The Effect of Studying with International Peers on Location Choices [a]

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August 4, 2021

Abstract

An established fact is that higher education attracts immigrants. How does this affect the intranational location choices of native graduates in their early careers? Using administrative Swiss data, I exploit idiosyncratic variation in the student composition across time within a study field and university. I show that a higher exposure to international students induces natives who grew up in rural places to work more often in urban areas, while I find no evidence for an effect on their residential choice. This implies that the economic activity of highly skilled individuals becomes more concentrated in urban locations. I also show that the response of natives is likely driven by changes in preferences rather than labor market conditions, despite relatively high stay rates of international students.

Keywords: international students, high-skilled immigrants, location choices, early career

JEL Codes: I23, J61, R12

[a] I am grateful to Albrecht Glitz for his suggestions and guidance. I have further benefited from comments from Beatrix Eugster, Reto Föllmi, Libertad González, Michael Knaus, Stefan Legge, Joan Monras, Gabriel Okasa, Frank Pisch, David Torun, Teodora Tsankova. I thank Alain Weiss from the Federal Statistical Office for accessessing and processing the educational datasets. I also thank seminar participants at the University of St.Gallen and the Universitat Pompeu Fabra for helpful comments.

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1 Introduction

Highly skilled individuals have ample international experience. An important part of this stems from geographic mobility during higher education. Between 2000 and 2018, the number of international students grew from 2.1 to 5.6 million (UNESCO, 2020). The flow can be expected to increase further because universities are interested in improving their rankings and raise tuition revenue, and firms want to attract international talent. International students benefit from educational opportunities in the destination country, thereby changing the cohort composition at universities. Understanding the consequences of peer effects on native decisions after graduation is relevant for researchers and policy makers, as there is little regulation of the international student flow and often of their transition to the labor market in the host country.

In this paper, I investigate how exposure to international students affects natives' decisions to work and reside in an urban place after graduation. The early career phase is one of exceptionally high mobility and also importance, as initial decisions can have lasting effects on one's career (De La Roca and Puga, 2016; Arellano-Bover, 2020). Location choices have implications on individual wages and living costs given the differences between rural and urban areas (Glaeser and Gottlieb, 2009). At a larger scale, they affect the distribution of economic activity and tax bases. Results show that a higher exposure to international students induces natives who grew up in rural places to work more often in urban areas. This finding can be driven by changes in natives' preferences and labor market conditions. Testing the relevance of both channels is important to understand in what ways international graduates differ from native graduates.

The empirical analysis in this paper relies on a Swiss dataset that links administrative data on peer exposure with survey data on native workplace and residential choices in the year after graduation over the period 2009–2019. The register dataset enables me to measure the proportion of international peers in a cohort without measurement error. It additionally allows me to distinguish international students who migrate to obtain a higher education degree from immigrant students who grew up in the country of study. The rich data further allow to study the decisions of where to work and where to live separately, which sheds light on the mechanisms. Switzerland has 17.8% international students in higher education, which is significantly above the OECD average of 5.8% (OECD, 2020). More than 60% of the international master's graduates stay in the Swiss labor market for at least one year after completing their university education. The context offers advantages for the effect identification, as the inflow of international students and admission to education are little regulated, which reduces selection induced by universities. Overall, the characteristics of

Switzerland are consistent with the broad empirical facts from the urban economics literature (e.g., Glaeser and Maré, 2001; Albert and Monras, 2020). I find evidence of an urban wage premium and of immigrants being overrepresented in cities.

To identify the effect of international student exposure on native peers' location choices, I exploit idiosyncratic variation in the student composition across time within a study field and university. Although students are not randomly allocated to fields and institutions, the variation in exposure to international students in adjacent cohorts is hard to predict, especially because they immigrate just at the time of enrolling into higher education. The variation is arguably exogenous conditional on individual and cohort level controls, and pairwise interacted fixed effects at the study field, university and year level (Carrell *et al.*, 2018). I also show that the proportion of international students does not systematically relate to observable individual characteristics of natives in the same cohort. The sample covers native master graduates from universities. By excluding international students, I mitigate reflection issues as discussed in Manski (1993).

In the main analysis, I distinguish between natives who grew up in urban places and those who grew up in rural places because location choice likely depends on the place of growing up (Bosquet and Overman, 2019). I show that natives from rural places are less likely to work and reside in urban locations one year after graduating from university than natives from urban places. With a higher proportion of international peers in a cohort, rural natives become more likely to work in urban locations. This is linked to an increase in interregional mobility across cantons and labor markets relative to the region of growing up. Results are driven by rural natives with a non-STEM degree and who are below the median age at graduation. The estimates of the workplace analysis are robust to various sensitivity checks. I do not find evidence that the natives' decision of where to reside is affected by the proportion of international students in the cohort.

The decision where to work can be made based on preferences and labor market conditions. International students can affect these channels through social interactions during their studies or a change in labor market competition after graduation. The positive peer effect on native graduates from rural areas suggests an alignment with immigrants' preferences for urban workplaces. I test if changes in wage expectations play a role given the urban wage premium. First, survey evidence shows that international graduates report more often than natives that a high salary is an important aspect of employment. Second, I find that natives with a higher international student exposure are more likely to report so as well. I test if international students affect native graduates' wages in the year after graduation, but estimates provide no evidence for a change. These results indicate that a change in the preferences for a higher wage trajectory over the career could drive rural natives into urban

workplaces, while urban natives do not respond due to their lower margin to adjust.

This study lies at the intersection of urban economics, immigration and education. The focus on international students is of special interest because these are highly skilled individuals and potential workers in the host country. Rosenzweig (2006) was the first to present a model that includes skill acquisition and seeking the rewards of high-skill employment to explain international student mobility. Kaushal and Lanati (2019) find that a major explanation for student flows to non-English speaking OECD countries is the desire for permanent settlement. Beine *et al.* (2014) look at differences in university characteristics and location features across and Beine *et al.* (2018) within destination countries. Compared to the latter paper that relies on data from one year, I build a panel dataset with tuition fees by student type and degree, and university quality. My findings imply that enrollment of international students tends to be responsive to changes in fees, while there is no evidence that enrollment of native students depends on tuition or university rankings.

I contribute to the peer effects literature that traditionally examines the role of ability, gender, race or disruptive behavior on educational performance. Evidence comes from mandatory school (Hoxby, 2000; Hanushek *et al.*, 2003; Lavy *et al.*, 2012; Balestra *et al.*, 2021) and higher education (Sacerdote, 2001; Stinebrickner and Stinebrickner, 2006; Booij *et al.*, 2016). A recent set of papers looks at foreign peers and how they affect educational outcomes of natives. There is evidence on pass rates in high school matriculation exams (Gould *et al.*, 2009), enrollment in higher education programs (Borjas, 2004; Machin and Murphy, 2017; Shih, 2017; Bound *et al.*, 2020), and study field choices (Anelli *et al.*, 2020). In this paper, I focus on the subset of international peers at higher education who are the target group for educated-oriented immigration policies. I study how exposure to international students affects the location choices of natives in their early career. The focus on this outcome relates to papers that investigate how gender, family background and disruptive behavior of peers in school affect wages or employment (Black *et al.*, 2013; Carrell *et al.*, 2018). In contrast to these papers that provide evidence on labor market outcomes at a given point in time, I focus on location choices that shape wage profiles and career prospects. I also complement studies finding that short-term international mobility during higher education affects own international mobility on the labor market (Parey and Waldinger, 2010; Di Pietro, 2012). Looking at intranational mobility as an outcome is motivated by the large number of native graduates who remain in their home country for work.

The literature that investigates labor market effects of immigration typically defines immigrants by country of origin or nationality, ignoring where the highest degree was obtained. However, the latter can affect the degree of substitutability between native and immigrant workers. Borjas (2009) finds that a higher share of foreign-born doctorates in a study field

lowers the earnings of native-born doctorates who graduate around the same time. His evidence is limited to science and engineering while I cover all study fields, which allows broader conclusions. I contribute to this literature by taking into account that international students can affect labor market outcomes not only through changes in labor market conditions but also in natives' preferences. To understand the potential impact of international students on labor market conditions, I approximate stay rates and extend the scarce estimates for OECD countries (OECD, 2011).

The economic geography literature explores how individuals decide where to locate. There are three established concepts that describe the spatial choices of immigrants: herd effects, networks, and economic opportunities (Jaeger, 2007). A recent approach comes from Albert and Monras (2020). They argue that immigrants move to expensive but high-productive cities because they spend a part of their income in their country of origin. I document that international graduates, like immigrants, have strong preferences to work and reside in urban and large locations. The literature further shows that natives with higher levels of education are more mobile than natives with lower levels (Malamud and Wozniak, 2012; Haapanen and Böckerman, 2017). In this paper, I focus on highly qualified native labor market entrants. This is in contrast to the work that studies mobility rates of natives after an inflow of immigrants (Card, 2001; Saiz, 2007; Saiz and Wachter, 2011; Gonzalez and Ortega, 2013; Fernández-Huertas Moraga *et al.*, 2019). I shed light on the decisions of where to work and where to live that is often reduced to one by looking at metropolitan areas or commuting zones due to data limitations (e.g., Diamond, 2016; Albert and Monras, 2020). This split is highly informative because of different mechanisms and implications on the distribution of economic activities and tax bases.

My analysis on native graduates also relates to the literature that looks at spatial mobility of graduates relative to where they have acquired higher education. Typically, the purpose of such studies is to evaluate whether in-state stipends (Bound *et al.*, 2004; Groen, 2004) or public funding of higher education by the home location (Oggenfuss and Wolter, 2019) pays off. My contribution is to investigate rural-urban movements of early career workers conditional on the place of growing up. The importance of the home region in location decisions is documented in the literature on home bias (e.g., Heise and Porzio, 2019). Its consequence for future labor market outcomes is also emphasized in the literature on intergenerational mobility (e.g., Chetty *et al.*, 2014).

The remainder of the paper is organized as follows. In Section 2, I discuss the role of international mobility in higher education. In Section 3, I describe the data and introduce the empirical strategy. In Section 4, I present the results, followed by a discussion in Section 5. Section 6 concludes.

2 International Mobility

2.1 International Students

Educational mobility is a growing phenomenon and promoted in Europe by the harmonization of higher education across countries. For this purpose, the Bologna Declaration, signed in 1999, set up the European Higher Education Area (EHEA).[1] Student mobility can be short-term (i.e., credit mobility) or for a complete study program (i.e., degree mobility). This paper considers the latter form of mobility that is measured by the number of matriculated international students in a country. By definition, international students have a nationality other than that in the country of study and do not have a certificate granting access to higher education from the destination country.

The United States receive the largest number of international students, but its share in all enrolled in 2017 is only 5.2% (see Bound *et al.*, 2021, for their role in the US). The European OECD countries have an average of 8.8% international students, while Switzerland has a significantly higher share of 17.8%. Of all OECD countries, Switzerland ranks fifth between Austria with 17.2% and the United Kingdom with 17.9% (OECD, 2020). International student flows are little regulated in most countries. As in the US, Switzerland does not have a cap on the number of permits allocated to international students. A confirmation of higher education admission and a proof of sufficient financial means are the main required documents to apply for a permit.[2]

In Switzerland, universities that offer general education receive the largest number of international students (24.5% in 2019). Universities of Applied Sciences and Universities of Teacher Education that focus on more specific skills have lower shares (11.1% in 2019). This study looks at universities because of their international orientation. The number of international students enrolled in bachelor's, master's or PhD programs at universities grew from 9,908 in 2000 to 36,035 in 2019. In relative terms, their share in all enrolled increased from 12.5% to 24.5%. This growth comes mainly from the years up to 2010, when the Bologna reform was introduced. Shares in 2019 are highest at the PhD level (54.2%), followed by the master's level (26.8%) and the bachelor's level (13.0%). I focus on the master's degree because the majority of university graduates enter the labor market with

[1] In 2021, the EHEA has forty-nine member countries including Switzerland. Similar initiatives exist in other regions. For instance, twenty-three countries in Latin America and the Caribbean agreed to strengthen regional integration in higher education in 2019.

[2] Swiss higher education institutions generally do not limit admission for native and international students with few exceptions. There is a national quota for study fields related to medicine. Some other fields, especially at Universities of Applied Sciences, require an application. The University of St.Gallen restricts itself to a share of 25% international students in all enrolled.

it.[3] Such a degree requires between 90 and 120 European Credit Transfer System (ECTS) credits, which corresponds to one and half to two full years of studying.

Of all international students enrolled in a university master's program in 2019, 64% are nationals of an EU or EFTA member country. The top three sending countries – France, Germany, Italy – account for 45% of all international students. The countries with the fourth and fifth largest shares are China (7.8%) and India (3.3%). International students are overrepresented in STEM fields (science, technology, engineering, mathematics). Their share in all enrolled is 41.6% compared to 16.1% in non-STEM fields in 2019. Moreover, universities have varying shares of international students, which is partly driven by their range of study programs but also by student preferences.[4] This distinct sorting shows that the level of exposure varies among native students.

Native and international students also differ in individual characteristics. 51% of the native master students enrolled in 2019 are female compared to 45.8% of the internationals. The average age of natives is 26.2 and of internationals 25.6 years. Part of these differences are linked to the study field choice. For example, STEM students are overall more likely to be male and younger than their peers in non-STEM fields. These statistics highlight the importance of comparing students within a field of study and university to understand differences in educational and labor market outcomes across student types.

2.2 Transition to the Labor Market

Holding a university degree from the country of destination can facilitate immigrants' entry into the labor market due to specific skills acquired during their studies or access to networks. Additionally, employers are familiar with the degree, which can reduce recruitment costs. Graduates who are EU or EFTA nationals can access the Swiss labor market based on the Agreement on the Free Movement of Persons. However, non-EU/EFTA graduates are subject to work permit requirements with some exemptions because of their Swiss university degree.[5]

[3] 86.9% of university students with a bachelor's degree complete higher education with a master's degree within three years. This share takes into account those who obtain a bachelor degree between 1990 and 2016 and enroll into a master's study until 2019. It likely underestimates the true share because enrollment into a master's degree abroad cannot be measured.

[4] 84.3% of all master students at the Graduate Institute Geneva are internationals. The university with the second largest share is the Universita della Svizzera italiana (73.5%). The University of Lucerne (11.6%) and the University of Bern (9.8%) have the lowest shares.

[5] Yearly quotas are defined at the federal level. On the other hand, non-EU/EFTA graduates can stay six months for job search after their graduation. The local priority requirement, which forces employers to prove that the vacancy cannot be filled with a native or EU/EFTA worker, is waived if the employment is of high scientific or economic interest. See Bundesgesetz über die Ausländerinnen und Ausländer und über die Integration, Art. 21, Par. 3.

Stay rates of international graduates are an important measure to understand international student flows. The most general approximation is based on permit status changes, since all individuals who once obtained a student permit are included. Using administrative data on immigration stocks (ZEMIS), the number of individuals reported with a student permit between 2002 and 2012 is in the denominator. The subset of them with a non-student permit in at least one year between 2002 and 2018 is in the numerator.

$$\text{Stay Rate} = \frac{\text{nr stayers with former student permit}_{2002-2018}}{\text{nr immigrants with student permit}_{2002-2012}}$$

The average stay rate is 27.3%. It is higher for EU and EFTA students (38.2%), within which the neighboring countries have the highest probability to stay (41.6%). Consistent with the generally more demanding work permit requirements, non-EU/EFTA students are less likely to transition to the labor market (18.5%). These shares should be considered lower bounds for the group of university master students.[6] For comparison, the average stay rate in fourteen OECD countries is around 25% with values between 17% and 33% in 2009 (OECD, 2011). These shares are also based on permit status changes but cover only individuals who are not part of a free movement regime in a given country.

Stay rates can be estimated specifically for university master's graduates using survey data. Since stayers are more likely to fill in the survey, this approach potentially results in an overestimation. The following stay rates should, thus, be considered upper bounds. Data for the period 2009–2019 show that 61.5% of international graduates report to live and 67.8% to work in the destination country. Graduates from non-EU/EFTA countries have a higher probability to stay for work (70.4%) than those from EU/EFTA countries (65.7%). Moreover, STEM graduates are more likely to stay for work (70.2%) than non-STEM graduates (65.9%).

Former international students staying in the destination country become resident immigrants. An established empirical fact is that immigrants are more likely to work and reside in larger cities than natives (e.g., Lewis and Peri, 2015). I show suggestive evidence that this holds based on Swiss data. I construct a concentration measure of immigrants in region r and year t following Albert and Monras (2020) and estimate the following equation:

$$\ln\left(\frac{nr\ immigrants_{rt}}{nr\ immigrants_{t}} / \frac{nr\ natives_{rt}}{nr\ natives_{t}}\right) = \alpha_0 + \alpha_1 \ln population_{rt} + \delta_r + \delta_t + \varepsilon_{rt} \qquad (1)$$

[6] Comparing student permit with student enrollment data shows that numbers for EU and EFTA students in the immigration dataset (ZEMIS) are similar to the inflow of bachelor, master and PhD students at universities (SHIS-studex). The number of non-EU/EFTA students is considerably higher in the ZEMIS dataset, suggesting that most of them are not graduating with a degree from a Swiss higher education institution. Therefore, the stay rates are likely to understate the true value, especially for non-EU/EFTA students.

Estimates in column (1) of Table B1 show that an increase in the municipal population by 1% is associated with a higher concentration of immigrants of around 0.3%. Results in columns (2) and (3) further confirm this relation at the level of the commuting zone of the workplace. Such a pattern can emerge due to relative labor supply or relative labor demand forces (Moretti, 2013).

3 Data and Methods

3.1 Data

The main dataset is a linked version of the Swiss Higher Education Information System (SHIS-studex) and the Survey of Higher Education Graduates (EHA). Both are individual level datasets and obtained from the Swiss Federal Statistical Office (FSO). The SHIS-studex is administrative data covering all enrolled students at a Swiss higher education institution since 1990. Information on enrollment and graduation by degree, field of study and institution is collected annually for the fall semester. Available personal characteristics are age, gender, nationality, and place of growing up. The latter variable refers to the time of obtaining the university entrance exam. It is defined at the municipality level for those with an entry exam from Switzerland and at the country level for all others. I distinguish international from native students based on the nationality and place of growing up. This dataset is used to calculate the peer composition in the year of graduation and, alternatively, in the year of first enrollment.

All graduates in even years are invited to participate in the EHA one and five years after graduation. Due to data quality, I focus on the first wave survey, which is sent out to all graduates in the year after completing a degree. The response rate of master graduates from universities was 57% in 2019. The available data covers the graduation cohorts 2002–2018. The FSO provides weights that take into account non-response. Participants self-report preferences in finding a job, labor market outcomes, working and residential locations. Information on the locations is available at the municipality level. The FSO adds variables such as the standardized yearly wage, which is normalized for full-time employment. I use this variable in the wage analysis. By linking the EHA to the SHIS-studex, I know the complete academic history of each survey participant. Additional information on the main datasets can be found in the Data Appendix C.

I supplement the education data with three self-collected series. The dataset on tuition fees includes the semester fee by university and degree, and separately for native and international students for the period 2000–2020. For the university quality I rely on the QS

World University Ranking, provided by Quacquarelli Symonds for the years 2004–2020.[7] The QS ranking is one of the best known global rankings and it exists since 2004. Almost 1,000 universities are considered. I build an index that reflects the perceived quality of an institution following Beine *et al.* (2018). Universities with a ranking above 400 or no ranking receive a value of 1. The universities with a better ranking receive a value according to the formula $Quality = 400 + 2 - Ranking$. Lastly, I collected data on travel time and distance by public transport and car between every municipality and the ten municipalities with a university. The API used relies on google maps for the calculations.

To measure stay rates of international students based on permit status changes, I use data from the Swiss Central Migration System (ZEMIS) which are obtained from the State Secretariat for Migration. The dataset includes the stock of foreign nationals as of December 31st each year and the daily inflow from 2002 onwards. From the Earnings Structure Survey (ESS) I derive information on the working population 26–65 that is employed in the private sector. This survey has been conducted by the FSO every two years since 1994 and firms are obliged to participate. In 2018 firms with around 2 million employees were surveyed. Individual information is reported at the worker level with the commuting zone (106 units) as the most detailed geographic unit. The main variables used are the work location and the standardized gross monthly wage for full-time employment. In addition, several publicly available datasets from the FSO on the resident population, the number of firms and employees are included in the analysis. In the analysis on the general population, immigrants and natives are distinguished by nationality. For deflating wages, I rely on a nationwide CPI with reference year 2015. Moreover, I use data from Wüest Partner on rental rates over the period 2010 to 2019 and on vacancy rates of rental objects over the period 2009–2018. These data relate to the first quarter of the year and are available for the five largest cities Basel, Bern, Geneva, Lausanne, and Zurich, which are the economic centers of the country.

The FSO classifies municipalities by density, size and accessibility into urban, intermediate and rural (Bundesamt für Statistik, 2017). Because of the similarities between intermediate and rural municipalities and because of the small share of individuals working there, I group the two together as rural units.[8] Out of 2,212 municipalities, 482 are urban, whereas 33 are categorized as cores of an agglomeration. This subset of urban cores includes, among others, the ten cities with a university. The geographic distribution of urban and rural municipalities is illustrated in Figure 1 and shows that urban locations and urban cores are present in all regions with some concentration in the northern part. Urban municipal-

[7] See the website of Quacquarelli Symonds for further information.

[8] There are 2,212 municipalities in January 2019. 22% of all municipalities are urban, 26% intermediate and 52% are rural. However, 63% of the population live and 75% of the labor force work in urban places. For rural places these shares are 16% of the population and 10% of the labor force.

ities tend to have larger populations than rural municipalities, but there is overlap as the population is just one of three criteria to define the categories (see Figure 2). The median population of rural municipalities is 1,156 and of urban ones 5,838 in 2018. Urban cores are the largest locations with a median population of 34,599.

3.2 Sample Selection and Summary Statistics

The sample builds on the EHA. The observation period 2009–2019 covers the time after all universities have implemented the Bologna reform. In the main analysis, I focus on a sample that includes natives. Natives are defined as master graduates who have a Swiss university entry exam. Around 4% of them have a non-Swiss nationality and are likely second or third generation immigrants. I consider master graduates who also have a bachelor's degree, which ensures that all individuals have completed their higher education within the Bologna framework, mitigating systematic differences across individuals. Around 96% of the native master students work and live in Switzerland one year after graduation. This large share highlights the importance of looking at intranational mobility.

Summary statistics on the outcome and control variables are presented in Panel A of Table 1. The variables are measured in the year after receiving the master's degree. 92% of all native graduates work in urban locations and 65% in urban cores. The average natural log of the population size of the workplace is 10.92 (55,271 in levels). Natives reside in relatively smaller places than where they work. The average natural log of the population size is 10.36 (31,571 in levels), while 82% live in an urban place and 52% in urban cores. They are on average almost 28 years old, 87% of them are single, and slightly more than half are female. 35% grew up in a rural municipality.[9]

The summary statistics in Panel B of Table 1 and the histogram in Figure 3 give an overview of the cohort composition that is constructed with SHIS-studex data. An average graduation cohort consists of about twenty-one individuals. This is a relatively small number and suggests that meaningful social interactions are likely between students. 22% of the students are international students. As the histogram shows, the size of the share of international peers shifts to the right over time. Subjects that relate to STEM, and business and administration receive the highest share of international students. In the empirical analysis I use the most narrow definition of fields of study to approximate best the level of interaction between native and international students. There were 48 distinct fields in the 2009 survey

[9]Note that the share of native graduates who grew up in rural places is very close to the share of the resident population in urban areas (37% in 2019). This suggests that the probability of obtaining a master's degree at a university is similar regardless of the place of growing up. The share of foreign residents in the population is 25.3% in 2019, indicating that a considerable fraction of the Swiss students are likely naturalized citizens.

and 69 in 2019. Around 64% of the international students are from EU and EFTA countries, in particular from the neighboring countries, and around half are female.

3.3 Empirical Strategy

What is the effect of studying with international students on the intranational location choices of native peers in early career? I estimate the following regression equation at the individual level i:

$$\begin{aligned} y_{ifst} = \beta_0 + \beta_1 share\ international\ peers_{fsc} + \beta_2 D_{ifst} \\ + \mathbf{X}'_{ifst}\gamma + \delta_{fs} + \delta_{ft} + \delta_{st} + \varepsilon_{ifst} \end{aligned} \tag{2}$$

where f, s and t represent the field of study, university and year. The main outcome variables y are indicators that equal 1 if a native graduate works or resides in an urban or urban core municipality, respectively. I complement the binary measures with the natural log of the resident population.

The measure of exposure to international peers is defined at the graduation cohort level f, s in time $c = t - 1$. I calculate the proportion of international peers by excluding the individual herself in the denominator: $share\ international\ peers_{fsc} = \frac{nr\ international\ graduates_{fsc}}{nr\ all\ graduates - 1_{fsc}}$. In an alternative specification, I measure international peer exposure in the year of enrollment e because the graduation cohort can be selected: $\frac{nr\ international\ students_{fse}}{nr\ all\ students - 1_{fse}}$. With a median study length of two years, peer exposure is measured three years or less prior to the survey in year t for 50% of native students. D_{ifst} is an indicator for the type of location of growing up. It equals 1 for rural and 0 for urban municipalities.

To only capture the random variation across time within a study field and university, I add fixed effects and control variables. The pair-wise fixed effects δ_{fs}, δ_{ft} and δ_{st} absorb variation that can affect student selection, for example, due to tuition fees or the range of fields offered by a university. The vector $\mathbf{X}$ includes age and its squared term, gender, civil status, canton of growing up, nationality. Besides age, the variables are controlled for with dummies. The dummy for the canton of growing up takes into account differences in the prior education, which is cantonally regulated. It is also a proxy for the distance to the nearest university and labor market opportunities. Moreover, $\mathbf{X}$ includes the cohort means of the individual controls and the natural log of the cohort size. Each individual observation is weighed with the survey weights. The standard errors are clustered at the cohort level.

Location decisions likely depend on the place of growing up (Bosquet and Overman, 2019) and this can affect an individual's responsiveness to peer exposure. In Equation 3, I

take this into account and allow the peer effect to vary with the place of growing up.

$$\begin{aligned} y_{ifst} = \beta_0 + \beta_1 share\ international\ peers_{fsc} + \beta_2 D_{ifst} \\ + \beta_3 share\ international\ peers_{fsc} \times D_{ifst} + \mathbf{X}'_{ifst}\gamma + \delta_{fs} + \delta_{ft} + \delta_{st} + \varepsilon_{ifst} \end{aligned} \tag{3}$$

The coefficient of interest is β_3. It shows the differential impact of a one unit change in the peer exposure for individuals from rural places compared to individuals from urban places on the probability to move to an urban place.

3.4 Identification

The empirical specification exploits random variation in the year-by-year cohort compositions similar to Carrell *et al.* (2018). The two key assumptions that must be fulfilled for causal estimates relate to selection and reflection.

Selection Students are not randomly allocated to cohorts. There can be self-selection and selection by universities. The latter is mitigated because of little to no education supply constraints in the Swiss context. In addition, universities cannot generate significant revenue from the relatively low fees, although international students pay on average more than native students.[10] Since twelve out of fourteen universities are public, making fee setting a rather slow political process, it tends not to be a means of selection.

University policies, on the other hand, can affect self-selection. In Table B2 I investigate the implications of tuition fees and the ranking on student enrollment by student type and degree. In column (3) of Panel A, an increase in tuition fees has a positive but insignificant effect on international master student enrollment. The university quality, which is derived from its ranking, does not play a significant role. The coefficient on tuition fees turns marginally significant when further controlling for the population size and the average wage rate of higher educated workers in the university location in column (4). Results in Panel B show that tuition fees and the ranking do not affect native student enrollment. As noted above, these correlations could be biased if, for example, universities change their fees in order to control the inflow of students. In my baseline specification, I include university-by-year fixed effects, which absorb variation specific to the universities and their locations that could differently affect enrollment by student type. Similarly, differences in the quality of faculties across universities or in the course language across fields could induce selection.

[10] Note that fees are set at the university level. Half of the universities price discriminate by student type. The average tuition fee per semester was CHF 1,055 for natives and CHF 1,514 for international students in 2020. Fees are largely publicly funded by the home canton of native students and by the university canton in the case of international students.

Changes at the field level are absorbed by field-by-university or field-by-year fixed effects.

The rough share of international students in a cohort can be a determinant of native student enrollment. Given the empirical strategy, the variation that I exploit comes from random year-by-year changes in the cohort composition. This is difficult to predict because accurate cohort-level information on student types is not publicly available, making informed choices about cohort composition difficult at enrollment. Since I measure peer peer exposure in the year of graduation where students are aware of their cohort composition, I test if exposure to international peers in the cohort of first enrollment affects the probability to graduate within four years. Results in column (1) of Table B3 shows that peer exposure has no significant effect on the probability to graduate. While the peer exposure has a marginally significant positive effect on the graduation rate in the study field of first enrollment, I do not find evidence that the graduation at the cohort level is affected as presented in column (4). Within a cohort, natives who want to avoid or intensify international competition can do so by selecting into different courses. Since this paper is conducted at the study field level, allocations at a narrower unit do not bias my results.

Existing work investigates native responses to international students by looking at enrollment and study field choices. These studies present evidence for crowding in effects of natives at the graduate level by referring to cross-subsidization, which is not a likely mechanism in this paper given the overall relatively low tuition fees.[11] In Table B4 I formally test for selection by native characteristics. I regress each individual control on the peer exposure measure, the cohort controls and the fixed effects. All coefficients are insignificant, suggesting that the share of international peers does not predict own characteristics. In Table B5 I test if individual characteristics predict their peer exposure, but again no evidence is found. To conclude, the empirical setting allows to exploit the natural variation among adjacent cohorts that is random and this approach is supported by the tests performed.

Reflection Peer effects can work in both ways, which Manski (1993) named the reflection problem. If the sample includes the relevant peer group, the estimated peer effect is partly a mechanical phenomenon because the behavior of international peers would be mapped onto the dependent variable (Angrist, 2014). Since I limit the sample to natives, I have a clear division between the international peers and the response of natives. In addition, the student type is pre-determined as it is defined by a combination of the nationality and the country

[11] Machin and Murphy (2017) find that a higher share of international students does not affect native undergraduates and increases the number of postgraduates. Shih (2017) finds higher enrollment of native graduates and Bound *et al.* (2020) lower enrollment of native undergraduates, respectively. In terms of study fields, Anelli *et al.* (2020) reports that a higher share of international students in a math introductory course increases the number of native STEM graduates. The cited studies are conducted in the US or UK context where enrollment quotas can apply and institutions often generate sizeable revenue with tuition fees.

that issued the university entry exam.

4 Analysis

In this section, I estimate the causal effect of exposure to international students on native peers' location choices in early career. I investigate the decisions of where to work and where to reside separately as they involve different costs and benefits (e.g., Moretti, 2013; Combes *et al.*, 2018). The direction of the effect is ambiguous a priori, as the potential mechanisms at work during the study period or after graduation can point in different directions.

4.1 Results

Place of work I begin by estimating Equation 2, where I am interested in the effect of exposure to international peers and growing up in a rural place on where to work after completing university. Table 2 presents results for different outcomes in the panels and for different sets of control variables in the columns. Results in Panel A show that an increase in international peer exposure is associated with a higher probability of working in urban locations. When augmenting the most basic specification in column (1) with fixed effects and control variables, the effect becomes smaller and statistically insignificant. Estimates further show that the place of growing up is an important predictor of where to work in the year after graduation. In the preferred specification with pair-wise interacted fixed effects and control variables in column (4), individuals who grew up in a rural place have a 2.8 percentage points lower probability to work in an urban area than natives who grew up in an urban place. The findings in Panel A are consistent with urban cores in Panel B and location size in Panel C as outcome variables. Overall, estimates in column (3) with pair-wise interacted fixed effects and in column (4) with additional control variables are comparable. Introducing controls slightly increases the adjusted R squared and shifts the coefficient on place of growing up towards zero, while the coefficient on peer exposure remains insignificant. If selection on observables is informative on selection of unobservables, the relatively stable coefficients suggest that omitted variable bias is limited (Altonji *et al.*, 2005; Oster, 2019).

Following Equation 3, I interact the two independent variables. The last column in Panel A of Table 3 shows that natives from rural places become more likely to work in urban areas as their exposure to international peers increases. A 10 percentage point increase in the peer exposure raises the probability by 0.4 percentage points (p-value 0.108). Panel B shows that this effect is driven by decisions towards working in urban core municipalities where the coefficient is more than twice as large and statistically significant at the 5% level.The

weaker response in Panel A is expected given that a high share of natives work in urban locations, leaving little margin to adjust: almost 92% of the native graduates work in an urban municipality, while 65% work in an urban core. Panels A and B show no evidence that individuals who grew up in urban areas are affected by the peer composition.

Is the positive effect on the work location choice driven by natives taking a job in the next bigger location or do they consider locations in regions further away than the one they grew up in? To answer this question, I look at how peer exposure affects the likelihood to work in a different region than that of growing up. I consider the canton and the labor market as the relevant types of region.[12] The canton as an administrative unit is interesting because it carries most of the educational costs of its citizens. The labor market corresponds to the area for job search, provided that the place of growing up is a relevant reference point. Evidence in the first two columns of Table B6 shows that natives from rural places are more likely to move interregionally as the share of international peers increases.

The first robustness test is shown in Panel C of Table 3 where I use the population size as a continuous outcome variable. Findings confirm that a higher exposure to international peers induces rural natives to work in larger places, as suggested by the difference in magnitudes of the coefficients in Panels A and B. In the specification presented in Table B7, I replace the indicator variable of where someone grew up with quintiles based on population size in 2005. Each quintile includes an equal number of native graduates.[13] The two third of the native graduates who grew up in the smallest municipalities are most responsive to peer exposure in their decisions to work in urban cores as shown in column (2). The peer exposure interacted with the third quintile, where more than half of the individuals are from urban areas, has the largest coefficient. This suggests that international peers also induce natives from urban but smaller places to work more often in urban cores.

In another robustness check in Table B8, I measure the share of international peers in the year of first enrollment instead of graduation. This addresses issues linked to endogenous adjustments of students during the study period, for example, in terms of drop outs, changes of universities or study fields. Results shown in columns (1)–(3) of Panel A are robust to the baseline, while the coefficient magnitude and significance slightly drop. In Panel B I exclude

[12]There are 16 labor markets and 26 cantons. Each labor market has at least one urban core. The mean share of employees in urban municipalities in a labor market is 70% in 2018. The lowest share is 44.6% and the highest 93.5%. The distribution is more unequal in cantons. The mean share of employees in urban municipalities in a canton is 68%, the lowest share 36.7% and the highest share 96.6%, when leaving out the two cantons that are completely urban or rural.

[13]In the first quintile, 83.6% of the individuals grew up in a rural place. In the second one the share is 61.4%, in the third 31.3% and in the top two quintiles it is roughly 0%. When focusing on individuals who grew up in urban cores, 96.6% of the individuals in the fifth quintile are from urban cores, in the fourth the share is 20.9% and in the lower quintiles it goes to zero.

long-term students taking four or more years to complete their master's degree because they are exposed to international students at a different intensity over time. Dropping these outliers leads to virtually unchanged results compared to the baseline findings. Finally, in an unreported analysis I take into account that one of the Swiss universities has a cap on the share of international students in all enrolled. This limits the variation in the proportion of international students at the university level and can affect selection. However, excluding this university from the sample does not change results.

Place of residence Table 4 presents the results of the non-interacted specification for the place of residence. The preferred specification in column (4) of Panel A shows that the coefficient capturing the peer effect is negative and marginally insignificant (p-value 0.101). Moreover, I find that natives from rural places are less likely to reside in urban areas after completing higher education than natives from urban places. Results from the interacted specification are shown in Table 5. In column (4) of Panel A, the negative coefficient of the peer effect becomes statistically significant at the 10% level (p-value 0.084). This negative effect is not driven by movements out of urban cores as shown in Panel B. It is also not observable when looking at movements across locations by population size in Panel C. In all three panels, the coefficient of the interaction term is positive and statistically insignificant.

The results in Table 5 imply that higher international peer exposure induces natives to live in rural areas, but that these movements take place within similarly sized municipalities. I test if the peer effect is linked to interregional movements in columns (3)–(4) of Table B6. I do not find evidence for a change in the propensity to live in a labor market or canton different to that of growing up, suggesting that movements are local. Next, I replace the indicator variable of the place of growing up with population quintiles in Table B7. Results in column (4) show that the peer effect is negative and significant for individuals in the top quintile. This result is surprising because more than 95% of the natives in the top quintile grew up in urban core locations. 95.0% of individuals from urban cores live in urban places after graduation, which implies a low margin for movements to rural areas. The results in columns (4)–(6) of Table B8 are based on the peer measurement in the year of enrollment instead of graduation. The peer effect on the probability to live in urban locations is not statistically significant and the same holds when dropping the long-term students in Panel B. This check suggests that the peer effect in the baseline specification is specific to the measurement of the cohort composition and, thus, not robust.

4.2 Heterogeneity

The main analysis has shown that native graduates who grew up in rural places are responsive to international peers in their decision of where to work. In Table 6 I look at heterogeneity in the estimates by considering two outcomes – the probability to work in urban core locations in columns (1) and (3) and the population size in columns (2) and (4).

In Panel A I split the sample into non-STEM and STEM graduates. STEM fields have on average a higher share of international students than non-STEM fields (see Table 1). Moreover, labor market characteristics such as the spatial distribution of occupations likely differ by type of skill. Results show that the peer effect is driven by non-STEM graduates. Panel B shows that the effect comes from both male and female natives. In Panel C I find that graduates at the median age of twenty-seven or younger drive the results.[14] Finally, in Panel D I split the sample into graduates from a canton with and without university, proxying distance to the closest university. The distance to the closest university is on average 19 minutes by car for individuals from a university canton and 44 minutes for individuals from a non-university canton. The gap persists with 51 versus 70 minutes when looking at the travel minutes to the effectively chosen university. Results suggest that this criteria has no clear impact on the responsiveness of natives. Natives who grew up in a university canton likely drive the movements towards urban cores, but natives who grew up in cantons without a university drive the movements towards larger work locations.

5 Discussion

International students can affect native preferences for wages and working conditions through interactions during their studies. In addition, those who stay in the host country after graduation can alter native labor market conditions. I discuss these mechanisms in the following sections.

Preferences Native and international students differ in where they work. Results in columns (1) and (2) of Table 7 show that international graduates are significantly more likely to work in urban cores and larger cities than native graduates. These differences are more pronounced in a subset with natives from rural places compared to natives from urban places. Albert and Monras (2020) document that financial preferences can be an underlying reason for the concentration of immigrants in large and typically expensive cities, where nominal wages are higher. Consistent with this is Figure A1a, which illustrates that 59.5% of the international graduates report that earning a high salary is important or very

[14] The allocation of the individuals at the median age of twenty-seven to one of the subsets is not decisive.

important to them. The share among native graduates is 44.3%.

I examine if international peers affect the importance that natives assign to wages, which could drive them to urban workplaces given the urban wage premium. Findings in columns (1) and (2) of Table 9 show that natives are more likely to report that a high salary is important to them as their exposure to international peers increases. Since the interaction term is not statistically significant, the financial preferences of natives who grew up in rural and urban areas are similarly affected. As the main analysis has shown, only native graduates from rural areas are on average responsive to international peer exposure in their workplace decisions. This can be explained by the fact that a high proportion of native graduates who grew up in urban areas also work there (93.2%), which implies that overall migration to urban areas is limited. At a finer level, results from the quantile specification in Table B7 suggest that individuals from urban but smaller places are also likely to work more often in larger cities as the international peer exposure increases. To conclude, findings are in line with a channel where a change in preferences for wage conditions induces native graduates to work in urban and larger locations.

The existence of an urban wage premium is an established finding in the literature (see, e.g., Behrens *et al.*, 2014, for different explanations). I provide evidence for Switzerland by estimating an average static earnings premium following Combes *et al.* (2008) and De La Roca and Puga (2016). In the first step, I include controls that vary across individuals. The regression in the second step includes only variation across regions.

$$\begin{aligned} w_{irt} &= \beta_0 + \delta_r + \mathbf{X}'_{irt}\gamma + \varepsilon_{irt} \\ \hat{\delta}_r &= \alpha_0 + \alpha_1 \ln \mathit{population}_r + \eta_r \end{aligned} \tag{4}$$

w_{irt} is the natural log of the yearly earnings of worker i in municipality r at time t. δ_r is a municipality fixed effect, the vector with control variables $\mathbf{X}$ contains individual and job characteristics, and year fixed effects. The variable *population* is the natural log of the average municipal population over the observation period. Standard errors are robust and clustered at the cohort level in the upper regression equation.

Results in column (2) of Table 10 show that a 10% increase in the municipal population is associated with 2.8% higher wages in the year after graduation. For comparison, I also estimate the premium for the native labor force. Column (2) of Table B9 shows that a 10% increase in the region's population size is associated with 5.0% higher wages.[15] The coefficient for the subset of high-skilled native employees in column (4) is 4.3%. In sum,

[15]The estimated premium in column (2) is comparable to elasticities of 0.037 in West Germany (Dauth *et al.*, 2021) or 0.046 in Spain (De La Roca and Puga, 2016).

the difference in urban wage premiums suggests that working in urban locations one year after graduation is likely associated with higher wage trajectories and not necessarily with immediate benefits.

Labor market conditions Stay rates of international graduates of above 60% suggest that international peers can affect native labor market conditions. Since native and international graduates from the same cohort are in the same skill-experience cell, a high degree of substitutability is expected (Borjas, 2003). However, the finding that rural natives become more likely to work in places where international graduates are concentrated does not suggest a negative wage impact. A mechanism whereby international stayers increase agglomeration benefits, and thus wages, would be more consistent to explain the main finding (see Glaeser and Gottlieb, 2009, for an overview). Yet, estimates in column (1) of Table 8 show no evidence that international peers affect native wages. This result also implies that native graduates who respond to the peer exposure do not benefit immediately from an urban wage premium, as the coefficient on the interaction term is close to zero.

Another potential mechanism relates to demand effects. Firms seeking to recruit international talent are likely to post vacancies in urban places given the spatial preferences of highly skilled immigrants. Since firms cannot perfectly discriminate between native and international applicants, an increase in vacancies is expected to attract natives too. As data on vacancies are not available, I instead test this hypothesis with data on the number of firms and employees. The analysis is limited to the ten municipalities with a university. They make around one third of the urban core municipalities and the majority of the graduates work there: 66.3% of the international stayers and 54.5% of the native graduates.[16] If there are demand effects, they are likely strongest in this subset of municipalities.

Table B10 presents correlations between the share of international graduates and the number of firms and employees, respectively, for all sectors in Panel A and the tertiary sector in Panel B.[17] I find that a higher share of international graduates is positively related to the number of firms and the number of employees. While the firm demand analysis is conducted at the municipality level, the peer effect study exploits variation at the cohort level. A conclusive link between the two analyses is hence difficult, but results suggest that demand effects may play a role in explaining the peer effects.

Other channels Exposure to international students can affect native location decisions

[16]Note that the correlation between the number of international graduates in a location and the number of international stayers in the same location is 0.86 with a p-value of 0.000. Separate correlations for the ten university cities show that they are significant in all but three cities (St.Gallen, Lugano, Fribourg).

[17]In the specifications in columns (3) and (6), I introduce lagged values of the share of international graduates to address reverse causality if the graduation year is endogenous to the number of vacancies in the university location (Messer and Wolter, 2010).

through further channels. First, survey data suggest that an international work environment is more important to international students than to natives as illustrated in Figure A1b. This is consistent with the results in columns (3) and (4) of Table 7 showing that international students are more likely to work for large and international firms. Do native graduates have a higher propensity to work for such firms, which tend to be located in urban areas, as their exposure to international students increases? Results in columns (2) and (3) of Table 8 show no evidence for this hypothesis. I also do not find indications that natives change their preferences by reporting more often that an international work environment is important to them as presented in columns (3) and (4) of Table 9.

Second, the literature documents that high-skilled individuals sort into urban places. For example, Bütikofer and Peri (forthcoming) show that individuals with a higher cognitive ability are more likely to migrate from rural to urban locations in Norway. Thus, location choice could further differ by grades, which could be affected by international peers. International students are a selected group and are likely to come from the upper end of the ability distribution of a given country due to the costs involved with studying abroad, in particular the high living costs in Switzerland. A simple regression of grades on the student type and pair-wise interacted fixed effects does, however, not reveal any systematic relation between the two variables. In line, column (4) of Table 8 shows that the exposure to international peers has no impact on the final grades of the natives.

Third, the peer effects analysis has shown that natives from rural places respond to the international student exposure in terms of where they work, but not in terms of where they live. Why is there a lack of responsiveness in the latter choice? Immigrants can increase demand for housing in places where they are concentrated, raise rental rates and potentially crowd out natives (Saiz, 2007; Gonzalez and Ortega, 2013). On the other hand, the group of international master students is small relative to the population and has gradually increased over time.[18] I explore correlations between the share of international graduates and rents in the five largest cities for which data on housing is available. The first two columns in Table B11 do not suggest a systematic link between the two variables. The share of international graduates does also not affect vacancy rates of rental properties as presented in the last two columns. Given that 79.5% of all international students graduate in one of these five cities and 60.5% of all international stayers work there, it is unlikely that rental markets in other urban areas with lower exposure to international students are affected. The literature discusses further channels to explain native relocation after an inflow of immigrants (Saiz and Wachter, 2011; Fernández-Huertas Moraga *et al.*, 2019). However, country of origin,

[18]For example, their share in the municipal population is between 0.33% in Zurich and 1.43% in Lausanne in 2019. In 2010, the shares were 0.26% in Zurich and 0.72% in Lausanne.

socioeconomic status or ethnicity should play only a limited role in the case of high-skilled immigrants. In conclusion, the natives' non-response in residential location choice is likely related to their willingness to commute. This is consistent with data showing that workers with higher levels of education commute the longest compared to workers with lower levels of education (Bundesamt für Statistik, 2021).

6 Conclusion

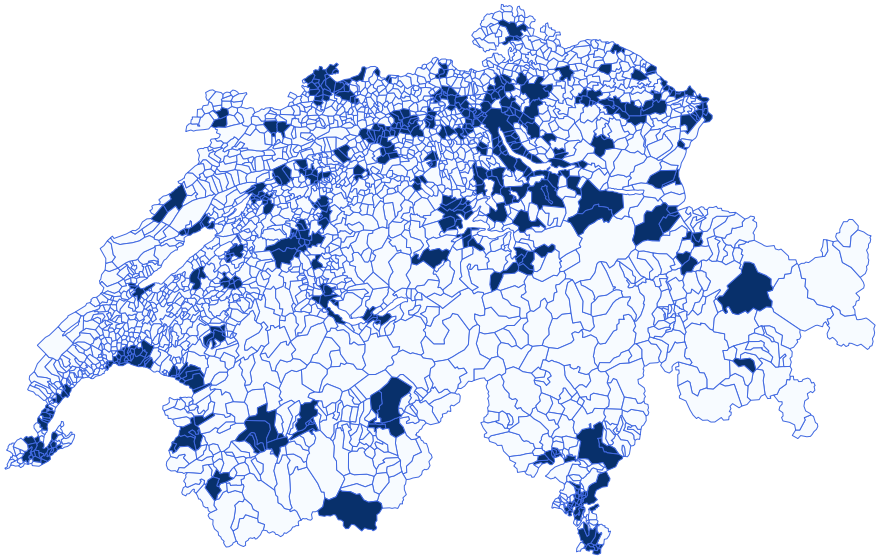
This paper provides novel evidence on how university cohort composition affects early career decisions of natives. The literature shows that such initial decisions can have long-term implications on individual labor market outcomes. I focus on the proportion of international students in a cohort because they are a growing group of (temporary) immigrants for whom few regulations currently apply. I show that native graduates from rural areas are less likely to work in urban places than native graduates from urban areas. This difference, however, decreases as the exposure to international students increases because rural natives become more likely to work in urban places. I find no evidence that exposure to international students affects the decision of where to reside.

International students are a politically and economically relevant group of immigrants for universities, firms, and the government. Despite the great similarity between native and international students, I do not find displacement effects of native graduates on the labor market. This could be due to skill shortage that is observable in many countries. The response of natives with respect to the work location has implications for policy makers. An increase in the concentration of economic activity in urban areas could enhance agglomeration benefits. At the same time, firms in smaller locations may struggle to recruit highly skilled workers.

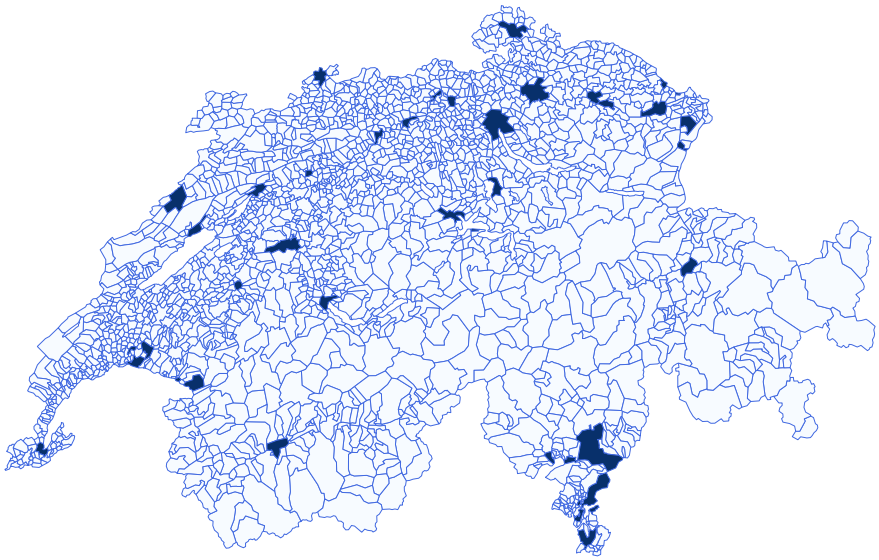
Figures

Figure 1: Spatial distribution of urban and rural municipalities

(a) Urban locations



(b) Urban core locations

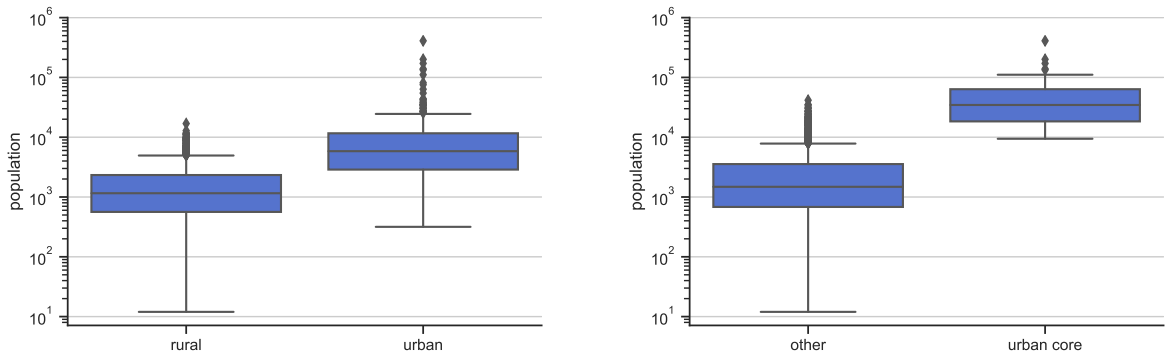


Note: The maps show the 2,212 municipalities of Switzerland. In figure (a), the dark blue units are classified as urban (482) and the light blue as rural. In figure (b), the dark blue units are classified as urban cores (33) and the light blue as the other urban und rural municipalities. Source: FSO.

Figure 2: Distribution of population across urban and rural municipalities

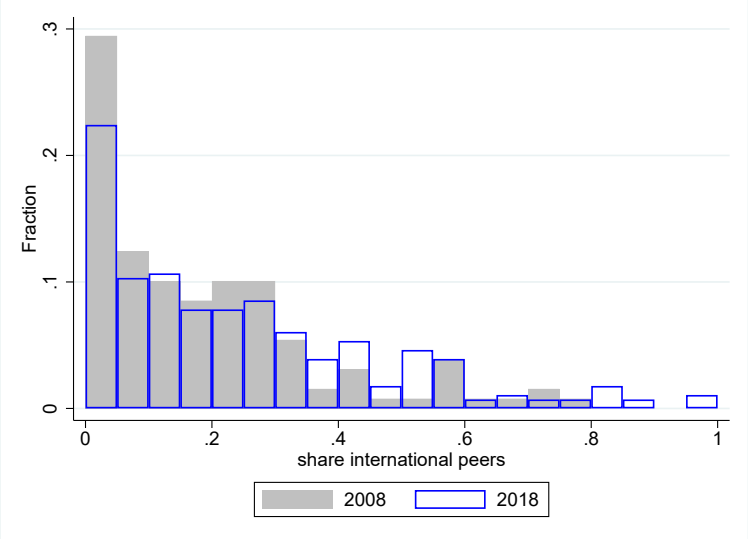
(a) Urban locations

(b) Urban core locations



Note: The boxplots show the distribution of the population across municipalities in 2018. Figure (a) plots the distribution by urban and rural category and figure (b) by urban core versus all other municipalities. The y-axis is in log scale. Source: FSO.

Figure 3: Share of international peers in a cohort



Note: The histogram shows the share of international peers in a graduation cohort in 2008 and 2018. A cohort is defined at the study field-by-university level. Bin width is 0.05. Source: SHIS-studex.

Tables

Table 1: Summary statistics

	Mean	Sd	Min	Max
Panel A: Outcome variables and controls				
working urban	0.92	0.28	0.00	1.00
working urban core	0.65	0.48	0.00	1.00
log population in work location	10.92	1.57	5.38	12.92
living urban	0.82	0.38	0.00	1.00
living urban core	0.52	0.50	0.00	1.00
log population in residence	10.31	1.80	3.71	12.92
growing up rural	0.35	0.48	0.00	1.00
age	27.67	3.08	23.00	75.00
single	0.87	0.34	0.00	1.00
female	0.51	0.50	0.00	1.00
non-Swiss nationality	0.04	0.20	0.00	1.00
Panel B: Cohort size and composition				
log cohort size	3.05	1.25	0.00	6.55
sh international peers	0.22	0.21	0.00	1.00
... in education	0.10	0.14	0.00	1.00
... in arts and humanities	0.16	0.21	0.00	1.00
... in social sciences, journalism	0.23	0.21	0.00	1.00
... in business, administration, law	0.26	0.22	0.00	0.86
... in natural sciences, maths, stats	0.26	0.18	0.00	1.00
... in ICT	0.38	0.25	0.00	0.95
... in engineering, manufacturing, construction	0.38	0.22	0.00	1.00
... in agriculture, forestry, veterinary	0.03	0.04	0.00	0.15
... in health and welfare	0.13	0.15	0.00	0.75
... from neighboring countries	0.10	0.14	0.00	1.00
... from EU/EFTA countries	0.14	0.16	0.00	1.00
... female	0.11	0.14	0.00	1.00

Note: The table shows summary statistics. Panel A presents statistics of the main sample covering the period 2009–2019. It includes native graduates who obtained a master's degree from a Swiss university between 2008 and 2018, and work and live in Switzerland in the year after graduation. The number of observations is 22,243. Panel B presents statistics on the graduation cohorts covering the period 2008–2018. A cohort is defined at the study field-by-university level. The aggregate study fields shown follow the ISCED-F 2013 classification. ICT is short for Information and Communication Technology. The number of observations is 1,447. Sources: EHA, FSO, SHIS-studex.

Table 2: Work location choice

	regression coefficient (1)	+ single FE (2)	+ interacted FE (3)	+ controls (4)
Panel A: Working in urban municipality				
sh international peers	0.096***	-0.026	0.020	0.022
	(0.028)	(0.020)	(0.031)	(0.031)
growing up rural	-0.044***	-0.036***	-0.036***	-0.028***
	(0.005)	(0.004)	(0.004)	(0.005)
Mean outcome	0.916	0.916	0.916	0.916
Sd outcome	0.278	0.278	0.278	0.278
N	22243	22243	22222	22222
Adj. R2	0.009	0.050	0.053	0.055
Panel B: Working in urban core municipality				
sh international peers	0.099	-0.045	-0.016	0.002
	(0.065)	(0.041)	(0.052)	(0.050)
growing up rural	-0.040***	-0.034***	-0.033***	-0.028***
	(0.009)	(0.008)	(0.008)	(0.008)
Mean outcome	0.654	0.654	0.654	0.654
Sd outcome	0.476	0.476	0.476	0.476
N	22243	22243	22222	22222
Adj. R2	0.003	0.061	0.067	0.075
Panel C: Log population of work municipality				
sh international peers	0.900***	0.091	0.053	0.098
	(0.275)	(0.141)	(0.170)	(0.166)
growing up rural	-0.210***	-0.167***	-0.166***	-0.111***
	(0.030)	(0.024)	(0.025)	(0.025)
Mean outcome	10.919	10.919	10.919	10.919
Sd outcome	1.573	1.573	1.573	1.573
N	22243	22243	22222	22222
Adj. R2	0.013	0.113	0.121	0.135

Note: The table shows results from estimating Equation 2. The sample consists of native individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable is displayed at the top of each panel. Column (1) includes only the two independent variables. In Column (2) I add fixed effects for the study field, university and year. In Column (3) I add pair-wise interacted fixed effects. Column (4) additionally includes individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table 3: Work location choice (interacted specification)

	regression coefficient (1)	+ single FE (2)	+ interacted FE (3)	+ controls (4)
Panel A: Working in urban municipality				
sh international peers	0.073***	-0.037*	0.009	0.009
	(0.024)	(0.022)	(0.032)	(0.033)
growing up rural	-0.056***	-0.042***	-0.042***	-0.036***
	(0.009)	(0.007)	(0.007)	(0.007)
rural x sh int peers	0.066**	0.032	0.035	0.041
	(0.033)	(0.025)	(0.026)	(0.026)
Mean outcome	0.916	0.916	0.916	0.916
Sd outcome	0.278	0.278	0.278	0.278
N	22243	22243	22222	22222
Adj. R2	0.009	0.050	0.053	0.055
Panel B: Working in urban core municipality				
sh international peers	0.068	-0.076*	-0.045	-0.030
	(0.062)	(0.042)	(0.052)	(0.049)
growing up rural	-0.056***	-0.050***	-0.050***	-0.045***
	(0.015)	(0.012)	(0.013)	(0.012)
rural x sh int peers	0.093*	0.090*	0.092**	0.100**
	(0.054)	(0.047)	(0.046)	(0.046)
Mean outcome	0.654	0.654	0.654	0.654
Sd outcome	0.476	0.476	0.476	0.476
N	22243	22243	22222	22222
Adj. R2	0.003	0.061	0.067	0.075
Panel C: Log population of work municipality				
sh international peers	0.782***	0.023	-0.014	0.002
	(0.276)	(0.149)	(0.173)	(0.169)
growing up rural	-0.270***	-0.202***	-0.204***	-0.163***
	(0.048)	(0.035)	(0.036)	(0.035)
rural x sh int peers	0.344*	0.199	0.213	0.303**
	(0.177)	(0.139)	(0.139)	(0.136)
Mean outcome	10.919	10.919	10.919	10.919
Sd outcome	1.573	1.573	1.573	1.573
N	22243	22243	22222	22222
Adj. R2	0.013	0.113	0.121	0.135

Note: The table shows results from estimating Equation 3. The sample consists of native individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable is displayed at the top of each panel. Column (1) includes only the two independent variables. Column (2) includes fixed effects for the study field, university and year. In Column (3) I add pair-wise interacted fixed effects. Column (4) additionally includes individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table 4: Residential location choice

	regression coefficient (1)	+ single FE (2)	+ interacted FE (3)	+ controls (4)
Panel A: Living in urban municipality				
sh international peers	0.043	-0.036	-0.074	-0.075
	(0.027)	(0.029)	(0.046)	(0.045)
growing up rural	-0.348***	-0.343***	-0.342***	-0.336***
	(0.010)	(0.010)	(0.011)	(0.011)
Mean outcome	0.823	0.823	0.823	0.823
Sd outcome	0.382	0.382	0.382	0.382
N	22243	22243	22222	22222
Adj. R2	0.191	0.204	0.205	0.214
Panel B: Living in urban core municipality				
sh international peers	0.034	-0.025	-0.024	-0.028
	(0.044)	(0.034)	(0.055)	(0.054)
growing up rural	-0.144***	-0.142***	-0.140***	-0.129***
	(0.007)	(0.007)	(0.007)	(0.008)
Mean outcome	0.516	0.516	0.516	0.516
Sd outcome	0.500	0.500	0.500	0.500
N	22243	22243	22222	22222
Adj. R2	0.019	0.047	0.046	0.076
Panel C: Log population of residential municipality				
sh international peers	0.387	-0.018	-0.074	-0.096
	(0.243)	(0.136)	(0.187)	(0.186)
growing up rural	-0.779***	-0.746***	-0.741***	-0.648***
	(0.030)	(0.030)	(0.031)	(0.033)
Mean outcome	10.313	10.313	10.313	10.313
Sd outcome	1.798	1.798	1.798	1.798
N	22243	22243	22222	22222
Adj. R2	0.045	0.106	0.107	0.163

Note: The table shows results from estimating Equation 2. The sample consists of native individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable is displayed at the top of each panel. Column (1) includes only the two independent variables. Column (2) includes fixed effects for the study field, university and year. In Column (3) I add pair-wise interacted fixed effects. Column (4) additionally includes individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table 5: Residential location choice (interacted specification)

	regression coefficient (1)	+ single FE (2)	+ interacted FE (3)	+ controls (4)
Panel A: Living in urban municipality				
sh international peers	0.028*	-0.043	-0.080*	-0.083*
	(0.016)	(0.029)	(0.048)	(0.048)
growing up rural	-0.356***	-0.347***	-0.346***	-0.341***
	(0.014)	(0.014)	(0.015)	(0.015)
rural x sh int peers	0.045	0.020	0.020	0.027
	(0.055)	(0.053)	(0.055)	(0.056)
Mean outcome	0.823	0.823	0.823	0.823
Sd outcome	0.382	0.382	0.382	0.382
N	22243	22243	22222	22222
Adj. R2	0.191	0.204	0.205	0.214
Panel B: Living in urban core municipality				
sh international peers	0.013	-0.037	-0.037	-0.041
	(0.044)	(0.035)	(0.057)	(0.057)
growing up rural	-0.154***	-0.148***	-0.147***	-0.136***
	(0.010)	(0.010)	(0.011)	(0.011)
rural x sh int peers	0.061	0.035	0.040	0.042
	(0.046)	(0.045)	(0.048)	(0.050)
Mean outcome	0.516	0.516	0.516	0.516
Sd outcome	0.500	0.500	0.500	0.500
N	22243	22243	22222	22222
Adj. R2	0.019	0.047	0.046	0.076
Panel C: Log population of residential municipality				
sh international peers	0.322	-0.009	-0.067	-0.121
	(0.231)	(0.137)	(0.194)	(0.193)
growing up rural	-0.813***	-0.741***	-0.737***	-0.662***
	(0.040)	(0.041)	(0.042)	(0.045)
rural x sh int peers	0.192	-0.027	-0.023	0.080
	(0.194)	(0.181)	(0.191)	(0.192)
Mean outcome	10.313	10.313	10.313	10.313
Sd outcome	1.798	1.798	1.798	1.798
N	22243	22243	22222	22222
Adj. R2	0.045	0.106	0.107	0.163

Note: The table shows results from estimating Equation 3. The sample consists of native individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable is displayed at the top of each panel. Column (1) includes only the two independent variables. Column (2) includes fixed effects for the study field, university and year. In Column (3) I add pair-wise interacted fixed effects. Column (4) additionally includes individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table 6: Work location choice – heterogeneity in peer effects

	Subset A		**Subset B**	
	working in urban core	log population workplace	working in urban core	log population workplace
	(1)	(2)	(3)	(4)
Panel A: Non-STEM (A) vs. STEM fields (B)				
sh international peers	-0.089	-0.229	0.040	0.210
	(0.060)	(0.201)	(0.088)	(0.309)
growing up rural	-0.044***	-0.149***	-0.057***	-0.257***
	(0.014)	(0.041)	(0.020)	(0.068)
rural x sh int peers	0.153***	0.465***	0.077	0.316
	(0.057)	(0.168)	(0.076)	(0.246)
Mean outcome	0.661	10.884	0.637	11.003
Sd outcome	0.473	1.527	0.481	1.676
N	15494	15494	6728	6728
Adj. R2	0.071	0.140	0.085	0.123
Panel B: Male (A) vs. female (B)				
sh international peers	-0.118	-0.117	0.023	-0.037
	(0.081)	(0.276)	(0.065)	(0.205)
growing up rural	-0.047***	-0.169***	-0.046***	-0.175***
	(0.017)	(0.052)	(0.016)	(0.050)
rural x sh int peers	0.113*	0.260	0.121*	0.532**
	(0.058)	(0.181)	(0.068)	(0.231)
Mean outcome	0.669	11.014	0.641	10.825
Sd outcome	0.471	1.585	0.480	1.554
N	10506	10506	11659	11659
Adj. R2	0.076	0.127	0.071	0.133
Panel C: Below (A) vs. above median age (B)				
sh international peers	-0.064	-0.015	-0.052	-0.071
	(0.071)	(0.209)	(0.085)	(0.295)
growing up rural	-0.052***	-0.179***	-0.033*	-0.121**
	(0.015)	(0.043)	(0.018)	(0.059)
rural x sh int peers	0.114**	0.300*	0.088	0.279
	(0.058)	(0.178)	(0.083)	(0.268)
Mean outcome	0.646	10.882	0.668	10.972
Sd outcome	0.478	1.562	0.471	1.586
N	13256	13256	8917	8917
Adj. R2	0.079	0.142	0.063	0.117
Panel D: From canton with (A) vs. without university (B)				
sh international peers	-0.096	0.030	-0.028	-0.019
	(0.117)	(0.379)	(0.058)	(0.203)
growing up rural	-0.049***	-0.079	-0.042***	-0.197***
	(0.017)	(0.051)	(0.014)	(0.044)
rural x sh int peers	0.130	0.073	0.065	0.304*
	(0.088)	(0.235)	(0.056)	(0.177)
Mean outcome	0.643	10.869	0.660	10.940
Sd outcome	0.479	1.615	0.474	1.553
N	6731	6731	15421	15421
Adj. R2	0.054	0.094	0.077	0.146

Note: The table shows results from estimating Equation 3. The sample consists of native individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable is displayed at the top of each column. All regressions include pair-wise interacted fixed effects, individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table 7: Differences in labor market outcomes between native and international graduates

	working in urban core (1)	log population workplace (2)	firm > 250 employees (3)	firm with int. branches (4)
Panel A: Full sample				
international student	0.049***	0.265***	0.089***	0.048***
	(0.013)	(0.048)	(0.011)	(0.013)
Mean outcome	0.661	10.969	0.400	0.292
Sd outcome	0.474	1.581	0.490	0.454
N	26200	26200	26200	26200
Panel B: Rural natives and internationals				
international student	0.064***	0.347***	0.096***	0.048***
	(0.015)	(0.054)	(0.013)	(0.014)
Mean outcome	0.655	10.956	0.416	0.320
Sd outcome	0.475	1.617	0.493	0.467
N	11626	11626	11626	11626
Panel C: Urban natives and internationals				
international student	0.040***	0.216***	0.083***	0.046***
	(0.012)	(0.046)	(0.011)	(0.013)
Mean outcome	0.676	11.056	0.417	0.306
Sd outcome	0.468	1.562	0.493	0.461
N	18188	18188	18188	18188

Note: The tables shows how labor market choices differ between native and international graduates. The sample consists of native and international individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable is displayed at the top of each column. The independent variable is an indicator which equals one if it is a former international student and zero if it is a former native student. The regressions include pair-wise interacted fixed effects. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Source: EHA.

Table 8: Peer effects on labor market outcomes and grades

	log yearly earnings (1)	firm > 250 employees (2)	firm with int. branches (3)	grades (4)
sh international peers	-0.004	-0.093	0.061	0.041
	(0.041)	(0.059)	(0.047)	(0.112)
growing up rural	0.005	-0.014*	-0.006	0.046**
	(0.007)	(0.008)	(0.008)	(0.021)
rural x sh int peers	0.001	0.024	0.006	-0.020
	(0.027)	(0.043)	(0.040)	(0.080)
Mean outcome	11.184	0.377	0.264	-0.015
Sd outcome	0.369	0.485	0.441	0.999
N	21604	21604	21604	20336
Adj. R2	0.276	0.134	0.271	0.184

Note: The table shows results from estimating Equation 3. The sample consists of native individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable is displayed at the top of each column. The dependent variables in columns (2) and (3) are indicators. The dependent variable in column (4) is standardized. All regressions include pair-wise interacted fixed effects, individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table 9: Peer effects on preferences in job finding process

	importance of high salary		importance of int. work environment	
	(1)	(2)	(3)	(4)
sh international peers	0.096*	0.091*	0.021	0.018
	(0.053)	(0.055)	(0.056)	(0.056)
growing up rural	-0.019**	-0.022*	-0.019***	-0.021**
	(0.008)	(0.012)	(0.006)	(0.009)
rural x sh int peers		0.014		0.011
		(0.045)		(0.036)
Mean outcome	0.443	0.443	0.303	0.303
Sd outcome	0.497	0.497	0.460	0.460
N	21424	21424	21424	21424
Adj. R2	0.074	0.074	0.115	0.115

Note: The table shows results from estimating Equation 3. The sample consists of native individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable equals one if an individual reports that earning a high salary in columns (1) and (2) or working in an international environment in columns (3) and (4) is important or very important. This is equivalent to a 4 or 5 on the scale (the scale goes from 1 to 5, see Figure A1). All regressions include pair-wise interacted fixed effects, individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table 10: Urban wage premium

	log yearly earnings (1)	municipality fixed effect coefficients column (1) (2)	log yearly earnings (3)	municipality fixed effect coefficients column (3) (4)
log population		0.028***		0.023***
		(0.006)		(0.005)
age	0.010**		0.014***	
	(0.004)		(0.004)	
age squared	-0.000		-0.000	
	(0.000)		(0.000)	
single	-0.021***		-0.018***	
	(0.007)		(0.006)	
female	-0.021***		-0.019***	
	(0.005)		(0.004)	
foreign national	-0.009		-0.008	
	(0.010)		(0.009)	
interns, research assistants	-0.380***		-0.283***	
	(0.028)		(0.013)	
self-employed	-0.325***		-0.212***	
	(0.034)		(0.026)	
Municipality FE	yes		yes	
Year FE	yes		yes	
University FE	yes		yes	
Study field FE	yes		yes	
Mean outcome	11.182		11.240	
Sd outcome	0.368		0.273	
Reduced sample	-		drop 5th pct	
N	21956	618	20847	607

Note: The table shows results from estimating Equations 4. The sample consists of native individuals with a university master's degree who work and live in Switzerland one year after graduation. The dependent variable in columns (1) and (3) is the natural log of the yearly earnings (standardized for full-time employment). The baseline category of the type of employment that is left out is employed. The independent variable in columns (2) and (4) is the natural log of the average population over the observation period 2009–2019. In the specification in columns (3) and (4), observations with unreasonably low earnings are dropped. The threshold is set at the 5th percentile of the wage distribution, i.e. 10.4088. Standard errors in parentheses are robust, which are clustered at the cohort level in columns (1) and (3). * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, FSO.

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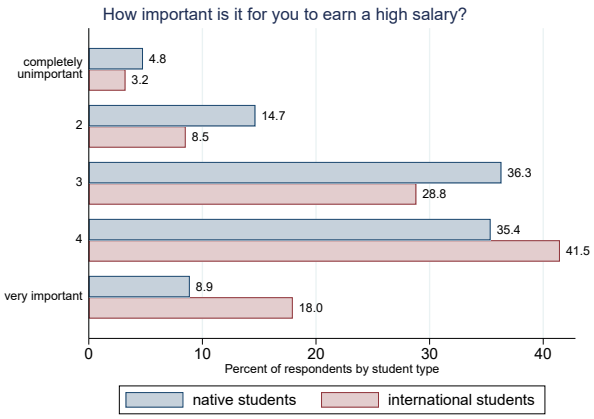
Appendix

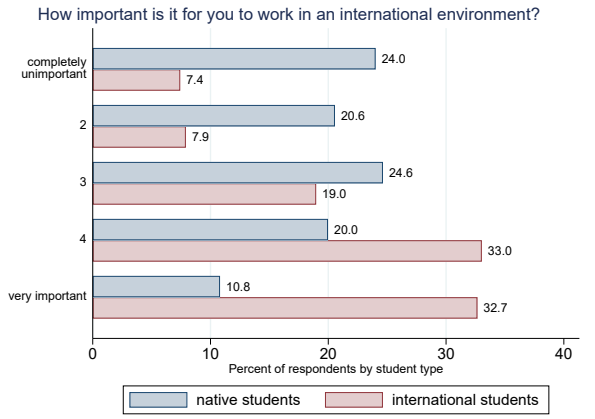
A Figures

Figure A1: Importance of wages and work environment in job search

(a) Wage



(b) International work environment



Note: The figures show how native and international master's graduates value a high salaray and an international work environment on a scale from 1 – completely unimportant – to 5 – very important. Source: EHA.

B Tables

Table B1: Immigrant concentration and city size

	Resident immigrants	Employed immigrants	Employed high-skilled immigrants
	(1)	(2)	(3)
log population	0.301***	0.915***	0.808**
	(0.063)	(0.331)	(0.322)
Year FE	yes	yes	yes
Region FE	yes	yes	yes
Mean outcome	-0.820	-0.059	-1.115
Sd outcome	0.866	0.541	0.537
N	34209	1272	1266

Note: The table shows results from estimating Equation 1. The sample consists of natives and immigrants who live or work in Switzerland. The dependent variable is the concentration of immigrants. The regression in column (1) uses yearly municipality level data between 2006 and 2018 and is based on the place of residence. The regressions in columns (2)–(3) use biennial data at the commuting zone level between 1996 and 2016 and is based on the work location. The subset of high-skilled workers in the last column includes those with a higher education degree. Standard errors in parentheses are clustered at the region level. * p<0.1; ** p<0.05; *** p<0.01. Sources: ESS, FSO.

Table B2: Enrollment of international and native students by degree

	log nr bachelor students		log nr master students	
	(1)	(2)	(3)	(4)
Panel A: Subset of international students				
log tuition fee	-0.269***	-0.190**	0.109	0.164*
	(0.091)	(0.091)	(0.094)	(0.088)
log ranking	0.003	0.006	0.031	0.025
	(0.023)	(0.020)	(0.029)	(0.028)
log population		-0.437		5.923***
		(1.736)		(2.256)
log high skill wage		-2.050***		1.650
		(0.594)		(1.014)
Year FE	yes	yes	yes	yes
University FE	yes	yes	yes	yes
Mean outcome	6.252	6.252	6.022	6.022
Sd outcome	0.823	0.823	1.041	1.041
N	143	143	148	148
Panel B: Subset of native students				
log tuition fee	0.128	0.171	0.061	0.078
	(0.121)	(0.133)	(0.169)	(0.161)
log ranking	0.006	0.004	0.050	0.045
	(0.010)	(0.011)	(0.033)	(0.030)
log population		1.458		4.012
		(1.378)		(2.885)
log high skill wage		0.547		2.227**
		(0.518)		(1.102)
Year FE	yes	yes	yes	yes
University FE	yes	yes	yes	yes
Mean outcome	8.110	8.110	6.999	6.999
Sd outcome	0.837	0.837	1.017	1.017
N	143	143	148	148

Note: The table shows determinants of university enrollment by student type and degree. The dependent variable is displayed at the top of each column. The control variables are the natural log of the population in the university location and the natural log of the average gross hourly wage rate of high-skilled workers in the commuting zone of the university. The biennial wage data is linearly interpolated. The observation period is 2005–2016. Standard errors in parentheses are robust. * p<0.1; ** p<0.05; *** p<0.01. Sources: ESS, FSO, SHIS-studex.

Table B3: Peer effects on probability to graduate with a master's degree

	probability to graduate	graduation in field of first enrollment	graduation at university of first enrollment	graduation in field and university of first enrollment
	(1)	(2)	(3)	(4)
sh international peers	0.040	0.080*	0.022	0.070
	(0.028)	(0.046)	(0.033)	(0.049)
Mean outcome	0.927	0.890	0.911	0.884
Sd outcome	0.260	0.312	0.285	0.321
N	89503	89503	89503	89503

Note: The table shows results from regressing the probability to graduate on the exposure to international peers in the first year of enrollment in a master's study. The sample consists of native students who enrolled between 2005 and 2015. The dependent variable is displayed at the top of each column. The graduation data covers the years 2005–2019. All regressions include pair-wise interacted fixed effects at the university, field of study and year level, and controls for age, age squared, gender, foreign nationality, canton of growing up, cohort size. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Source: SHIS-studex.

Table B4: Test for selection by native peers

	growing up rural	age	female	foreign nationality	single
	(1)	(2)	(3)	(4)	(5)
sh international peers	-0.027	0.662	-0.007	-0.002	0.002
	(0.028)	(0.472)	(0.022)	(0.007)	(0.024)
Mean outcome	0.354	27.674	0.505	0.042	0.869
Sd outcome	0.478	3.076	0.500	0.200	0.338
N	22222	22222	22222	22222	22222

Note: The table shows how the treatment predicts observable individual characteristics. The sample consists of native graduates from Swiss universities who live and work in Switzerland one year after graduation. The dependent variable is displayed at the top of each column. The regressions include pair-wise interacted fixed effects and cohort level controls. Standard errors in parentheses are clusterd at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table B5: Test for selection by international peers

	Outcome: share international peers					
	(1)	(2)	(3)	(4)	(5)	(6)
growing up rural	-0.0006					-0.0005
	(0.0003)					(0.0003)
age		0.0003				0.0003
		(0.0008)				(0.0008)
age squared		-0.0000				-0.0000
		(0.0000)				(0.0000)
female			-0.0001			0.0001
			(0.0003)			(0.0003)
foreign nationality				-0.0001		-0.0001
				(0.0005)		(0.0005)
single					0.0001	0.0005
					(0.0006)	(0.0006)
Mean outcome	0.180	0.180	0.180	0.180	0.180	0.180
Sd outcome	0.158	0.158	0.158	0.158	0.158	0.158
N	22222	22222	22222	22222	22222	22222

Note: The table shows how observable individual characteristics predict the treatment. The sample consists of native graduates from Swiss universities who live and work in Switzerland one year after graduation. The dependent variable is displayed at the top of the columns. The regressions include pair-wise interacted fixed effects, fixed effects for the canton of growing up and cohort level controls. Standard errors in parentheses are clusterd at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table B6: Peer effects on interregional mobility

	Workplace		Residence	
	different labor market	different canton	different labor market	different canton
	(1)	(2)	(3)	(4)
sh international peers	0.009	0.043	-0.006	0.052
	(0.057)	(0.056)	(0.053)	(0.055)
growing up rural	0.017	-0.011	0.029***	0.022**
	(0.011)	(0.010)	(0.009)	(0.009)
rural x sh int peers	0.086**	0.142***	0.023	0.020
	(0.041)	(0.041)	(0.038)	(0.038)
Mean outcome	0.505	0.547	0.282	0.306
Sd outcome	0.500	0.498	0.450	0.461
N	22222	22222	22222	22222
Adj. R2	0.149	0.227	0.090	0.137

Note: The table shows results from estimating Equation 3. The sample consists of native graduates from Swiss universities who live and work in Switzerland one year after graduation. The dependent variable is displayed at the top of each column. It is an indicator that equals 1 if the place of work or the place of residence one year after graduation is different to that of growing up. The location is defined at the labor market or cantonal level. All regressions include pair-wise interacted fixed effects, individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table B7: Work location and residence (robustness check on the measure of place of growing up: population quintiles instead of urban-rural classification)

	Workplace			Residence		
	working urban	working in urban core	log population workplace	living urban	living in urban core	log population residence
	(1)	(2)	(3)	(4)	(5)	(6)
sh international peers	0.004	-0.100	-0.288	-0.141***	-0.066	-0.163
	(0.038)	(0.064)	(0.215)	(0.051)	(0.069)	(0.236)
4th population quintile	-0.013	-0.043**	-0.135**	-0.032***	-0.321***	-0.757***
	(0.009)	(0.017)	(0.053)	(0.008)	(0.021)	(0.058)
3rd population quintile	-0.012	-0.058***	-0.196***	-0.136***	-0.394***	-1.029***
	(0.010)	(0.019)	(0.057)	(0.010)	(0.016)	(0.051)
2nd population quintile	-0.030***	-0.072***	-0.255***	-0.211***	-0.375***	-1.231***
	(0.011)	(0.019)	(0.057)	(0.013)	(0.017)	(0.060)
1st population quintile	-0.036***	-0.059***	-0.255***	-0.308***	-0.408***	-1.631***
	(0.010)	(0.016)	(0.051)	(0.016)	(0.017)	(0.077)
4th quintile x sh int peers	0.012	0.080	0.330	0.043	0.022	-0.023
	(0.033)	(0.062)	(0.219)	(0.034)	(0.074)	(0.215)
3rd quintile x sh int peers	0.033	0.191***	0.657***	0.136***	0.087	0.185
	(0.035)	(0.070)	(0.220)	(0.045)	(0.067)	(0.209)
2nd quintile x sh int peers	0.037	0.158**	0.581***	0.087*	-0.027	0.034
	(0.040)	(0.072)	(0.223)	(0.051)	(0.071)	(0.223)
1st quintile x sh int peers	0.025	0.117*	0.498***	0.110**	0.042	0.036
	(0.036)	(0.064)	(0.189)	(0.055)	(0.067)	(0.268)
Mean outcome	0.916	0.654	10.919	0.823	0.516	10.313
Sd outcome	0.278	0.476	1.573	0.382	0.500	1.798
N	22222	22222	22222	22222	22222	22222
Adj. R2	0.054	0.075	0.135	0.124	0.136	0.211

Note: The table shows results from estimating Equation 3 with population quintiles instead of the rural-urban classification of the place of growing up. The sample consists of native graduates from Swiss universities who live and work in Switzerland one year after graduation. The dependent variable is displayed at the top of each column. The regressions include pair-wise interacted fixed effects, individual and cohort controls. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table B8: Work location and residence (robustness check on the peer measure: enrollment instead of graduation cohort)

	Workplace			**Residence**		
	working urban	working in urban core	log population workplace	living urban	living in urban core	log population residence
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Full sample						
sh international peers	-0.033	-0.056	-0.154	0.011	-0.044	-0.307
	(0.040)	(0.063)	(0.217)	(0.050)	(0.067)	(0.211)
growing up rural	-0.037***	-0.047***	-0.163***	-0.340***	-0.135***	-0.658***
	(0.008)	(0.013)	(0.037)	(0.016)	(0.012)	(0.049)
rural x sh int peers	0.040	0.090*	0.237*	0.007	0.017	0.020
	(0.026)	(0.048)	(0.139)	(0.057)	(0.049)	(0.192)
Mean outcome	0.916	0.655	10.919	0.823	0.516	10.313
Sd outcome	0.278	0.476	1.572	0.382	0.500	1.798
N	22094	22094	22094	22094	22094	22094
Adj. R2	0.056	0.076	0.136	0.215	0.077	0.165
Panel B: Subset of natives graduating within 3 years						
sh international peers	-0.027	-0.032	0.009	-0.005	-0.078	-0.305
	(0.041)	(0.066)	(0.211)	(0.050)	(0.072)	(0.244)
growing up rural	-0.038***	-0.054***	-0.188***	-0.345***	-0.139***	-0.677***
	(0.008)	(0.013)	(0.038)	(0.017)	(0.012)	(0.049)
rural x sh int peers	0.049*	0.102**	0.299**	0.003	0.024	0.058
	(0.027)	(0.051)	(0.149)	(0.058)	(0.050)	(0.196)
Mean outcome	0.915	0.652	10.911	0.821	0.510	10.291
Sd outcome	0.279	0.476	1.570	0.384	0.500	1.796
N	20451	20451	20451	20451	20451	20451
Adj. R2	0.055	0.076	0.134	0.219	0.074	0.162

Note: The table shows results from estimating Equation 3 with the peer exposure based on the cohort in the first year of enrollment instead of graduation. The sample consists of native graduates from Swiss universities who live and work in Switzerland one year after graduation. The dependent variable is displayed at the top of each column. All regressions include pair-wise interacted fixed effects, individual and cohort controls. Estimates in Panel A are based on the full sample. Estimates in Panel B are based on the sample with individuals who need three years or less between enrollment and graduation. Standard errors in parentheses are clustered at the cohort level. * p<0.1; ** p<0.05; *** p<0.01. Sources: EHA, SHIS-studex.

Table B9: Urban wage premium of native employees

	All workers		**Workers with higher education**	
	log montly earnings (1)	region fixed effect coefficients column (1) (2)	log monthly earnings (3)	region fixed effect coefficients column (3) (4)
log population		0.050***		0.043***
		(0.005)		(0.014)
age	0.029***		0.046***	
	(0.000)		(0.001)	
age squared	-0.000***		-0.000***	
	(0.000)		(0.000)	
female	-0.124***		-0.097***	
	(0.001)		(0.002)	
single	-0.029***		-0.039***	
	(0.001)		(0.002)	
firm tenure	0.005***		0.007***	
	(0.000)		(0.000)	
firm tenure squared	-0.000***		-0.000***	
	(0.000)		(0.000)	
lower management	0.151***		0.117***	
	(0.001)		(0.003)	
middle management	0.335***		0.332***	
	(0.002)		(0.003)	
top management	0.397***		0.499***	
	(0.002)		(0.004)	
upper-secondary education	0.180***			
	(0.002)			
higher education	0.388***			
	(0.002)			
Region FE	yes		yes	
Year FE	yes		yes	
Firm FE	yes		yes	
Mean outcome	8.847		9.191	
Sd outcome	0.444		0.480	
N	1976130	106	345309	106

Note: The sample in columns (1) and (2) covers native employees of age 26–65 in the private sector. Columns (3) and (4) include the subset of employees with a higher education degree (university, university of applied sciences, university of teacher education). The dependent variable in columns (1) and (3) is the natural log of the monthly standardized gross wage for full-time employment. The natural log of the population is the average over the observation period 2012–2016 (biennial data). The geographic unit is the commuting zone. Standard errors in parentheses are robust. * p<0.1; ** p<0.05; *** p<0.01. Sources: ESS, FSO.

Table B10: Firm outcomes in university cities

	Log nr firms			Log nr employees		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All sectors						
sh international graduates	0.475**	0.531***		0.258***	0.225**	
	(0.188)	(0.195)		(0.094)	(0.091)	
log population		-0.209	-0.158		0.125	0.306**
		(0.199)	(0.174)		(0.118)	(0.130)
lagged sh int graduates			0.460***			0.218**
			(0.159)			(0.087)
Year FE	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes
Mean outcome	9.259	9.259	9.259	11.533	11.533	11.533
Sd outcome	0.746	0.746	0.746	0.811	0.811	0.811
N	80	80	70	80	80	70
Panel B: Tertiary sector						
sh international graduates	0.427**	0.505***		0.175*	0.179**	
	(0.172)	(0.174)		(0.089)	(0.088)	
log population		-0.291*	-0.230		-0.015	0.186
		(0.170)	(0.162)		(0.165)	(0.154)
lagged sh int graduates			0.445***			0.162*
			(0.148)			(0.089)
Year FE	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes
Mean outcome	9.168	9.168	9.168	11.421	11.421	11.421
Sd outcome	0.756	0.756	0.756	0.827	0.827	0.827
N	80	80	70	80	80	70

Note: The sample contains the ten municipalities with a university. The dependent variable is displayed at the top of the columns. The observation period is 2011–2018. Standard errors in parentheses are robust. * p<0.1; ** p<0.05; *** p<0.01. Sources: FSO, SHIS-studex.

Table B11: Rental market in the five largest cities

	Log median rent per m^2 and year		Vacancy rate (in %)	
	(1)	(2)	(3)	(4)
sh international graduates	-0.181	-0.305	0.366	-0.509
	(0.210)	(0.294)	(1.839)	(2.076)
log population		0.357		2.153
		(0.457)		(4.229)
Year FE	yes	yes	yes	yes
Region FE	yes	yes	yes	yes
Mean outcome	5.638	5.638	0.440	0.440
Sd outcome	0.182	0.182	0.262	0.262
N	50	50	50	50

Note: The sample contains the five largest cities. The dependent variable is displayed at the top of the columns. The vacancy rate goes from 0 to 100. The observation period is 2010–2019 in the first two columns and 2009–2018 in the second two columns. Standard errors in parentheses are robust. * p<0.1; ** p<0.05; *** p<0.01. Sources: FSO, SHIS-studex, Wüest Partner.

C Data

This appendix provides additional information on the two main education datasets that are provided by the Swiss Federal Statistical Office (FSO). Individual level data are used throughout the analysis. The smallest available geographical unit is the municipality by zip code, defined as of January 2019. The municipalities are grouped to broader units following the most recent definitions from the FSO. The split into urban and rural locations is based on characteristics measured in 2012. Urban cores are defined as cores of a big agglomeration (Kernstadt einer grossen Agglomeration, code 111) or of a medium sized agglomeration (Kernstadt einer mittelgrossen Agglomeration, code 121). The mapping of municipalities into sixteen labor markets is based on 2018 data. The allocation of municipalities to cantons is unchanged over time.

Swiss Higher Education Information System (SHIS-studex)

The SHIS-studex is an administrative dataset with information on enrollment and graduation. Universities report individual characteristics and enrollment information by field of study for all matriculated students each fall semester. Information on degrees obtained is reported by graduation date. Information on the study fields is available at three levels of aggregation. I use the most detailed definition of a field with 69 categories in 2019 (i.e., level 3). For example, the field of economics and business administration – the definition at level 1 and 2 – is split into economics, business administration, business informatics, and other related studies at level 3. These Swiss-specific fields can be linked to the ISCED-F 2013 codes (International Standard Classification of Education: Fields of Education and Training) from the UNESCO with a matching scheme provided by the FSO. In the analysis I use the Swiss-specific definitions, while presenting summary statistics by the ISCED-F 2013 broad fields with nine categories to enhance readability (fields falling in the tenth category "Services" are not offered at Swiss universities).

Note that in the analysis on university enrollment by student type (see Table B2), the distance learning university is excluded because it cannot be assigned to a unique location.

Survey of Higher Education Graduates (EHA)

The EHA is a survey conducted one and five years after graduation. Individuals graduating in even years receive the first survey in the year after graduation. Participation in the second survey is relatively low because only those who sent back the first survey receive the second one. For example, 58% of the graduation cohort in 2014 returned the first wave survey. Data

on the second wave is available for 40% of the initial cohort. The low participation is in particular apparent among the international students of the graduation cohorts 2008–2018. None of them takes part in any of the second wave surveys.

The EHA assigns graduates to twelve out of fourteen universities covering 98.9% of all master students enrolled in 2019. The two missing institutions are the Graduate Institute Geneva and the distance learning university. To estimate the survey weights, the FSO considers the distribution of enrolled students along several lines: university, broad study field (level 1), degree, gender, international versus native student. Thus, the weighted sample of university master graduates by survey wave is representative for the relevant population. Note that the EHA has been conducted in its current form since 2003. Data on earlier years are available but cannot be linked to the SHIS-studex and weights are not provided.