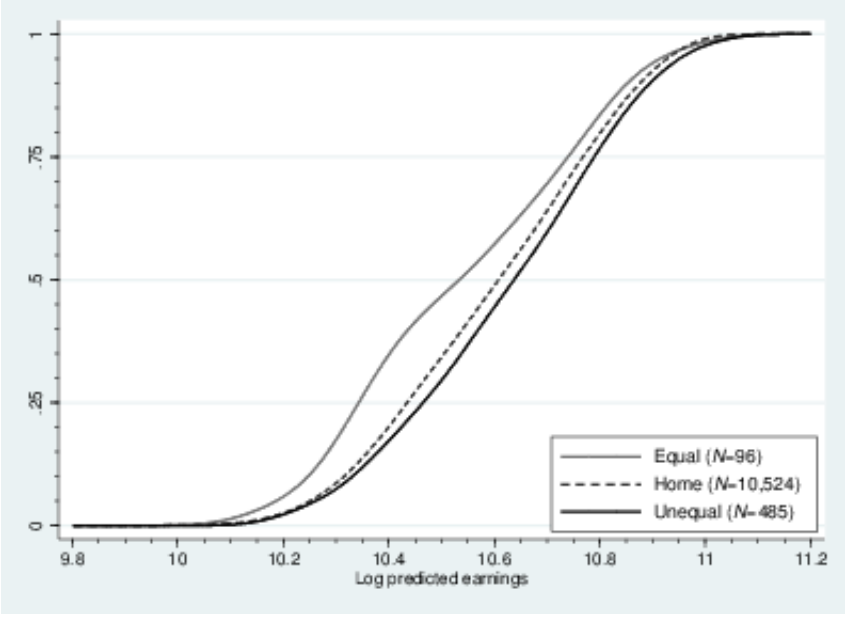
Figure 3 (a) shows the results. The dashed line represents the CDF of non-migrants. Median predicted log earnings for this group is 10.61, with lower and upper quartile of 10.43 and 10.76, respectively. The thick solid line is the CDF for migrants to unequal destinations, relative to Germany, such as the US. This line is located to the right of the CDF for non-migrants, indicating that this group is positively selected in terms of earnings potential. This group possesses skill bundles which, according to the returns estimated in the wage regression, are valued more highly that those of non-migrants: Predicted median log earnings for these movers are 10.65 (compared to 10.61 for the non-migrants), with a first quartile of 10.48 (10.44) and 18.80 (10.77), respectively, and from the figure we can see that these migrants are positively selected over almost the full range of earnings seen. We now turn to migrants who move to more equal destinations. Here, the pattern between migrants and non-migrants is reversed: Migrants to more equal countries are strongly *negatively* selected relative to non-migrants. This pattern is particularly pronounced over the middle part of the distribution. The median and the first quartile of predicted earnings are 7 log points lower for migrants, and the difference exceeds 10 log points at the 35th percentile. Thus, these differences between the distribution functions are substantial in magnitude. For example, these differences are of the same order of magnitude as standard estimates for the returns to an entire additional year of education in the U.S. (Card, 1999). Referring to the estimates presented in Table 5, the difference is as large as the estimated wage difference

[23] We will discuss below whether these differences are statistically significant.

Figure 3: Predicted earnings of migrants to more and less equal countries and non-migrants



(a) CDF



(b) CDF - Smoothed

between a BSc degree and the traditional degrees (which were then replaced as part of the Bologna process), or three times the estimated wage premium corresponding to an internship completed prior to the studies. Overall, the ordering of the distribution functions corresponds to the prediction of the model.

Since the CDFs for the migrants are constructed from a limited sample size, we also present a smoothed version of the CDF, using a kernel smoothing approach.[24] The results, shown in Figure 3 (b), reveal a very similar pattern to the results discussed beforehand, with migrants to unequal destinations positively selected, and migrants to equal destinations negatively selected, relative to the non-migrants.

A natural question to ask is whether the pronounced differences seen in Figures 3(a) and (b) are statistically significant. For this purpose, we implement a Kolmogorov–Smirnov test, and the results are reported in Table 6. As can be seen from the table, all pairwise tests between the three distributions are statistically significant at the one percent level. Given the relatively modest sample size of those migrating to more equal countries, this is a striking result. Similar results are obtained using the Wilcoxon/Mann-Whitney rank sum test.[25]

Table 6: Selection measured with predicted earnings

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS			Heckman Selection		
	Migrants to More Equal	Stayers	Migrants to Less Equal	Migrants to More Equal	Stayers	Migrants to Less Equal
Observations	96	10524	485	96	10524	485
Mean predicted earnings	10.540	10.599	10.624	10.545	10.602	10.628
Mean pred. earnings: Migrants - Stayers	-0.059		0.025	-0.056		0.027
Kolmogorov-Smirnov test (p - value)	0.002		0.053	0.013		0.008

The inequality seen in potential destination countries varies within the group of more equal and less equal countries, respectively. We therefore go one step further

[24]We choose the bandwidth separately for each migrant group to account for the differences in the corresponding sample sizes. Bandwidth is chosen according to Silverman's rule of thumb, which we then rescale with a factor of 0.6 to avoid oversmoothing.

[25]Note that these tests do not take into account that the vector of coefficients β is estimated in a first step.

and split both foreign destinations up into two groups each. Thus, we now compare five different types of destinations: very unequal, somewhat unequal, home, somewhat equal, and very equal. As before, equal and unequal is relative to the inequality in the home country. Figure 4 shows the corresponding CDF graphs. It is important to keep in mind that the sample sizes of migrants are limited especially when we split up migration destinations as we do here, in particular for the equal countries. Nonetheless, it is remarkable that the pattern of selection follows the prediction across the five groups: The most equal countries have the strongest negative selection, moderately equal countries have a somewhat negatively selected set of migrants, moderately unequal countries have slightly positively selected migrants, and very unequal countries receive strongly positively selected migrants.

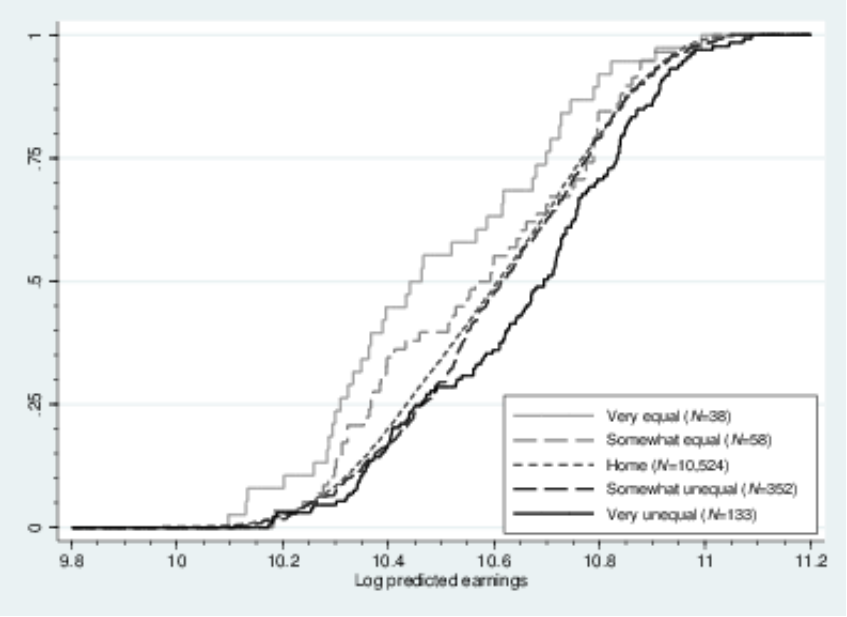
3.2 Controlling for Selection in Augmented Mincer Regression

There are two reasons why we do not expect this adjustment to have a large effect on our estimates. First, while the migrants constitute a relevant sub-group in the population of graduates, the number of migrants relative to the overall population is limited. As Table 3 indicates, around 5% of individuals work abroad. Thus, the degree of selection among those seen at home is likely to be much more limited than in other applications, such as studies on female labor force participation for example. Second, the graduates can decide to move to either a more equal or a less equal destinations. Given that migrants to unequal destinations are, on average, positively selected in terms of observables, while migrants to more equal destinations are, on average, negatively selected, we expect this to reduce the overall degree of selection in our observed sample.

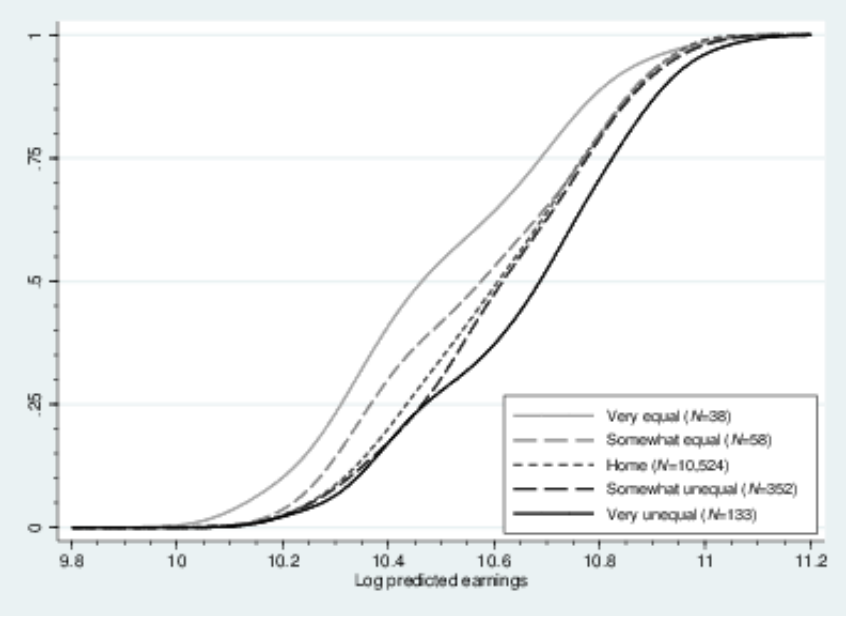
To identify the selection equation, we use the following instrumental variables strategy: If a department participates in the European ERASMUS student exchange program, students are more likely to experience a study abroad spell during their studies. Later on, these graduates have a higher probability of working abroad, suggesting that university-level mobility programs have long-run effects on international mobility of graduates (Parey and Waldinger, 2011). In our selection equation, we therefore include a measure of the availability of ERASMUS scholarship places (relative to the number

Figure 4: Predicted earnings of migrants and non-migrants

(a) CDF



(b) CDF - Smoothed



Notes: Panel A plots CDFs of predicted earnings (prediction based on returns estimated in column (1) of Table 5) for five groups of individuals: migrants to very equal countries, migrants to somewhat equal countries, non-migrants, migrants to somewhat unequal countries, and migrants to very unequal countries. Panel B plots a kernel smoothed version of the CDFs.

of students). The required assumption for the validity of the instrument is that the availability of the ERASMUS scheme can be excluded from the wage regression, that is that this variable does not have a direct effect on wages. The following analysis is based on this assumption.

Column (3) of Table 5 shows the first stage estimates. Consistent with the findings in Parey and Waldinger (2011), the availability of ERASMUS has a significant effect on the probability of being abroad. Having children increases the probability of working in Germany, while further degrees, such as a completed PhD, reduce the probability. Earlier mobility (between high school and studies) increases the probability of working abroad.

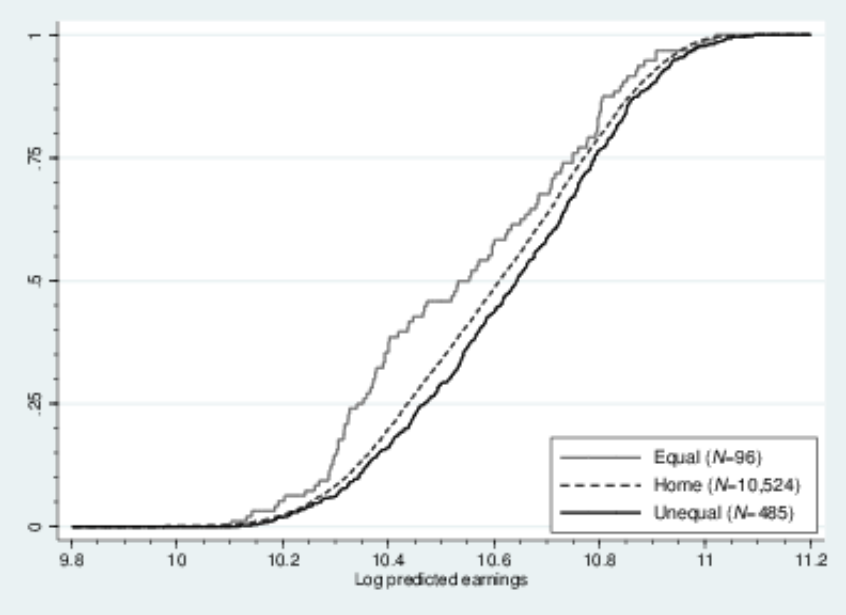
Column (2) of Table 5 shows the wage regression estimates accounting for selection. The Mills ratio in this specification is quantitatively small and insignificant, consistent with our discussion above. It is therefore not surprising that the other estimated coefficients are almost identical to those estimated in column (1). The resulting CDFs of earnings potential by migration status are presented in Figure 5, these are very similar to the earlier results in Figure 3. These results suggest that accounting for sample selection in the wage regression does not have any substantial effects on our results.

4 Further Results

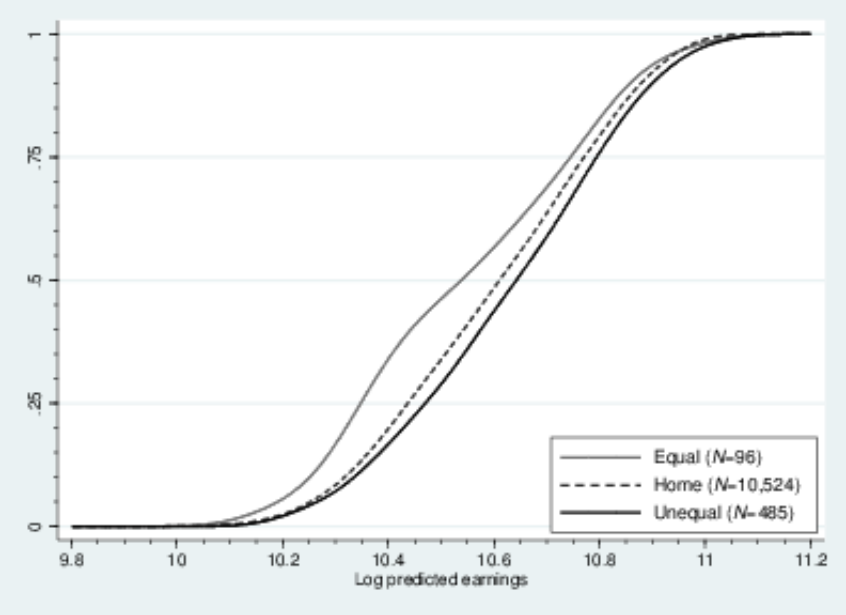
4.1 Selection of Migrants by Country

The analysis presented in the previous section splits graduates into three groups: non-migrants, migrants to less equal countries, and migrants to more equal countries. Our data allow us to investigate the selection of migrants to each of the 19 destinations in our sample. We compute average predicted earnings of migrants to each country and correlate it with the 75/25 differential in that country (Figure 6). Circle sizes indicate the number of migrants in each country. Apart from a few small outliers, migrants to more equal countries have lower predicted earnings than migrants to less equal countries. This observation is true even within the group of more equal countries or within the group of less equal countries.

Figure 5: Predicted earnings of migrants and non-migrants - Earnings prediction corrected for selection

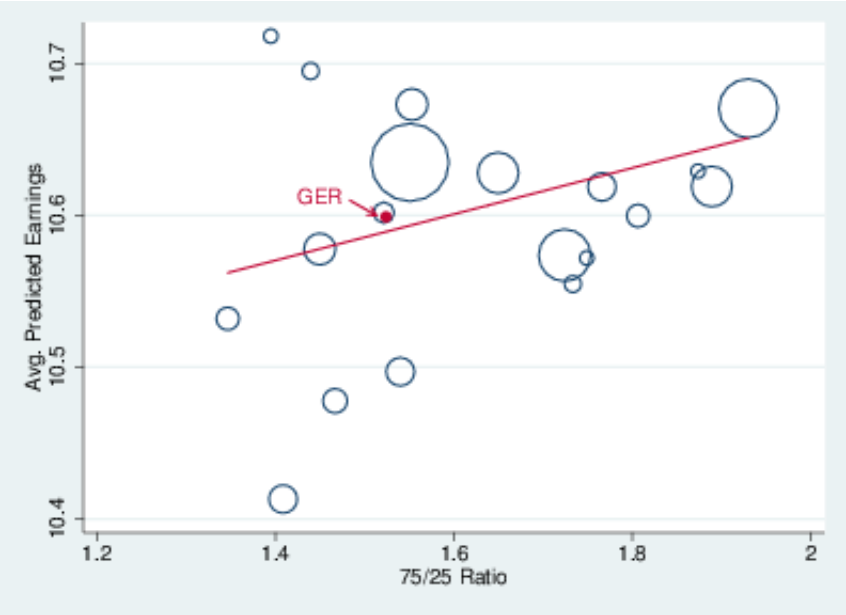


(a) Empirical CDF



(b) Smoothed CDF

Figure 6: Predicted earnings and inequality across destinations



Notes: The figure shows average predicted earnings for migrants to each country and the corresponding 75/25 inequality ratio. Circle sizes are proportional to the number of migrants in each destination. The regression line shown in the figure is estimated in a weighted regression with weights equal to the number of migrants in each country.

Despite the very small size we estimate a weighted OLS regression line that is reported in the figure. The slope of the line is equal to 0.125 with a standard error of 0.061 (p-value 0.053).[26] This estimate indicates that migrants to destinations with a 75/25 differential that is higher by 0.4 (the difference in the 75/25 differential between Germany and the United States) have predicted earnings that are 5 log points higher.

4.2 Selection in Different Subsamples

In additional tests we explore migrant selection for different subgroups. To save space Table 7, column (1) reports differences in predicted earnings between migrants to more equal countries and stayers. Column (2) reports differences in predicted earnings between migrants to less equal countries and stayers. Columns (3) and (4) report corresponding differences in predicted earnings that are based on models that correct for selection in the augmented Mincer regression.

The difference in means of predicted earnings between migrants to more equal countries and stayers is negative for all subgroups (columns 1 and 3). For migrants to less

[26] An unweighted regression has a slope equal to 0.103 with a standard error of 0.094 (p-value 0.290).

Table 7: Selection of subgroups

	(1)	(2)	(3)	(4)
	OLS		Heckman Selection	
	More Equal - Home	Less Equal - Home	More Equal - Home	Less Equal - Home
Baseline				
Obs. abroad	96	485	96	485
Mean	-0.059	0.025	-0.056	0.027
p25	-0.093	0.029	-0.090	0.032
p50	-0.068	0.031	-0.067	0.033
p75	-0.023	0.018	-0.021	0.021
Females only				
Obs. abroad	57	216	57	216
Mean	-0.025	0.013	-0.023	0.015
p25	-0.030	0.013	-0.027	0.016
p50	-0.065	0.029	-0.065	0.030
p75	-0.034	0.007	-0.034	0.011
Males only				
Obs. abroad	39	269	39	269
Mean	-0.031	0.034	-0.028	0.037
p25	-0.036	0.047	-0.034	0.050
p50	-0.007	0.039	-0.003	0.044
p75	-0.035	0.015	-0.033	0.016
Graduates without children				
Obs. abroad	81	396	81	396
Mean	-0.027	0.023	-0.025	0.025
p25	-0.062	0.022	-0.059	0.025
p50	-0.017	0.038	-0.017	0.039
p75	0.008	0.018	0.008	0.019
Migrants to European countries				
Obs. abroad	89	386	89	386
Mean	-0.071	0.016	-0.069	0.018
p25	-0.110	0.020	-0.111	0.022
p50	-0.088	0.019	-0.085	0.023
p75	-0.041	0.013	-0.041	0.015
Without migrants to the US				
Obs. abroad	96	398	96	398
Mean	-0.059	0.014	-0.056	0.016
p25	-0.093	0.020	-0.090	0.021
p50	-0.068	0.017	-0.067	0.020
p75	-0.023	0.013	-0.021	0.015
High School grade < 2.0				
Obs. abroad	45	255	51	255
Mean	-0.055	0.011	-0.053	0.013
p25	-0.128	0.010	-0.126	0.013
p50	-0.085	0.013	-0.084	0.015
p75	0.002	0.019	0.006	0.022

Standard errors computed using bootstrap (499 replications). See text for details.

equal countries the difference to stayers is always positive (columns 2 and 4). These patterns suggest that the selection that we observe for the whole sample also holds in the various sub-samples.

While the negative selection to more equal countries seems fairly similar for males and females, the positive selection to less equal countries seems stronger for males than for females (Table 7, panels B and C). We also investigate migrant selection of graduates without children as migration decisions for them may be less constrained than for other individuals. While the positive selection to less equal countries can be observed both at the mean and along the whole distribution the negative selection to more equal countries that we observe at the mean seems to concentrated in the lower half of the predicted earnings distribution (Table 7, panel D).

We also investigate whether the observed selection patterns are driven by the countries that we include in our analysis. In a first test we restrict the sample to European countries, only. As there no restrictions to migration within European Union this sample provides the cleanest test for the basic Roy/Borjas model. The negative selection to more equal countries is slightly more pronounced in this sample while the positive selection to less equal countries is slightly less pronounced because the sample does not include the United States which attracts some of the brightest university graduates (Table 7, panel E). We also investigate migrant selection in a sample of countries without the United States one of the most important destination in the group of less equal countries. Not surprisingly, the positive selection to less equal countries is less pronounced compared to the baseline results but even without the United States migrants to less equal countries are positively selected (Table 7, panel E).

Finally, we investigate migrant selection among the higher skilled of the high-skilled. In particular we investigate selection for graduates who have completed high school with an average grade better than 2.0 (the best grade is 1.0 the worst passing grade is 4.0). The negative difference in mean predicted earnings confirms that the very high-skilled among the high-skilled who migrate to more countries are on average negatively selected. For this group the negative selection seems to be driven by the bottom half of the predicted earnings distribution. Higher skilled migrants to less equal countries are

positively selected across the whole distribution of predicted earnings (Table 7, panel F).

4.3 Decomposing Migrant Selection

Our findings indicate that predicted earnings are higher for migrants to less equal countries but lower for migrants to more equal countries, compared to non-migrants. Predicted earnings can be considered a summary measure of different skills. In the following we decompose the difference in predicted earnings between migrants and non-migrants to understand the characteristics that drive the observed selection patterns. We use the estimated coefficients from our augmented Mincer regression (Table 5, column (1)) and multiply them by the average values of each characteristic in each group (non-migrants, migrants to less equal countries, migrants to more equal countries). We thus obtain:

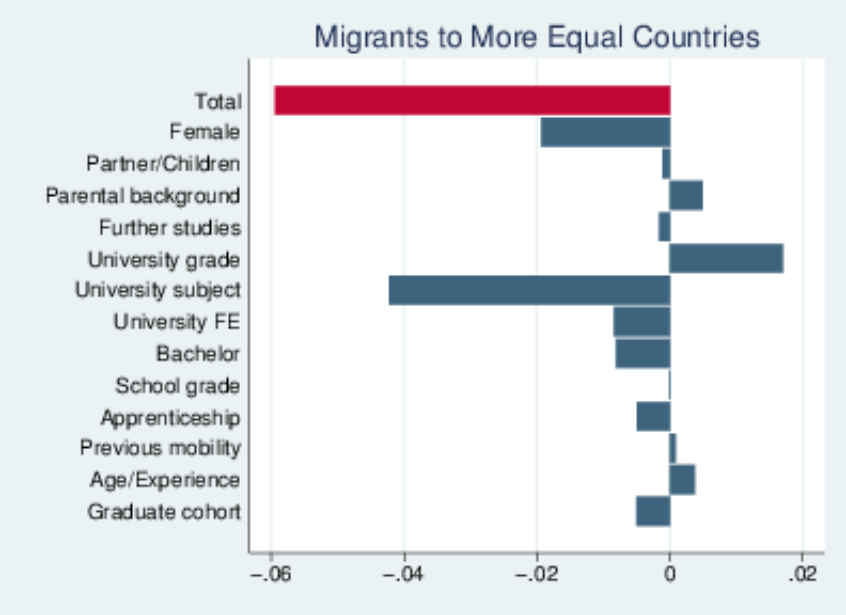
$$\hat{\beta}(\bar{x} \mid \text{Migration status})$$

for each characteristic x. We then subtract $\hat{\beta}\bar{x}_{Home}$ (non-migrants) from $\hat{\beta}\bar{x}_{Less\,Equal}$ (migrants to less equal countries) and obtain a measure of how much each characteristic contributes to the positive selection of migrants to less equal countries. Similarly, we subtract $\hat{\beta}\bar{x}_{Home}$ (stayers) from $\hat{\beta}\bar{x}_{More\,Equal}$ (migrants to more equal countries) to decompose the negative selection of migrants to more equal countries. Finally, we add these differences across groups of characteristics, such as personal characteristics or university fixed effects, and plot them in Figure 7.

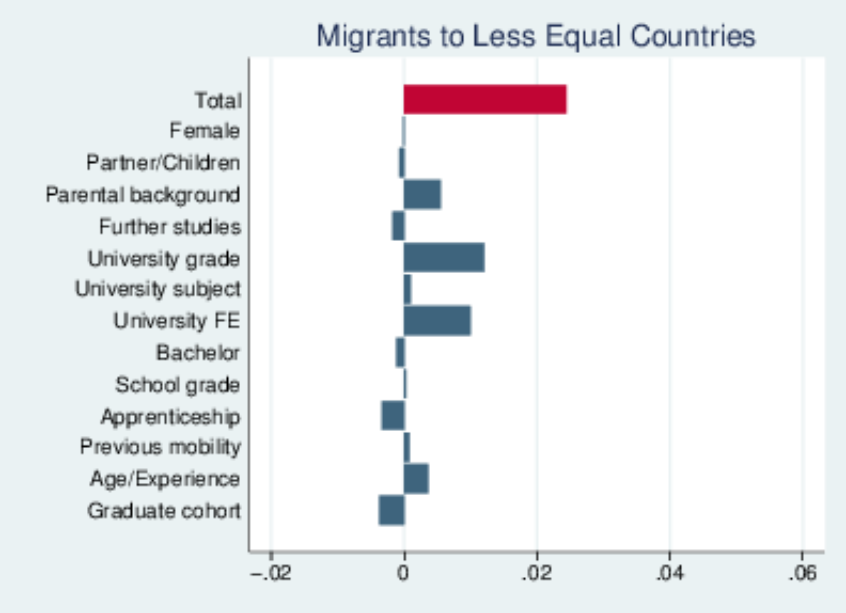
The positive selection of migrants to less equal countries is mostly driven by their university career. They have better grades and attend better universities than stayers. The negative selection of migrants to more equal countries is driven by their university subject, university quality, and gender. They study subjects with lower returns in the labor market, enroll at worse universities, and are more often female.[27] Interestingly, migrants to less equal countries have better grades at university, despite being negatively

[27]While gender contributes to the negative selection of migrations to more equal countries it is not the most important driver. As shown above the negative selection of migrants to more equal countries also holds for males, only.

Figure 7: Decomposition of predicted earnings



(a) Migrants to more equal countries



(b) Migrants to less equal countries

Notes: Subfigure (a) decomposes the mean difference in predicted earnings between migrants to more equal countries and non-migrants. The top bar (red) corresponds to the total difference in predicted earnings. The other bars decompose the total difference into the contributions of groups of characteristics (e.g. parental background). The size of the bars are obtained by multiplying estimated returns ($\hat{\beta}$ from column (1) in Table 5) with average charactistics ($\bar{x}$ of migrants and non-migrants and then substracting $\hat{\beta}\bar{x}_{Home}$ from $\hat{\beta}\bar{x}_{More\,Equal}$. Subfigure (b) presents the equivalent decomposition of the mean differences in predicted earnings between migrants to less equal countries and non-migrants.

selected overall. This finding is consistent with findings that suggest that most migrants are positively selected in terms of education.

The decomposition indicates that migrants selection is not uniform across different characteristics and could at least partially explain the different findings in the literature. The use of a summary measure for observed skills, such as predicted earnings, may be useful to understand overall selection, that can then be decomposed to understand selection according to different characteristics.

5 Conclusion

The seminal work of Borjas has emphasized how migrant selection is driven by inequality in the host country: when skills are correlated across countries, high-skilled individuals benefit from the upside in less equal countries, and low-skilled individuals benefit from the insurance in more equal countries. This insight has motivated a substantial literature, that has taken the predictions of the model to the data. In spite of the strong economic forces at work, and the large differences in inequalities across many host-source country pairs, the overall results have been mixed. Subsequently, researchers have investigated modifications to the original model, such as accounting for moving costs, which vary with the skill of the migrant (Chiquiar and Hanson, 2005), to help reconcile the model with the observed patterns of selection.

In this paper, we study migrant selection among university graduates using predicted wages to measure skills. We classify destinations into more or less equal countries using newly constructed inequality measures that capture inequality for university graduates. We find that migrants to more equal countries, such as Sweden, are negatively selected, while migrants to less equal countries, such as the United States, are positively selected, compared to non-migrants. The observed selection patterns are consistent with the predictions of the basic Roy/Borjas model.

In additional results, we show that migrant selection follows the predictions of the basic Roy/Borjas model even within the subgroups of more or less countries. We also demonstrate that the selection pattern holds across gender and when we restrict destination countries in our sample. We also show that the basic selection pattern holds for the very high-skilled among the high-skilled.

When we decompose predicted earnings into its various skill components we find that selection is not uniform across all measures. The negative selection to more equal countries is mostly driven by gender, university subject and university quality. The positive selection to less equal countries is mostly driven by university grades and university quality.

Our findings indicate the importance of the Roy/Borjas model for the selection of high-skilled migrants in a setting where migration costs are low because credit con-

straints are unlikely to be binding and legal mobility restrictions are low or non-existent.

References

Abramitzky, R., Boustan, L. P., and Eriksson, K. (2012). Europe's Tired, Poor, Huddled Masses: Self-Selection and Economic Outcomes in the Age of Mass Migration. *American Economic Review*, 102(5):1832–1856.

Belot, M. V. K. and Hatton, T. J. (2012). Immigrant Selection in the OECD. *Scandinavian Journal of Economics*, 114(4):1105–1128.

Borjas, G. J. (1987). Self-Selection and the Earnings of Immigrants. *American Economic Review*, 77(4):531–553.

Borjas, G. J. (2008). Labor Outflows and Labor Inflows in Puerto Rico. *Journal of Human Capital*, 2(1):32–68.

Borjas, G. J. and Doran, K. B. (2012). The Collapse of the Soviet Union and the Productivity of American Mathematicians. *Quarterly Journal of Economics*, 127(3):1143–1203.

Borjas, George, J. (2014). *Immigration Economics*. Harvard University Press.

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

Brücker, H., Bertole, S., Facchini, G., Mayda, A. M., and Peri, G. (2012). Part 1 Understanding Highly Skilled Migration in Developed Countries: The Upcoming Battle for Brains. In Boeri, T., Brücker, H., Docquier, F., and Rapoport, H., editors, *Brain Drain and Brain Gain - The Global Competition to Attract High-Skilled Migrants*, pages 15–188. Oxford University Press.

Card, D. (1999). The causal effect of education on earnings. *Handbook of labor economics*, 3:1801–1863.

Card, D., Heining, J., and Kline, P. (2013). Workplace heterogeneity and the rise of west german wage inequality. *Quarterly Journal of Economics*, 128(3):967–1015.

Chambers, E. G., Foulon, M., Handfield-Jones, H., Hankin, S. M., and Michaels, E. G. (1998). The war for talent. *McKinsey Quarterly*, pages 44–57.

Chiquiar, D. and Hanson, G. H. (2005). International Migration, Self-Selection, and the Distribution of Wages: Evidence from Mexico and the United States. *Journal of Political Economy*, 113(2):239–281.

Destatis (2013). Bildunsstand der Bevölkerung. `https://www.destatis.de/DE/Publikationen/Thematisch/BildungForschungKultur/Bildungsstand/BildungsstandBevoelkerung5210002137004.pdf?__blob=publicationFile`. Federal Statistical Office, Germany.

Dustmann, C., Frattini, T., and Preston, I. P. (2013). The effect of immigration along the distribution of wages. *The Review of Economic Studies*, 80(1):145–173.

Dustmann, C., Ludsteck, J., and Schönberg, U. (2009). Revisiting the german wage structure. *Quarterly Journal of Economics*, 124(2):843–881.

Feliciano, C. (2005). Educational Selectivity in U.S. Immigration: How Do Immigrants Compare to Those Left behind? *Demography*, 42(1):131–152.

Fernández-Huertas Moraga, J. (2011). New evidence on emigrant selection. *Review of Economics and Statistics*, 93(1):72–96.

Grogger, J. and Hanson, G. H. (2011). Income maximization and the selection and sorting of international migrants. *Journal of Development Economics*, 95(1):42–57.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica*, 47(1):pp. 153–161.

Ibarraran, P. and Lubotsky, D. (2007). Mexican Immigration and Self-Selection: New Evidence from the 2000 Mexican Census. In Borjas, G. J., editor, *Mexican Immigration to the United States*, chapter 5, pages 159–192. University of Chicago Press.

Kaestner, R. and Malamud, O. (2014). Self-Selection and International Migration: New Evidence from Mexico. *Review of Economics and Statistics*, forthcoming.

Kerr, W. R. and Lincoln, W. F. (2010). The Supply Side of Innovation: H-1B Visa Reforms and U.S. Ethnic Invention. *Journal of Labor Economics*, 28(3):473–508.

Luxembourg Income Study (LIS) (2013). Database (multiple countries). `http://www.lisdatacenter.org`.

Moser, P., Voena, A., and Waldinger, F. (2014). German Jewish Émigrés and US Invention . *American Economic Review*, 104(10):3222–3255.

OECD (2013). OECD Tax Statistics, Taxing Wages. `http://www.oecd-ilibrary.org/taxation/data/taxing-wages_ctpa-twg-data-en;jsessionid=lrtgpce2k79d.x-oecd-live-02`.

Oosterbeek, H. and Webbink, D. (2011). Does studying abroad induce a brain drain? *Economica*, 78(310):347–366.

Orrenius, P. M. and Zavodny, M. (2005). Self-selection among undocumented immigrants from mexico. *Journal of Development Economics*, 78:215–240.

Parey, M. and Waldinger, F. (2011). Studying Abroad and the Effect on International Labor Market Mobility. *Economic Journal*, 121(551):194–222.

Pekkala Kerr, S., Kerr, W. R., and F., L. W. (2014). Skilled Immigration and the Employment Structures of U.S. Firms. *Journal of Labor Economics*.

Ramos, F. A. (1992). Outmigration and Return Migration of Puerto Ricans. In Borjas, G. J. and Freeman, R. B., editors, *Immigration and the Workforce: Economic Consquences for the United States and Source Areas*, chapter 2, pages 49–66. University of Chicago Press.

Stolz, Y. and Baten, J. (2012). Brain Drain in the Age of Mass Migration: Does Relative Inequality Explain Migrant Selectivity? *Explorations in Economic History*, 49(2):205–220.

Widmaier, S. and Dumont, J.-C. (2011). Are recent immigrants different? A new profile of immigrants in the OECD based on DIOC 2005/06. OECD Social, Employment and Migration Working Papers 126.