DETERMINANTS OF SLOVAK STUDENT MIGRATION: BORDER EFFECTS AND ACCESSIBILITY OF HIGHER EDUCATION

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Abstract

This paper examines geospatial determinants of Slovak students' decisions to pursue tertiary education abroad, focusing on two factors: proximity to state borders and accessibility to domestic higher education institutions. Using a dataset of 505 Slovak secondary-school graduates from the 2024 cohort, the study applies a series of "go/no-go" logit models at various territorial levels (LAU1, NUTS3, NUTS2) and across distance radii ranging from 1 to 300 kilometres. The analysis shows that although students living in border districts exhibit a slightly higher likelihood of preferring to study abroad, the effect is statistically insignificant across all regional aggregations. In contrast, access to domestic tertiary institutions at medium to longer distances (95 - 185 km) significantly reduces the probability of choosing to study abroad, suggesting that regional educational accessibility plays a role in shaping student preferences. The findings contribute to the understanding of spatial determinants in student migration and highlight the need to further explore socioeconomic and institutional drivers influencing study abroad decisions.

Key words: Higher education accessibility, Border effect, Student migration, Brain drain
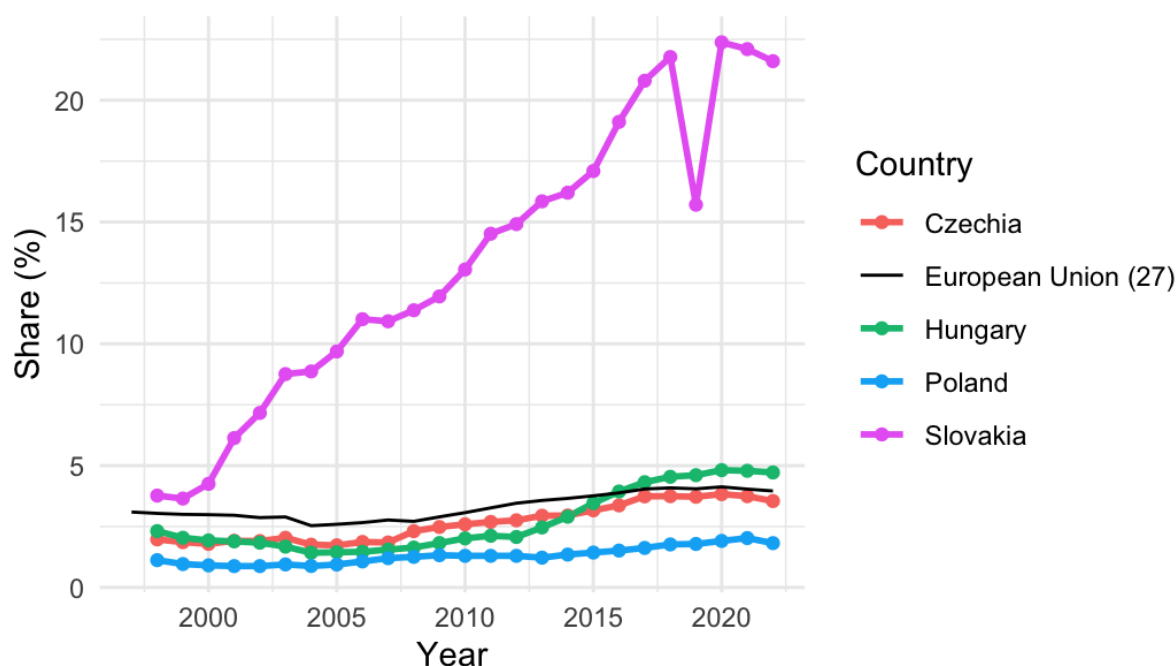
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Introduction

The issue of student migration, often discussed in the context of brain drain, is a phenomenon observable throughout Europe. Due to globalization and deregulation of travel within the Schengen area, studying abroad has become substantially more accessible to many (Kuzma, 2025).

Slovakia, however, remains one of the countries with the highest share of students pursuing tertiary education abroad (if European micronations and island states are excluded) with a large percentage of students seeking to obtain tertiary education outside its borders. This disproportionate outflow of emigrating students is best seen when compared with its historically

and socio-economically comparable neighbouring countries that form the Visegrad Group, also known as V4.

When compared to its neighbours, as reported by the UNESCO Institute for Statistics (2025), data from 2016 to 2022 show that, on average, every fifth high school graduate leaves Slovakia (20.4%), whereas within the other V4 countries, the percentage is significantly lower. Hungary ranks second with an average of (4.5%), followed by the Czech Republic (3.7%) and Poland (1.8%). The EU27 average over the selected years is 4%. The trend of the other V4 countries seems rather stabilized shown in Figure 1.

Fig. 1: Share of students studying abroad

Source: UNESCO Institute for Statistics (2025)

Data collection of student migration outflows is a considerably challenging task. The Schengen area and the absence of internal border controls pose a challenge to collecting reliable data on migrating students. One of the more accessible sources of information is data provided directly by universities; however, these records are typically incomplete.

The systematic lack of usable data creates difficulties for conducting a meaningful quantitative assessment of the situation. The research on this topic relies on sample surveys. One such survey was conducted in 2024 by a research agency Therapolis. This survey was an extensive questionnaire amongst Slovak high school graduates finishing their studies in academic year 2023/2024 and was conducted in the months of June and July. The chosen period

made it possible to identify the universities to which respondents had been accepted, as it took place after most admission procedures.

The sample size (n = 505) represents 1.15% of all successful graduates in the specified academic year, of whom 19.6% (n = 99) preferred to study abroad. It consisted of 44.8% male and 55.2% female respondents with an average age of 18.96 years.

1   Methodology

In the interest of diversifying the respondents and obtaining results as close to the population as possible, the analysis focuses on their place of residence. Since the survey does not provide information about specific municipalities, NUTS4 (LAU1) units are used.

This poses a potential problem, as the respondent may be located anywhere within the LAU1 unit. Two hypothetical solutions emerge: 1) analysis based on the centroid of every LAU1 unit, or 2) analysis based on the main LAU1 municipality, also known as the district town. In almost all cases, except NUTS4 - Ilava, where the most populated town is Dubnica nad Vahom and in Zarnovica where the most populated town is Nova Bana, the district town is the most populous, which increases the probability that the respondent truly resides there. For the purposes of the analysis, the second option appears more viable. The differences between district towns are negligible, as Ilava and Dubnica nad Vahom are only 6 km apart, while Zarnovica and Nova Bana are 12km apart.

For the purposes of analysing the proximity of tertiary institutions, based on CVTI SR (2024) data, coordinates of 105 active public university faculties were collected using Google Maps. Based on this data, rings with (25, 50, 75, 100, 150) kilometre radii were constructed around the coordinates of each LAU1 district town.

Using the obtained data, multiple "go/no-go" Logit models were built to determine the determinants of one's preferability to study abroad. The logit model is based on the logistic function and transforms the linear combination of predictor variables into a probability value that ranges between 0 and 1. It models the log-odds of the probability of a binary outcome. The logit model can be represented as shown in formula 1:

$$\ln\frac{p}{1-p} = \ \beta_0 + \beta_1 X \qquad (1)$$

where p is the probability of the binary outcome; X - predictor variable; $\beta 0$, $\beta 1$ - coefficients to be estimated (Kwilinski, 2023).

2   Border proximity analysis

Historically, European borders have been brittle and moved quite frequently. The lines of separation between countries often moved depending on their political and military success. Former political borders became "scars of history" and often crossed areas populated by the same ethnic group, dividing them and thus generating specific identities (Kolosov, 2018).

Nowadays, as borders are rather stabilized, the cross-border region is, as mentioned by Ratti (1993), "necessarily an area of separation and of contact", which constitutes a "tension space" for economic relationships (Williams et al., 2001). One of which is the exchange of human capital, which is partly driven by migration flows. Student mobility can be understood as one of the flows that will create future jobs in European countries (Chrancokova, 2014).

2.1. General border presence analysis

Every LAU1 unit was either assigned 1 if there exists a current border with a foreign country, or 0 - the district is not connected to a border with a foreign country. For the LAU1 units of Kosice - Okolie and Kosice I-IV, the units were merged, as the division into smaller districts is primarily bureaucratic and no cultural and behavioural differences are to be expected. The same aggregation strategy was applied to Bratislava I-V. The sample size had not covered every single one of the LAU1 units, so although (Revuca, Roznava, Sobrance, Medzilaborce, Humenne, Stropkov, Namestovo, Myjava, Skalica) are understood as border districts of Slovakia, no survey respondents are currently residing in them. The results of the go/no-go logit model can be seen in Table 1.:

Tab. 1: Border presence model

(Intercept)	-1.621***
Std. error	(0.185)
P - value	(<0.001)
Border_con	**0.346**
Std. error	(0.233)
P - value	(0.137)
Num.Obs.	505
AIC	501.6
BIC	510.0
Log.Lik.	-248.780
RMSE	0.40
• p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001	

Source: Own calculations, based on Therapolis (2024) data

The results suggest that students from border districts have a 41.3% higher likelihood of preferring to study abroad compared to those residing in non-border LAU1 units. However, this effect is not statistically significant (p = 0.137), suggesting that the observed difference may result from random variation in the data. The estimated probability of preferring to study abroad of students from non-border districts is approximately 16.5%.

After further calculations, no statistically significant differences were observed on NUTS3, nor on NUTS2 level, as seen in Table 2. below. However, positive trends can be observed in some NUTS2 regions where border region students in central Slovakia show a 67.9% higher likelihood of preferring to study abroad and in eastern Slovakia where students show 69.3% higher likelihood. Yet, these differences remain statistically insignificant.

Tab. 2: NUTS2 border presence model

	Bratislava (NUTS2)	*West SVK (NUTS2)*	*Central SVK (NUTS2)*	*East SVK (NUTS2)*
(Intercept)	**-2.485***	**-1.792***	**-1.419***	**-1.531***
Std. error	(1.041)	(0.326)	(0.288)	(0.390)
P - value	(0.017)	(<0.001)	(<0.001)	(<0.001)
Border_con	**1.099**	**-0.059**	**0.518**	**0.527**
Std. error	(1.083)	(0.460)	(0.437)	(0.452)
P - value	(0.310)	(0.898)	(0.236)	(0.244)
Num.Obs.	83	158	122	142
AIC	81.1	131.5	134.0	158.9
BIC	85.9	137.6	139.7	164.8
Log.Lik.	-38.554	-63.758	-65.022	-77.447
RMSE	0.38	0.35	0.42	0.42
• **p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001**				

Source: Own calculations, based on Therapolis (2024) data

The results indicate that Slovak students, whether residing in border or non-border regions, are not necessarily influenced to prefer studying abroad based only on mere border proximity or physical closeness to a neighbouring country. This aligns with evidence that shared language and economic differentials matter more than simple geographic closeness (Broersma et al., 2020).
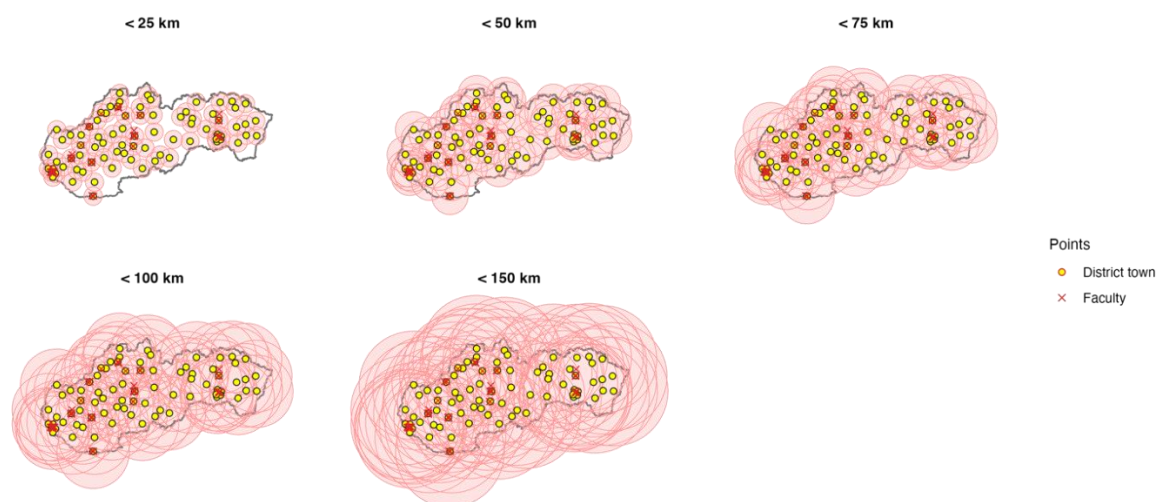
3   Tertiary institution proximity analysis

Historically, Ordovensky's (1995) study on individual and institutional determinants of students' choice of post-secondary education finds that students living closer to a given type of higher education institution are more likely to enrol in that type of institution. Building on this, Sá et al. (2004) analyse the determinants of regional demand for higher education in the Netherlands and find that the university-specific distance-decay elasticity of first-year demand is greater than 1 for most universities. This implies elastic demand with regionally demarcated catchment areas, i.e., proximity materially shapes where students go. In mentioned studies, the idea of proximity shaping one's university preference has been analysed primarily in within-country migration context. This raises the question of whether cross-border migration may also constitute a relevant determinant.

For the purposes of tertiary institution proximity analysis, no merging strategy for Bratislava I-V and Kosice I-IV was applied, as merging could potentially result in the loss of valuable information. However, since Kosice - Okolie district lacks a relevant district town from which a radius could be drawn, a centroid was calculated, using the *sf* library in R, and used.

Circles of five radii were then drawn from each of the 79 Slovak district towns: 25km (short distance), 50km and 75km (middle distance), and 100km and 150km (long distance). With this range of radii, entire NUTS3 and NUTS2 units were considered. The different proportionalities are shown in Figure 2.

Fig. 2: Range of logit models with district town and faculties locations

Source: Own calculations

For each of the radii, a logit regression was performed to analyse whether the presence of a tertiary institution within the specified range influences the probability of preferring to study abroad. Results shown in Table 3. show that for the radii of short to middle distance (25km, 50km, 75km) the estimated coefficients are small, negative, and based on p-value, statistically insignificant. This suggests no clear effect on shorter to middle distances. This changes for the 100 and 150 kilometres radii, where estimated coefficients are negative and statistically significant ($p < 0.05$), implying that a greater availability to tertiary education of any kind, at these distances, decreases the likelihood of preferring to studying abroad by 1.63% for the 100km radius and by 1.28% for the 150km radius. That suggests that regional, approximately on NUTS2 level, rather than local, accessibility to higher education plays a stronger role in shaping respondents' preferences. Immediate proximity of institutions may not be sufficient to alter preferences, but broader educational opportunities within a commutable distance can provide viable alternatives to studying abroad.
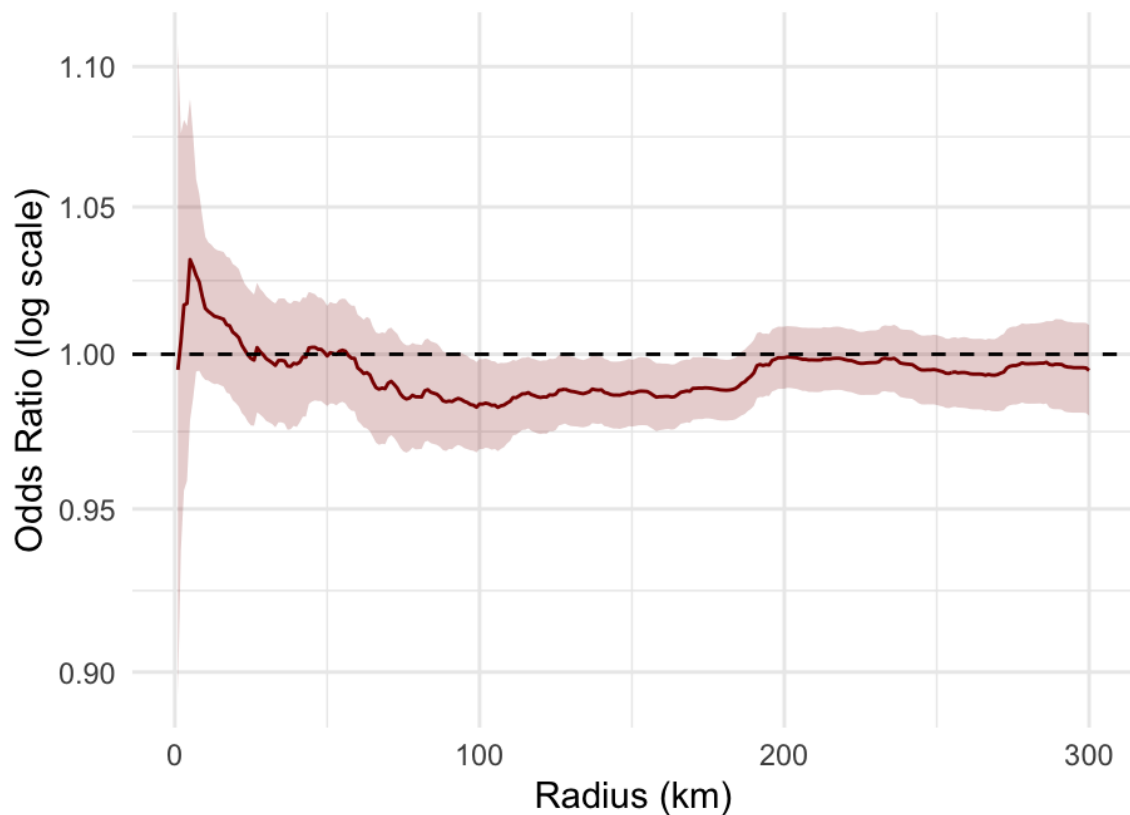
Tab. 3: Logit models for each of the radii

	< 25 km	< 50 km	< 75 km	< 100 km	< 150 km
(Intercept)	-1.400***	-1.400***	-0.968**	-0.750*	-0.690*
Std. error	(0.146)	(0.201)	(0.299)	(0.317)	(0.327)
P - value	(<0.001)	(<0.001)	(0.001)	(0.018)	(0.035)
fac_within_25km	-0.001				
Std. error	(0.011)				
P - value	(0.901)				
fac_within_50km		-0.001			
Std. error		(0.008)			
P - value		(0.946)			
fac_within_75km			-0.014		
Std. error			(0.009)		
P - value			(0.117)		
fac_within_100km				-0.017*	
Std. error				(0.008)	
P - value				(0.030)	
fac_within_150km					-0.013*
Std. error					(0.006)
P - value					(0.022)

Num.Obs.	505	505	505	505	505
AIC	503.8	503.8	501.3	499.0	498.6
BIC	512.2	512.3	509.8	507.4	507.0
Log.Lik.	-249.898	-249.903	-248.655	-247.483	-247.292
RMSE	0.40	0.40	0.40	0.40	0.40
• p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001					

As part of a sensitivity analysis, shown in Figure 3., "go/no-go" logit models were constructed for radii ranging from 1-300 kilometres. At very short distances, the estimates fluctuate considerably due to small sample sizes, but quickly converge around an odds ratio of 1. Beyond approximately 50 km, the estimates stabilize slightly below unity, suggesting that the presence of institutions within broader commuting ranges is consistently associated with a reduced likelihood of studying abroad. The relatively narrow confidence bands after the initial fluctuations indicate robust estimates across a wide range of radii.

Fig. 3: Odds ratio and its confidence interval by radius (1-300km)

The results show that if a university is within immediate reach, decisions are not significantly influenced. At longer distances, between 95 and 185 kilometres, the estimates consistently fall below one, showing that access to institutions within a longer distance reduces the likelihood of preferring to study abroad. This suggests that when domestic study is feasible with some travel, students are more inclined to remain at home. Beyond the 185-kilometre radius, however, the effect diminishes and converges back towards unity. In this case, the marginal difference between travelling long distances within Slovakia and studying abroad becomes negligible, as both options imply a comparable distance for mobility and other factors might take place in one's decision.

Conclusion

The share of Slovak students leaving Slovakia to obtain tertiary education is objectively high and has continued to rise over the past seven years. The paper aimed to analyse geospatial factors, namely border proximity and accessibility of tertiary institutions, influencing one's decision to study abroad or to remain to pursue higher education in the Slovak republic.

The analysis of border proximity showed that students residing in border districts exhibit a somewhat higher probability of preferring foreign universities, however, the observed effect was not statistically significant at any tested level of territorial aggregation. Consequently, while geographical closeness did not appear as a decisive determinant in this specific dataset, the limitations of sample size suggest caution. A larger sample might be required to definitively rule out border proximity as a driver of student migration, given the slight positive correlation observed.

In contrast, the analysis of tertiary institution proximity shows that when a university is located within immediate reach, individual decisions are not significantly influenced. However, at longer ranges, between 95 and 185 kilometres, the estimated „go/no-go" model coefficients fall below unity, indicating that access to higher education at such distances decreases the likelihood of preferring to study abroad by approximately 1.63% for the 100km radius and by 1.28% for the 150km radius. This suggests that when domestic study is doable with moderate travel requirements, students tend to remain within the national university system. Beyond the 185-kilometre radius, the effect diminishes and converges back towards unity, implying that the difference between long-distance domestic study and studying abroad becomes negligible.

The findings show that, albeit marginally, geospatial factors also play a role in decisions that Slovak high school graduates make on a yearly basis. As shown in Kuzma (2025), more prevalent determinants of preference are socioeconomic.

The topic of Slovak student migration remains highly relevant and offers numerous opportunities for further research, including the development of more complex models incorporating socio-economic factors in border regions, the use of exact residential addresses of respondents, or an examination of how the preferences differ across cohorts of different fields of studies.

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