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Condemned to low educational capital? Temporal-spatial transformation of the educational structure in Slovakia and possible determinants of spatial differentiation

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Abstract

The last three decades have brought a historically unique qualitative and quantitative transformation of Slovakia's educational structure. Never in history have we identified such a dynamic inclination towards tertiary education. This applies especially to women, who, thanks to this, already achieve higher education than men in younger cohorts with completed educational paths. However, this transformation also results in significant spatial differences in the quality of education achieved. The question remains whether these differences are stable over time or, on the contrary, if a particular educational convergence is gradually occurring. The article aims to provide a detailed analysis of changes in the educational structure of the population in Slovakia's districts based on the results of the 1991 and 2021 population censuses. Using more complex indicators to measure the overall educational structure of district populations, we will focus not only on the spatial distribution of educational capital but also on identifying undersized areas and their possible transformation over time. At the same time, we will identify potential factors behind these differences. We will focus not only on the length of study and the share of people studying, but also on selective migration, which in some districts of Slovakia may be an important determinant of brain drain and thus deepen their backwardness.

Key words:
educational structure, average length of education, inter-cohort changes, migration by education, population census 1991, population census 2021, districts, Slovakia

1 INTRODUCTION

The educational structure of the Slovak population is among the most dynamically changing population characteristics after 1989 (Šprocha, 2009). The extension of the education period is a manifestation and, at the same time, a consequence of the overall economic, social, political, and cultural transformation. As confirmed by some partial analyses (Lubelcová, 2022; Šprocha & Tišliar, 2018), a historically unique quantitative-qualitative transformation has been taking place in Slovakia, especially since the beginning of the 21st century, the dominant feature of which has been the inclination towards the tertiary level of education in the last two decades (Šprocha & Tišliar, 2018). Slovakia has never in history achieved such high numbers and shares of men and women with university education (Krišková, 2023). Moreover, the results of the last two population censuses, 2011 and 2021, clearly confirmed that a new phenomenon has emerged: women are already achieving a higher level of education (Krišková, 2023; Šprocha & Tišliar, 2018). This is primarily a consequence of a certain "feminisation" of tertiary education, since in the youngest cohorts with completed educational paths (or at the age when we assume that these are completed), tertiary education is clearly achieved much more often by women (Šprocha & Tišliar, 2018).

These changes receive relatively much attention at the national level in Slovakia (e.g., Krišková, 2023; Lubelcová, 2022; Šprocha, 2009; Šprocha & Tišliar, 2018). In geography, information on spatial differences in the population according to the highest educational attainment has been provided only by some works (Bleha et al., 2014; Lauko et al., 2012; Mládek et al., 2006; Šprocha, 2011a, 2012). However, they do not reflect the latest knowledge; they are limited to fundamental structural analysis and lack the ambition to achieve a deeper understanding of the regional differences identified. However, we can clearly say that they point to temporal and spatial differences in the education achieved in Slovakia.

The study aims to provide a more comprehensive analysis of spatial differences in the educational attainment of the male and female populations at the district level in Slovakia. The aim is first to point out the state at the beginning of the quantitative-qualitative transformation and then to the current situation. We will focus on persons for whom we can assume the completion of their educational careers, namely, in the period after the Second World War. In this way, we aim to eliminate the influence of older men and women who completed their education under the specific conditions of the significantly undersized network of secondary and higher education institutions in Slovakia. Unlike

previous works, we do not analyse the entire group of persons aged 15 (or 16) and over, but instead focus on the quality of education attained at ages 25–64. In addition, we apply a specific inter-cohort approach to approximate the dynamics and the potential qualitative increase in educational attainment between two age cohorts of men and women.

Among the article‘s partial objectives, it is possible to include an effort to empirically examine two key factors of district-level educational structures in Slovakia. Specifically, we will try to identify possible spatial differences in the representation of studying persons and the resulting average time spent actively participating in formal education. The second is an analysis of migration between Slovakia‘s districts by educational attainment in the period 1996–2024. We will try to identify the primary target and source areas, especially of migrating persons with secondary and higher education.

Quantitative-qualitative transformation of the educational structure in Slovakia after 1989 and possible factors of its spatial differences

With the implementation of societal, cultural, economic and political changes after 1989, Slovakia gradually experienced an educational expansion. However, as some research confirms (Šprocha, 2009), there are two phases. In the first, in the 1990s, the transformation towards a secondary education system with a general certificate was completed, especially among men. As Katrňák and Fónadová (2022) add, it was not until the Bologna Declaration of 1999 that a massive tertiary expansion was triggered.

Despite this development, several analyses (Ballas et al., 2012; Hertz et al., 2008; Rodríguez-Pose & Tselios, 2011a) continue to confirm the persistence of relatively significant spatial differences in educational attainment across and within individual European countries. Similarly, the conclusions of Katrňák and Fónadová (2022), reflecting earlier studies from Western Europe (e.g., Raftery & Hout, 1993; Shavit & Blossfeld, 1993), suggest that expanding educational systems may not automatically reduce inequality in educational opportunities. This could be one of the important factors in the persistence of regional differences in educational attainment.

According to Rodríguez-Pose and Tselios (2011b), the expansion of education itself does not have a clear impact on regional differences in educational structure. For example, Ram (1990) assumes that in the initial stages, the differences deepen and only later do they decrease. On the contrary, Hannum and Buchmann (2005) assume that with the expansion of education, talented people will have greater chances of higher education regardless of their social origin. An important factor is the economic cost (Rodríguez-Pose & Tselios, 2011b). Suppose they are lower, and there is no need for significant private investment. In that case, it is assumed that even people on the lower social ladder will increase their education as education expands. However, according to Ceroni (2001), as the cost of education rises, poorer classes demand higher returns from the education they acquire. In their opinion, there is an attempt to move towards the „optimal“ educational path after considering the cost-benefit calculation. However, as Barr (2004) and Rodríguez-Pose and Tselios (2011b) point out, people from marginalised regions, with less educated parents and lower family living standards, are less informed and have fewer resources to correctly identify the „optimal“ level of education for their children.

The existence of differences in the highest educational attainment at the regional level can be explained by the interaction of various historical, economic, social and cultural factors.

Among the classic external factors of spatial differences in educational attainment, some economic factors of regions are also mentioned (for details, see, e.g., Broer et al., 2019). For example, access to paid work is perceived positively (Rodríguez-Pose, 2002; Rodríguez-Pose & Tselios, 2011b). The better the conditions on the regional labour market, the smaller the differences in education are. This is especially true regarding unemployment and long-term economic inactivity (Rodríguez-Pose & Tselios, 2011b). The region‘s high economic level is reflected in higher investments in education, greater school accessibility and quality, and higher educational attainment (Danielle, 2021). We must also not forget that these areas also bring wider employment opportunities for graduates. This is also often associated with higher family incomes, which are subsequently reflected in their children‘s efforts to achieve higher education (Chmielewski & Reardon, 2016; Reardon, 2011).

Another group is some demographic aspects. Spatial differences in educational attainment are greater for men than for women (Zahl-Thanem & Rye, 2024). However, as Rodríguez-Pose and Tselios (2011b) add, in countries that support gender equality in labour market participation and childcare, women‘s decisions about extending their educational careers are easier than in more conservative societies where women are encouraged to stay at home with their children, especially in their first years of life. At the micro level, connecting boys to local community “traditional” employment opportunities may also play a role, and women may need to invest more in education to enter the labour market (Zahl-Thanem & Rye, 2024). This is closely related to the structure, especially the size, of the family as an important factor in educational inequalities. According to Rodríguez-Pose and Tselios (2011b), it is generally true that the more children there are in a family, the worse the prospects for equal education and the more likely it is that educational inequalities will form. The nature of the family also negatively affects educational attainment. Sandefur and Wells (1999) found that children growing up in one-parent families have worse prospects for a higher-quality education than children from two-parent families. Religion is also often included among the important factors of spatial differences in educational attainment (Iannaccone, 1998; Keister, 2003). Areas with the same religion have closer social ties; religion influences demographic behaviour and attitudes towards work; influences family traditions and culture; contributes to the identification of valued life paths and behaviour; and strengthens social contacts that provide various types of information and opportunities (Rodríguez-Pose & Tselios, 2011b).

One dimension that often influences regional differences in educational attainment is the distinction between urban and rural areas. Several studies (e.g., Byun et al., 2012; Newbold & Brown, 2015; van Maarseveen, 2021; Zahl-Thanem & Rye, 2024) consistently show that people living in urban areas have higher educational attainment. This may be related to the “local labour market effect”. The return on higher education may be perceived as higher in urban areas, which could subsequently affect the educational paths of young people in urban and rural areas (van Maarsveen, 2021; Zahl-Thanem & Rye, 2024). In addition, colleges and universities are primarily located in urban areas.

The geographic accessibility of educational infrastructure may be another determinant of a region's educational structure and, thus, of spatial differences in the quality of human capital (e.g., Griffith & Rothstein, 2009; Spiess & Wrohlich, 2010; Sá et al., 2004, 2006). The proximity of a specific type of school may even influence not only the level, but also the type and field of study (Helland & Heggen, 2018).

Physical distance is often identified as a significant factor in lower educational attainment among people from rural areas, particularly those from spatially and transport-marginalised regions (Frenette, 2006; Kjellstrøm & Regnér, 1999; Wang et al., 2021). This is especially true for people from lower social classes (Frenette, 2006), whose children are more often encouraged to pursue their educational paths in institutions close to their home (Zarifa et al., 2018). Fray et al. (2020) add that, in addition to physical distance, it is necessary to consider the costs of transportation itself, emotional separation, loss of a supportive environment, and limited knowledge of educational paths. Although new technologies and improvements in public transport may have reduced the distance barrier in recent decades (Urry, 2007), as some partial results suggest (Helland & Heggen, 2018; Zahl-Thanem & Rye, 2024), the situation is not improving significantly in several European and non-European countries.

Migration selectivity is also closely linked to several of the above aspects (Bernard & Bell, 2018; Gonzál-Leonardo et al., 2022; Tamarru & Leetmaa, 2007). Young people's attendance in education can contribute to the consolidation of regional differences in the structure of the population's educational attainment. Centres that attract university students and, at the same time, retain them through job opportunities gain a competitive advantage, while peripheral regions suffer from brain drain. This was identified mainly in the case of the functional urban region of the capital city of Bratislava and its hinterland (Novotný & Pregi, 2017, 2019), as well as in some other regions of Slovakia (Novotný & Pregi, 2016), or in the example of an older study for all districts of Slovakia (Šprocha, 2011b, 2011c), as well as a more recent study analysing migration by educational attainment at the level of functional urban regions in Slovakia (Pregi & Novotný, 2019). The results confirmed that the impact of migration is selective across different spatial levels of educational attainment. Compared to general migration, selective migration shows stronger spatial polarisation in Slovakia (Pregi & Novotný, 2019). A higher intensity of migration among persons with higher education was identified (Šprocha, 2011b, 2011c).

Finally, it is necessary to mention the political and institutional factors. Support for education through scholarships, affordable accommodation, or regional investments can address regional disparities. European research shows that active policies aimed at equal access to education reduce regional inequalities, whereas centralised systems with insufficient sensitivity to local specificities tend to deepen them (European Commission, 2018).

At the individual (micro-) level, existing educational inequalities are perceived as a result of different educational attainment by individuals or are a consequence of the fact that these individuals may have different chances to obtain a specific education in the context of their family origin, gender, ethnicity, or place of residence (Goldthorpe, 2010; Katrňák & Fónadová, 2022). These social, cultural, and economic characteristics related to their family origin can form social barriers and contribute to the emergence of educational inequalities (Katrňák, 2004; Goldthorpe, 2010). According to Katrňák and Fónadová (2022: 13), unequal educational opportunities refer to the social and economic features of the family environment in which children grow up, which either restrict or, conversely, give them an advantage in the educational system (also Katrňák, 2004). As research from Slovakia also shows (e.g., Madarasová Gecková et al., 2010; Sopóci & Hrabovská, 2022), efforts to obtain higher education are mainly found among children from higher-status families. Research by Džambazovič and Gerbery (2022) confirmed that, in the Slovak context, parental expectations, in combination with the family's economic, cultural, and social resources, shape the family's educational climate and are an important factor in the differentiation of students' educational aspirations.

2 METHODOLOGY AND DATA SOURCES

The analysis of the educational structure of districts in Slovakia was based on the results of the 1991 and 2021 population censuses. The 1991 data represent the state at the beginning of quantitative and qualitative changes in the education process in Slovakia. The 2021 results allow us to analyse the situation after approximately three decades of quantitative and qualitative changes. Given the relatively significant gender differences (e.g. Bleha et al., 2014; Šprocha & Tišliar, 2018), in our article, we will analyse the educational structure of men and women separately.

From the perspective of age definition, when analysing the educational structure, we will focus on people aged 25–64. We will not include younger age groups in the analysis, both because the highest educational attainment indicator is only found in population censuses for persons aged 16 and over, and also because the extension of the period of education means that we cannot speak with certainty about the completion of educational careers until the age of around 23–24. For older persons aged 65 and over, we have excluded them from the analysis for the following two reasons. The first is that we are trying to analyse the educational structure and its spatial differences in relation to the population whose educational careers were completed after World War II. The second aspect is the fact that we try to eliminate the possible influence of the oldest individuals, who both had specific educational paths largely influenced by limited opportunities for obtaining higher forms of education, and also underwent potential selection due to different mortality risks that can be identified between educational groups (Mészáros, 2015).

Since there were differences in the details of educational level classification between the 1991 and 2021 population censuses, we had to proceed to the formation of "classical" educational levels. In the study, we use the following basic levels of education: primary education and with no school education, secondary education without a general certificate, secondary education with a general certificate, higher (technical) education, and tertiary education (Tab. 1, 2).

At this point, we must also mention the group of persons who did not report their highest level of education in the 1991 and 2021 Population Censuses.[1] Although there are various techniques for using such a specific group in the analysis (e.g., dividing it according to the identified structure), given the relatively small number, we decided to exclude this group from further calculations.

Tab. 1. The concept of aggregation of educational categories surveyed in the 1991 Population Census is applied in the article

Education classification, the 1991 Population Census	**Applied educational classification**
With no school education (aged 15+) Primary education	Primary and with no school education
Secondary vocational education with no graduation Secondary technical education with no graduation	Secondary without a general certificate
Secondary vocational education with graduation Secondary technical education with graduation Secondary education with graduation - general	Secondary with a general certificate
Higher technical education	Higher (technical) education
Higher education	Tertiary education

Tab. 2. The concept of aggregation of educational categories surveyed in the 2021 Population Census is applied in the article

Education classification, the 2021 Population Census	**Applied educational classification**
With no school education (aged 15+) Elementary - 1st level of primary school Elementary - 2nd level of primary school Primary education (not specified)	Primary and with no school education
Secondary technical (vocational) education with no graduation - with a final examination certificate Secondary technical (vocational) education with no graduation - with no certificate of apprenticeship (on-the-job training, pre-employment training) Secondary technical (vocational) education with no graduation (not specified) Secondary technical (vocational) education with no graduation - with a certificate of apprenticeship	Secondary without general certificate
Complete secondary education with graduation - general Complete secondary education with graduation - technical Complete secondary education with graduation - technical (vocational) with a certificate of apprenticeship Complete secondary education with graduation (not specified)	Secondary with general certificate
Higher technical education - higher technical (school-leaving examination, graduation diploma) Higher technical education - post-secondary (post-graduation qualifying) Higher technical education - post-secondary (school-leaving examination in the fields of study for secondary technical school graduates) Higher technical education (not specified)	Higher technical education
Higher education - 1st level (Bc.) Higher education - 2nd level (Ing.; Mgr.; MUDr.; etc.) Higher education - 3rd level (PhD.; etc.) Higher education (not specified)	Tertiary education

This approach also largely solved the problem of working with potentially small numbers of people when breaking down the district-level educational structure in more detail. In addition to the share of the leading educational groups, especially men and women aged 25–64, across individual districts of Slovakia, we will also aim to capture the "quality" of education achieved by applying a summary indicator. For this purpose, we construct an indicator of the average length of education (ALE). This expresses the difficulty of the education achieved by the average time required to attain it. In accordance with Mazouch and Fischer (2011), we will use the standard number of years needed to complete a given level of education as time. The basis is then to assign the appropriate number of years of its standard length (d) to each level of education. For our purposes, we worked with the following time frames:

1. Persons without education l = 0 years[2],
2. Persons with primary education l = 9 years,[3]
3. Persons with secondary education without a general certificate l = 12 years,
4. Persons with secondary education without a general certificate l = 13 years,
5. Persons with higher (technical education l = 14.5 years,
6. Persons with tertiary education l = 18 years.[4]

The calculation of the average length of education for men and women separately in individual districts of Slovakia was, in accordance with the above, carried out using the following relationship:

$$ALE^{sex,\ district} = \sum_{e=1}^{6} s_e^{sex,\ district} \cdot l_e \qquad (1)$$

$s_e^{sex.district}$ the proportion of men or women who have achieved a certain level of education in the district (e = 1 – 6),
l_e the standard number of years required to achieve a certain level of education (e = 1 – 6).

As Mazouch and Fischer (2011) state, ALE is an indicator that allows measuring the level of human capital in quantitative terms, while its construction is neither demanding in terms of input data nor complex in calculations. A particular limitation may be the setting of coefficients for the standard length of education. In essence, we must also realise that this is a simplification of reality, since in individual cases the standard length of education for a given level may not reflect the actual time required to achieve it. Situations involving an administrative change of such length (e.g., extending or shortening compulsory

school attendance) can be equally problematic. However, we believe that such "disturbing" influences cannot significantly affect the obtained results.

The inter-cohort approach provides a specific view of the transformation of the educational structure in Slovakia's districts. The intention is to analyse how the educational structure and the derived average length of education changed across specific age cohorts and how dynamically this process occurred. The younger cohort included people aged 25–34 years, and the older cohort included people aged 50–59 years. For both groups of cohorts, the ALE indicator was constructed for each district (see above), the difference in its values between the younger and older cohorts was calculated, and inter-cohort differences in the representation of individual main educational groups were also analysed. This allowed us to roughly explain some of the reasons for the existing spatial differences in inter-cohort ALE values.

An important determinant of the resulting educational structure is the length of education and the associated early completion of educational paths (compared to the average) or, conversely, the inclination towards higher forms of education that require longer studies in the formal educational process. We tried to express the length of education itself, its spatial differences and possible changes over time through two indicators. The first represented the share of men or women who, in individual districts of Slovakia, reported in the 1991 and 2021 censuses that their current economic activity was as a secondary school or university student aged 20–24. To provide a more comprehensive view of the length of the educational process, we constructed the education expectancy (EE). For our purposes, it presents how many years of life a man or woman in individual districts of Slovakia would spend studying or actively participating in formal education. The basic data source for the construction of EE was the results of the 1991 and 2021 Population Censuses. Specifically, it concerns the shares of men and women who declared that they were studying or that their economic activity at the time of the census was as pupils, students, secondary school students, or university students.

Unlike the analysis of the educational structure, we process these data with respect to the „natural" timing of educational paths in Slovakia for 1-year age groups of persons aged 16–29. The education expectancy indicator was constructed using the following formula:

$$EE^{sex,\ district} = \sum_{x=16}^{29} \frac{E_e^{sex,\ district}}{P_e^{sex,\ district}} \qquad (2)$$

$E_x^{sex.district}$ number of men or women in the district aged (x) who are studying or are pupils of primary school,

$P_x^{sex.district}$ number of men or women in the district aged (x)[5];

The analysis of migration by highest educational attainment between districts of Slovakia was carried out using anonymised data of the SOSR (1996 – 2024)[6] from the annual collection of data on population migration within the framework of the Report on Migration (Obyv 5–12). This captures all changes in permanent residence. We focused on persons with secondary education with general certificate and tertiary education. The available data allowed us to evaluate the crude migration balance rate separately for men and women in each district of Slovakia for the period 1996–2024. In line with the age definition approach presented above, we focused only on persons aged 25–64.

3 RESULTS

Educational structure and average length of education

Since the beginning of the 1990s, the educational structure of people aged 25–64 in Slovakia has undergone dynamic quantitative and qualitative changes. This is also confirmed by empirical data obtained from the 1991 and 2021 population censuses (Fig. 1). Since the beginning of the 21st century, we have registered a historically unprecedented inclination towards tertiary education. While in 1991, less than 13% of men and 9% of women aged 25–64 in Slovakia had a university education, in 2021 their share increased to almost 24% for men and 33% for women (Fig. 1). This also means that, for the first time in history, the female part of the Slovak population has a higher level of education. As a result of these structural changes, the average length of education achieved by men and women aged 25–64 has also increased. In the male population, this is an increase from 12.3 to 13.5 years, and in the female population, from 11.6 to more than 14 years.

From a spatial perspective[7], the quantitative and qualitative transformation of the educational structure has increased the share of people with higher levels of education across all districts. This development has been significantly uneven. As a result, there has also been a particular deepening of differences in the quality of the educational structure, especially among women. This is also confirmed by the average length of education achieved. While at the beginning of the 1990s, the minimum value in the districts of Slovakia for men was 11.1 years and the maximum reached 15 years, currently it is 12 and almost 16.4 years. For women, it was almost 10.7 years and 14.1 years, while in the 2021 census, it was 12.4 and 16.8 years.

In terms of district differences, it was already possible to identify some areas that were significantly lagging in the quality of education achieved at the beginning of the 1990s. These districts were also characterised by the lowest values of the average length of education (Fig. 2, 3). For men, these were mainly some districts in the north and the south of central Slovakia (Fig. 2, 3). They were also joined by other units in the east, as well as border districts in the south-west of Slovakia (Fig. 2, 3). For women, spatial differences in the average length of education were not that significant in the early 1990s. Most districts belonged to the first interval (up to 12 years, Fig. 3).

It is not surprising that the highest values of the average length of education are identified in those districts where the share of men and women with higher education, and also complete secondary education, was the highest (Fig. 4 ,5). Overall, smaller spatial differences, as well as lower average length of education for women, were generally related to a relatively dynamically growing share of persons with primary education aged 45 and over (see Fig. 3).

We can assume that these differences were primarily caused by the economic focus of individual districts, the concentration of educational institutions, the service sector, and science and research in the areas of the largest cities and the country's economic centres. Equally important factors were probably the migration tendencies of the more educated

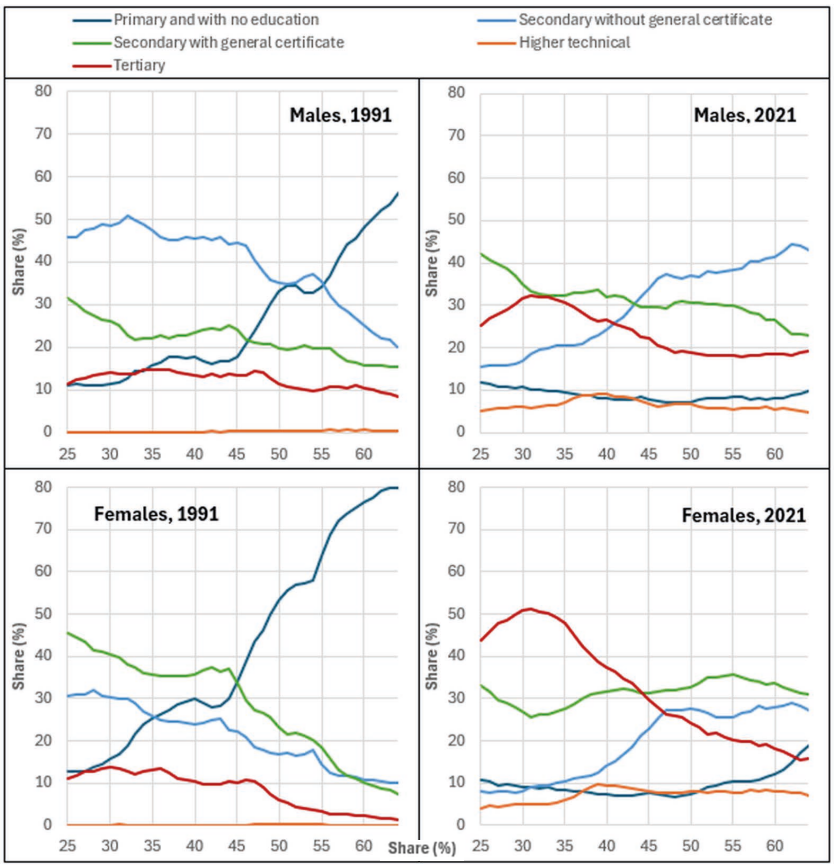


Fig. 1. Share of men and women aged 25–64 by graduated level of education in Slovakia, the 1991 and 2021 Population Censuses
Source: author's calculations

population from rural areas to cities and economic centres. The specific educational and regional policies of the previous political regime also likely contributed to regional differences.

In all districts of Slovakia, the share of people with complete secondary and, especially, higher education has increased significantly over the past three decades. This was also reflected in the average length of education. However, some spatial differences have remained, and even more they have deepened due to the different dynamics of the quantitative and qualitative transformation of the educational structure. The clearly worst situation in 2021 remained in the districts of south-central Slovakia and in several districts of eastern Slovakia (Fig. 4, 5).

According to data from 2021, the best educational profile was again shown by the urban districts of Bratislava and Košice, districts with significant secondary and higher education centres (Fig. 4). For women, it was a wider, relatively continuous area consisting of several districts in north-western and most of central Slovakia (Fig. 5). In the west, this group also included the districts of Trnava and Nitra as important centers of secondary and higher education, as well as the districts in the hinterland of Bratislava. In eastern Slovakia, apart from Košice, the highest average length of education for women was in the Prešov district - another important educational and economic center of the country (Fig. 5).

Although the expansion of education since the early 1990s has, at first glance, brought about a qualitative increase in the educational level of the populations of individual districts in Slovakia, our analysis also points to a particular deepening of regional differences. It is not surprising that the most favourable situation is primarily in the largest cities, in the economic centres of the country, which not only have institutional prerequisites, but also their local economies generate opportunities for more educated people, and therefore investments in education return faster here, but are also often migration destinations for more educated people from other regions (see below).

Inter-cohort differences in average length of education

A specific view of spatial differences in educational attainment is provided by the analysis of inter-cohort shifts in the average length of education between them. At the beginning of the 1990s, the smallest values for both sexes can be identified in districts that were characterised by generally better educational parameters of their population (e.g. Bratislava, Košice, Banská Bystrica, Žilina, Trenčín, etc.). On the contrary, in several districts with an overall worse educational structure of men and women we can identify relatively significant inter-cohort differences in this period. The key factor in the identified spatial inter-cohort differences in the early 1990s was the timing and extent of the replacement of the model of educational paths ending with primary education by a model of completed secondary education without a certificate for men and secondary education without a certificate or with a certificate for women.

Since the 1990s, however, the shift from secondary with certificate (partly for men) to tertiary education (both sexes) has come to dominate the transformation of educational paths. Therefore, in 2021, the largest inter-cohort differences were found in districts in which were relatively dynamic growth of the share of people with tertiary education. These were, for example, some units in the southwest, north of central Slovakia, or some districts in the northeast (Fig. 6,

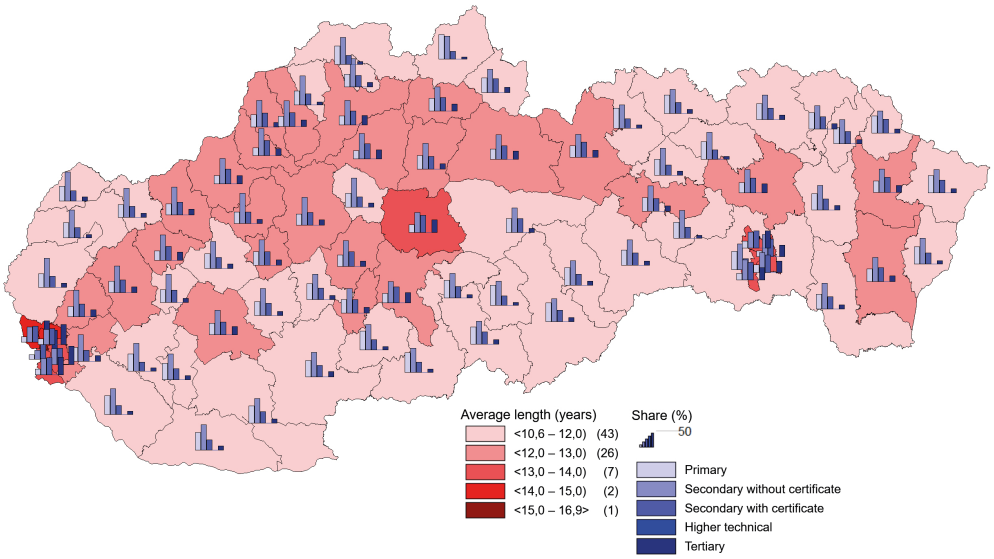


Fig. 2. Average length of education and structure of men by highest education attained aged 25–64 in districts of Slovakia, 1991
Source: author's calculations

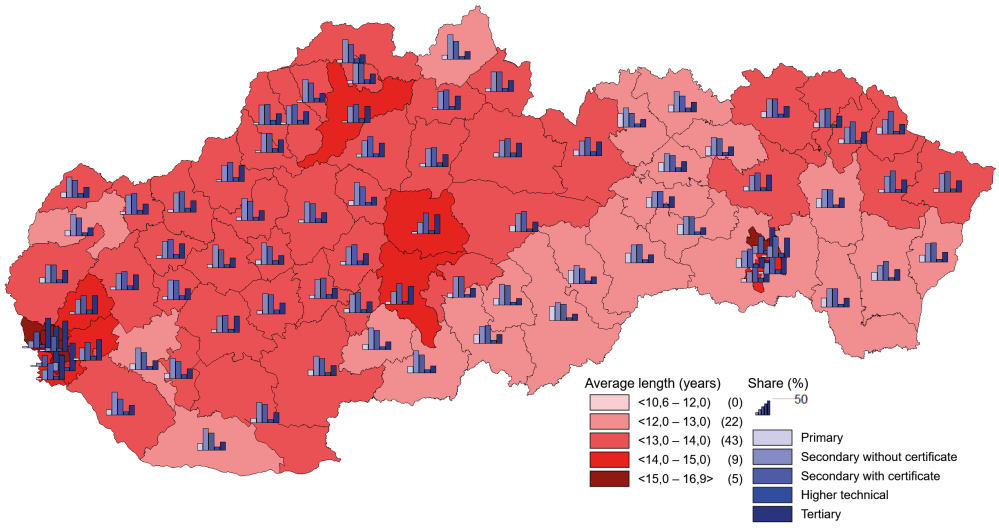


Fig. 3. Average length of education and structure of men by highest education attained aged 25–64 in districts of Slovakia, 2021
Source: author's calculations

7). The situation was completely opposite in some districts in the south of central and eastern Slovakia. In this area, we can also identify a certain increase in the share of persons with secondary with certificate and tertiary, but a non-negligible determinant of the relatively small inter-cohort dynamics was the increase in the representation of persons with primary education in younger cohort.

However, some urban districts of Bratislava and Košice also record relatively low dynamics of inter-cohort changes. In their case the older cohorts already achieved a relatively significant share of persons with university education and therefore the opportunities for further inter-cohort improvement here were not as significant as in other districts.

The results also clearly show that larger inter-cohort differences were created among women (Fig. 7). This also confirms the significant inter-cohort dynamics with which the educational structure of women in Slovakia has transformed. On the other hand, the obtained results point out that this phenomenon was not symptomatic for all districts.

Share of students and education expectancy

The share of male students in Slovakia aged 20–24 years in 1991 was only less than 11%. For women, it was even less than 10%. Three decades later, the share of male students in the same age group had already reached almost 24%, and for women it was even almost 34%.

The highest shares of male and female students can be identified in the urban districts of Bratislava and partly also in the districts of Košice I, II and Banská Bystrica. A completely opposite situation arose in some districts in the south and north of central Slovakia and also in the east, where the share of students was up to 7%. It is also interesting that a relatively negative situation was also in some districts in the west and southwest of Slovakia (Fig. 8).

In the following three decades, there was a relatively dynamic increase in the share of persons participating in formal education. However, the gender dimension was confirmed and the obtained results also indicated the existence of significant spatial differences. The worst situation in terms of active participation in formal education of men and women aged 20–24 remains in the area of southern, central

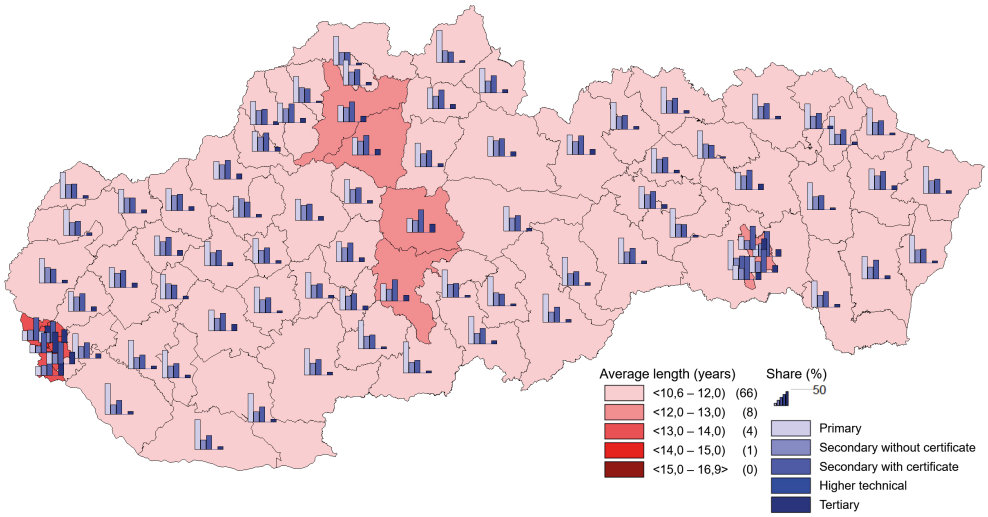


Fig. 4. Average length of education and structure of women by highest education attained aged 25–64 in districts of Slovakia, 1991
Source: author's calculations

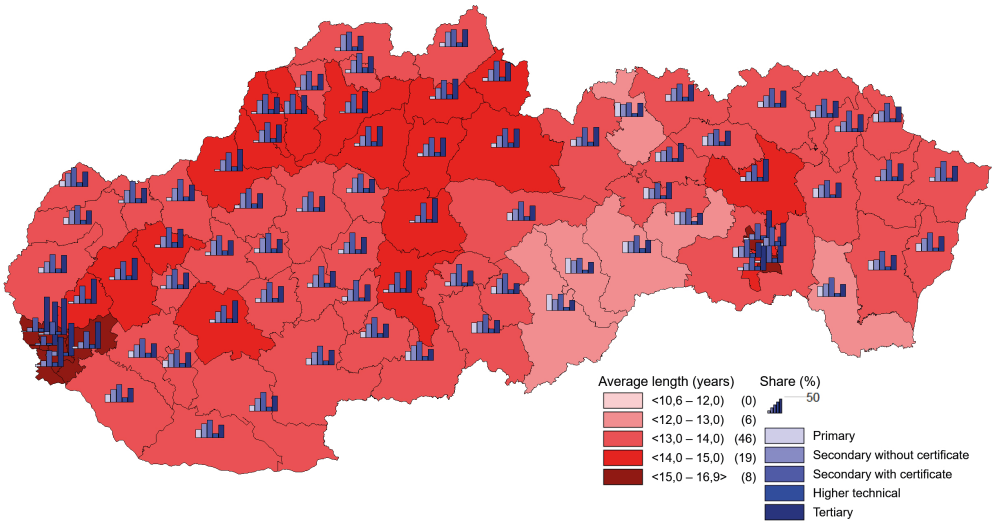


Fig. 5. Average length of education and structure of women by highest education attained aged 25–64 in districts of Slovakia, 2021
Source: author's calculations

and eastern Slovakia. However, some districts in the west and southwest of Slovakia are also problematic for both sexes.

The highest shares of male students in 2021 are registered mainly in the urban districts of Bratislava and Košice, but also in some units with large economic centers, or in districts located in their hinterland. The situation is more specific for women. Relatively higher shares of female students are also found in other units in the north and northeast districts of Slovakia. The explanation may lie not only in the easier accessibility of higher education for young people living in these districts, in the overall increase in the status and necessity of tertiary education for young people, but also potentially in the form of a kind of institutional protection against the unfavourable situation of young people when entering the local labour market early, which in several of these units is characterized by generally more unfavourable economic conditions.

The values of the education expectancy at the age of 16 depend directly on the share of studying persons. For both sexes, there was a relatively significant increase between the 1991 and 2021 censuses. While in the early 1990s it was at the level of 2.6 years for men and almost 2.7 years for women, according to data from 2021, the average number of years that a person aged 16 spends studying in Slovakia has increased to 4.6 years for men and almost 5.2 years for women.

The dynamic increase in the number of years spent in formal education has also brought greater regional differences. On the one hand, these are mainly the urban districts of Bratislava, Košice, some districts with large economic centres, or with connections to them, where the education expectancy reached the highest values (Fig. 9). On the other hand, we find a relatively compact area of the south of central and eastern Slovakia, as well as several districts in the north of eastern Slovakia, in which this indicator reached below-average to very low values for both sexes (Fig. 9).

Spatial differences in migration by education

In addition to the differentiation in the nature of educational paths and the associated different levels of education achieved, an important determinant of

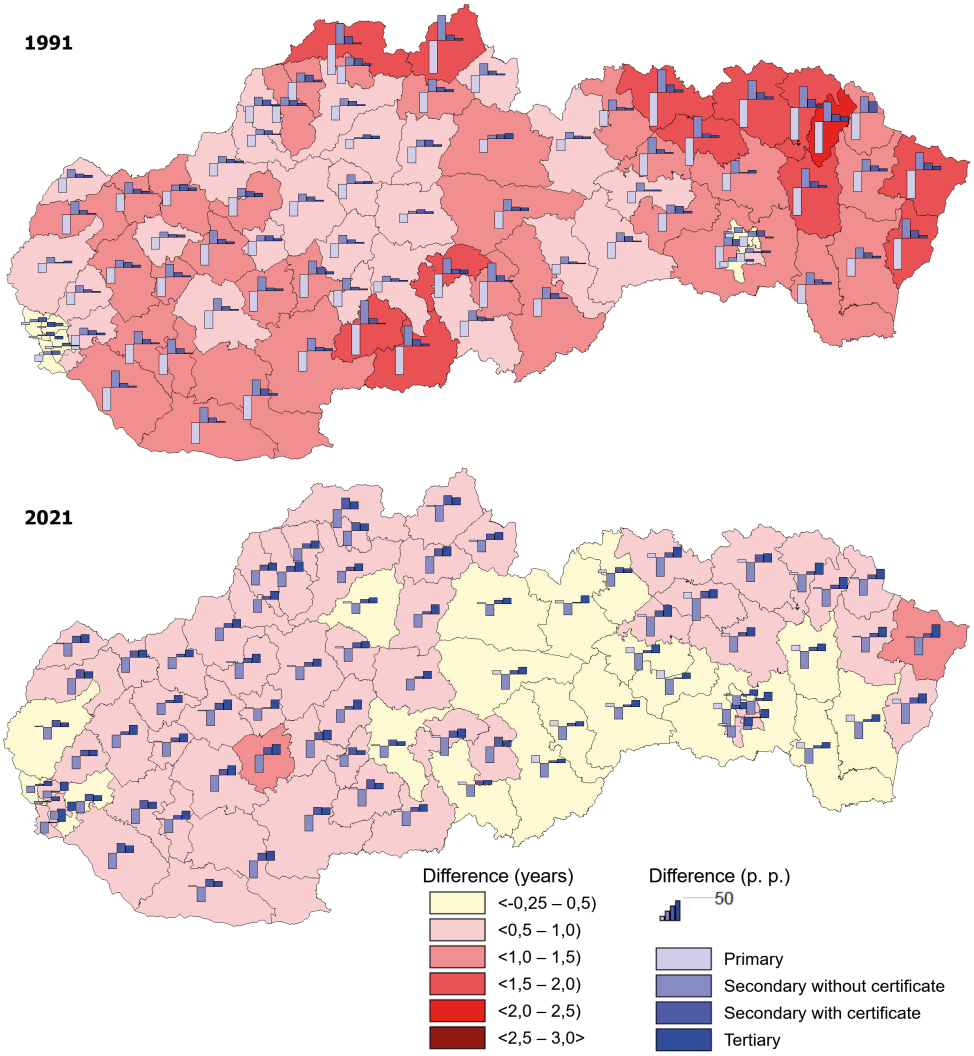


Fig. 6. Inter-cohort differences in the average length of education of men in the districts of Slovakia in 1991 and 2021
Source: author's calculations

existing and over time persistent spatial differences in the educational structure may also be the selectively acting migration process. It can be assumed that, especially in districts with worse socio-economic characteristics, emigration may be an important life strategy for people with higher education. This brain drain would subsequently contribute to the worsening of the situation of loss regions in terms of the educational structure of their population.

The data obtained for the period 1996–2024 confirm that the most people with secondary education with general certificate and tertiary education aged 25–64 were clearly acquired by the urban districts of Bratislava (with the exception of Bratislava V), then by the districts in the hinterland of the capital and the Košice-okolie district. The situation was completely opposite in several districts of eastern and partly also central Slovakia (Fig. 10, 11). Among women with tertiary education, migration losses are even greater.

4 DISCUSSION

The expansion of higher education, which we can identify (not only) in the European area, has different development trajectories, and its origins can be identified in different periods (OECD, 2017). Slovakia, together with some other countries of the Eastern Bloc (Czech Republic, Estonia, Latvia), was among the first to reach 80% of persons aged 25–64 with at least upper-secondary education[8]. Even now, according to the Eurostat database (2025), Slovakia (together with the Czech Republic, Poland, Lithuania, Latvia, and Estonia) is among the leaders among EU27 member states in this statistical indicator[9]. On the other hand, several of these post-communist countries had a relatively stable and low share of tertiary-educated individuals (OECD, 2017). Only the second half of the 1990s and the beginning of the 21st century brought a dynamic transformation of this situation. As Bukodi (2010) notes in this regard, Poland, Estonia, and Hungary initiated these changes earlier and with greater dynamism. The Czech Republic, Slovakia, and Slovenia joined later and with less dynamism (Bukodi, 2010).

The results of our analysis confirmed, in line with earlier studies (e.g., Bleha et al., 2014; Mládek et al., 2006), the long-term persistence of differences in educational attainment across Slovak districts. Similarly, we do not find any significant differences in terms of spatial patterns themselves. In terms of educational structure, average length of education, and active participation in education, significantly better characteristics were observed in districts of the largest cities and in districts with large economic (and university) centres. An opposite situation was identified, in line with works (Bleha et al., 2014; Mládek et al., 2006), especially in the south of central and eastern Slovakia. The persistence of

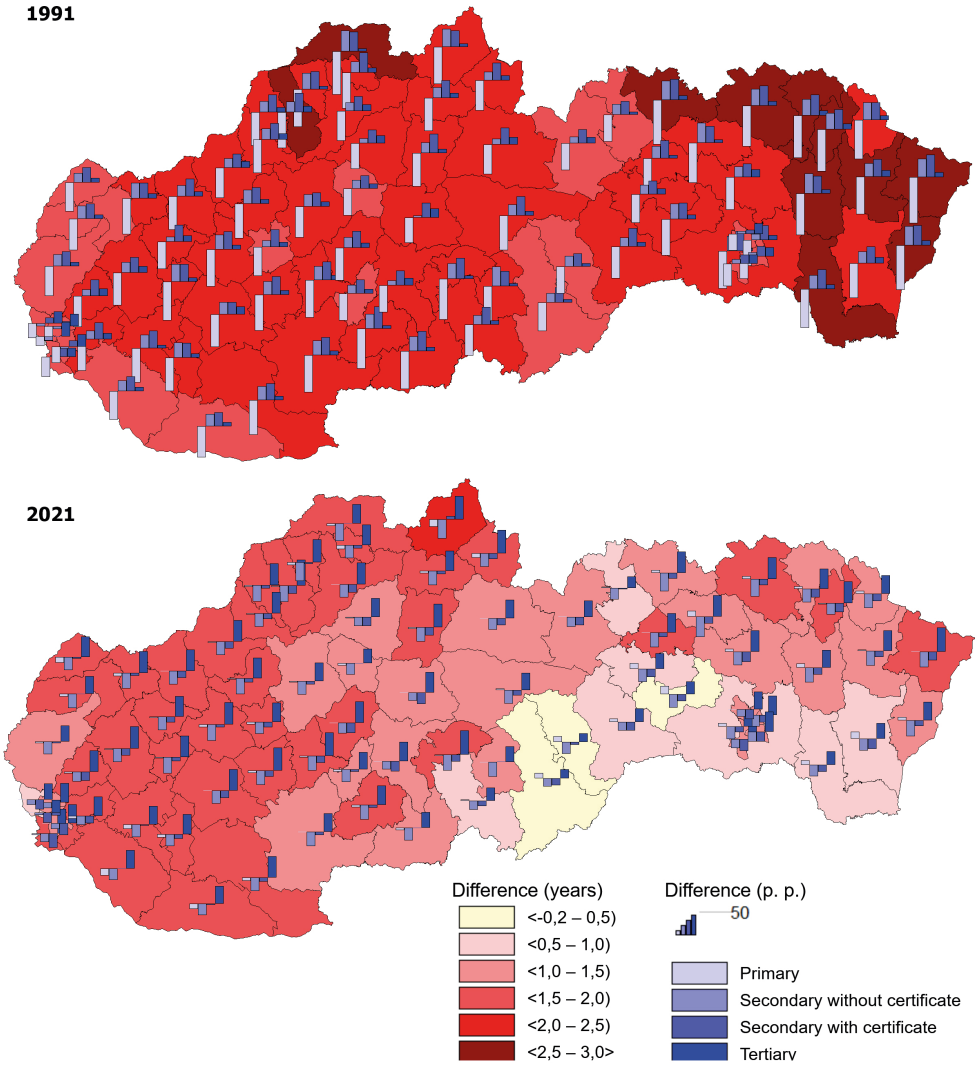


Fig. 7. Inter-cohort differences in the average length of education of women in the districts of Slovakia in 1991 and 2021
Source: author's calculations

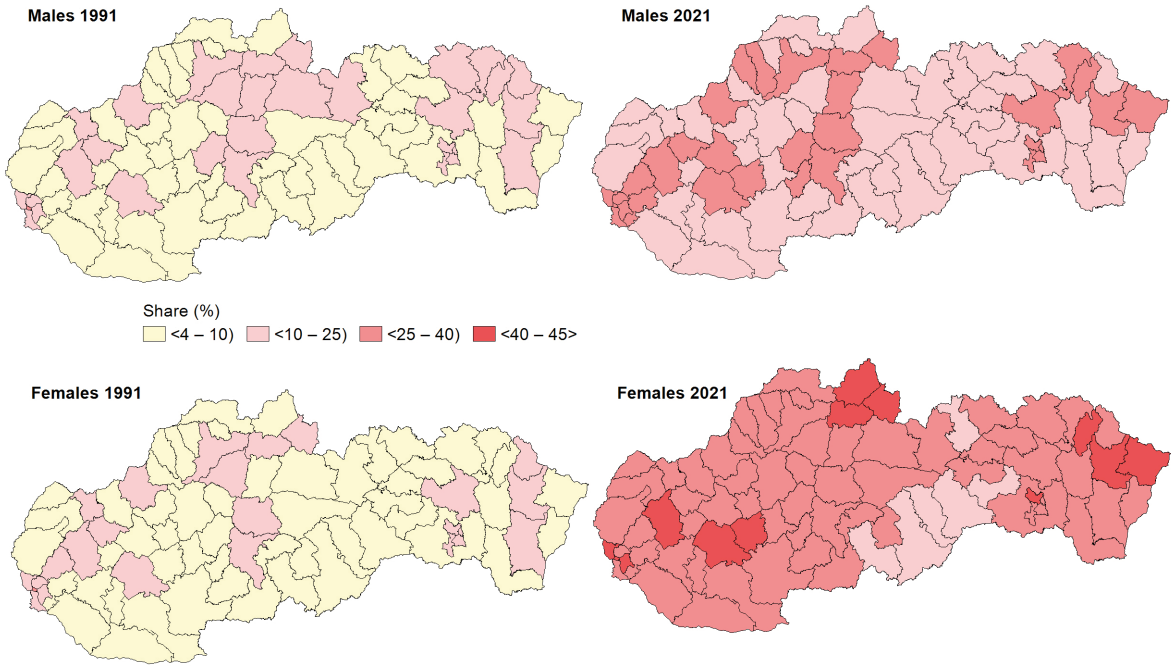


Fig. 8. Share of studying men and women aged 20–24 in districts of Slovakia in 1991 and 2021
Source: author's calculations

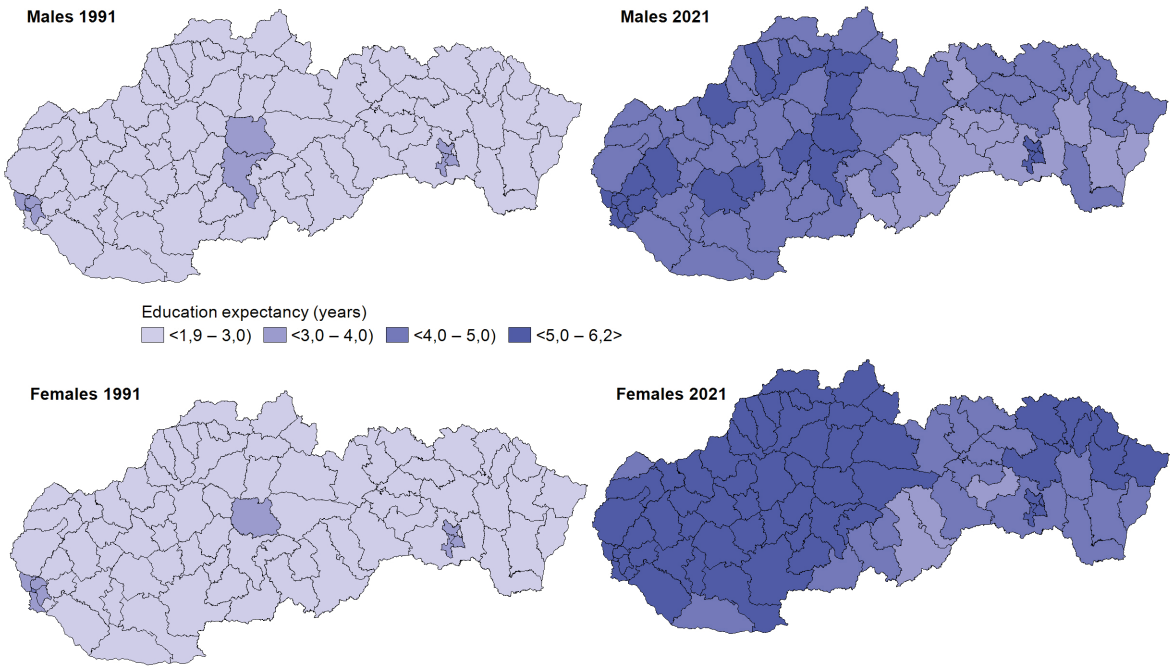


Fig. 9. Education expectancy for men and women in districts of Slovakia in 1991 and 2021
Source: author's calculations

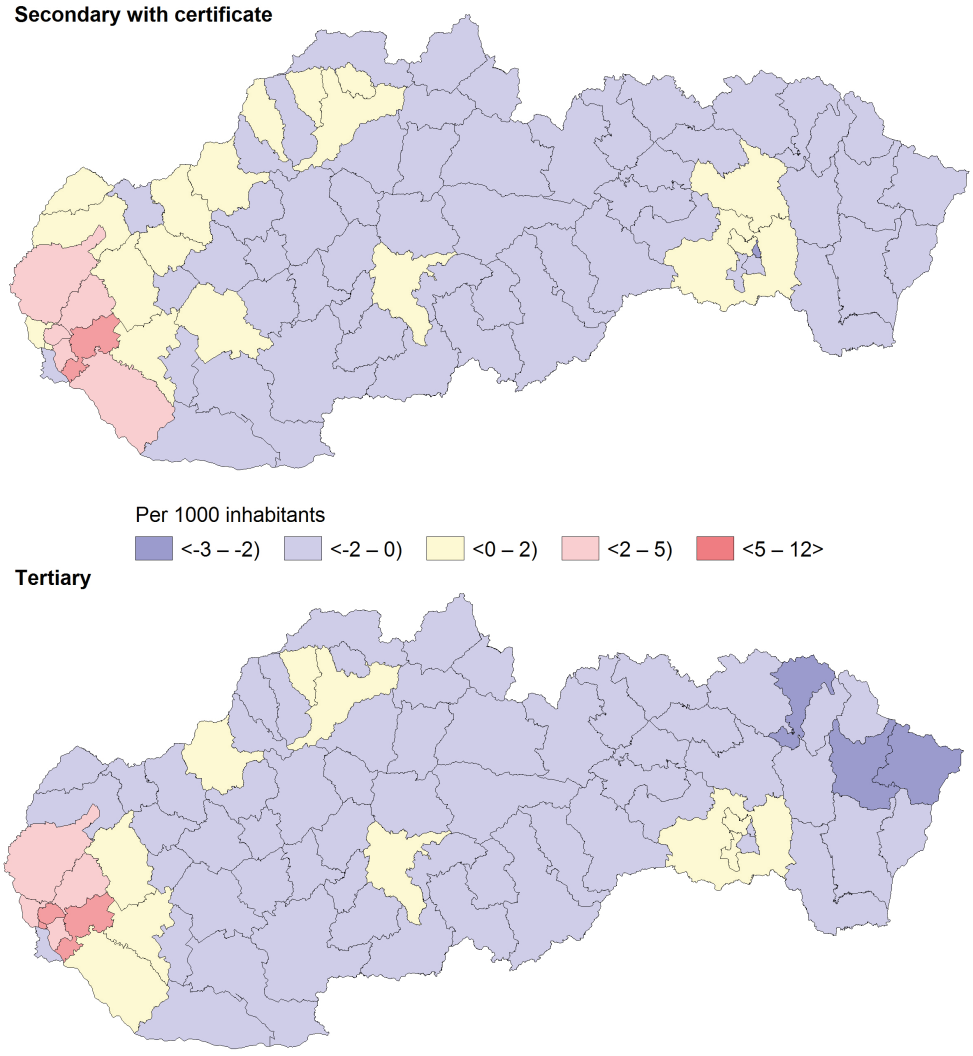


Fig. 10. Crude migration balance rate of men with secondary education with general certificate and tertiary education in districts of Slovakia, 1996–2024
Source: author's calculations

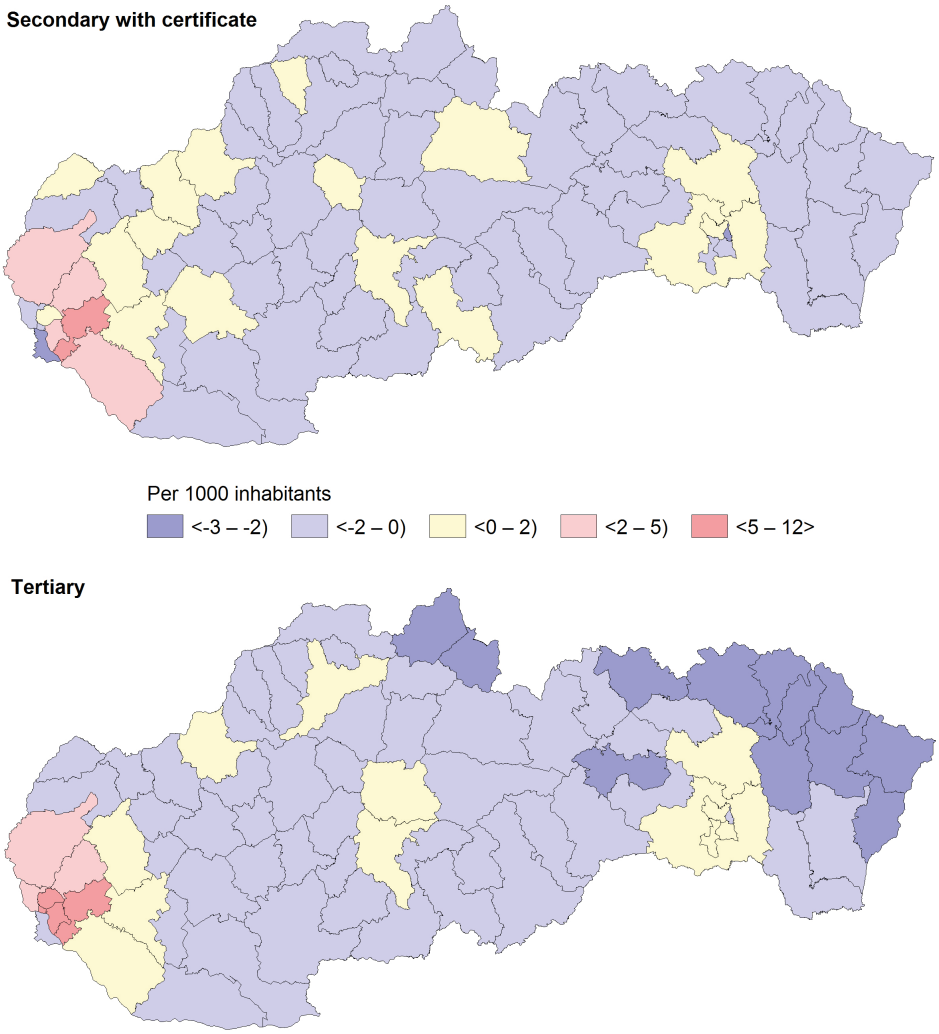


Fig. 11. Crude migration balance rate of women with secondary education with general certificate and tertiary education in districts of Slovakia, 1996–2024
Source: author's calculations

spatial differences in the educational structure in Slovakia is in line with findings in other European and non-European countries (e.g. Ballas et al., 2012; Byun et al., 2012; Zahl-Thanem & Rye, 2024). The delay in the quantitative and qualitative transformation of education with a bias towards the tertiary level, together with the effects of the specific conditions of the previous regime with a preference for secondary education, created a relatively uniform model of educational paths in the early 1990s (Šprocha, 2009; Šprocha & Tišliar, 2018). This was also reflected to a large extent at the regional level. In fact, only the areas of the largest cities and some larger economic (and university) centres were characterised by higher education, a higher average length of education, higher educational expectancy, and more frequent participation in education at the age of 20–24 in 1991. Spatial differences (especially among men) were minor (compared to the situation from the 2021 census). The emerging educational expansion in the 1990s, especially its second phase since the beginning of the 21st century, has brought an apparent deepening of regional differences. This applies especially to women, for whom the dynamics of qualitative improvement of the educational structure were much more pronounced. At the district level in Slovakia, some findings from abroad were confirmed (Ballas et al., 2012; Hertz et al., 2008; Rodríguez-Pose & Tselios, 2011b; Katrňák & Fonádová, 2022), which indicated a connection between stagnation or even growth in educational inequalities and educational expansion with a bias towards tertiary education.

The reasons for the existing relatively significant regional differences, as well as the lagging behind on the one hand and the advancement on the other hand in the districts of Slovakia, are most likely a combination of a more complex set of factors. If we focus on districts with a significantly worse educational profile (lower average length of education, lower education expectancy, and a below-average share of students) then one explanatory factor will be their overall worse socio-economic position, according to the analyses (Rodríguez-Pose & Tselios, 2011b). In many cases, these are districts with above-average unemployment, higher economic inactivity, and lower incomes, which represent important determinants of the formation of educational inequalities. Moreover, according to van Maarsveen (2021) and Zahl-Thanem and Rye (2024), in areas with worse socio-economic characteristics, higher education and the associated higher costs of obtaining it may not yield sufficient „added value" compared to the gains from the „problematic" labour market. We can thus agree with the conclusions of Zahl-Thanem and Rye (2024) that a more significant aspect, especially for people from lower social backgrounds, may be the connection between „traditional, already tried" educational paths

and „traditional“ job opportunities. On the contrary, in the largest cities of Slovakia, as well as in other districts with economic centres, the effect of the added value of higher education is evident also from the significantly better socio-economic characteristics of these regions, as well as from the job opportunities for people with higher education. In the context of studies (Frenette, 2006; Sá et al., 2004, 2006; Wang et al., 2021), another important factor in problematic districts of Slovakia may be the absence of a broader range of secondary and especially tertiary educational institutions, which, together with spatial and transport marginalization and thus direct and indirect costs (time, emotional separation, loss of a supportive environment; see Fray et al., 2020), may represent an important obstacle when deciding to continue educational paths. These factors are often significantly suppressed in districts with the best educational characteristics of the local population, since either a wide range of educational institutions is located directly in them, or their transport accessibility is much better. Moreover, in the case of large centres and border regions in western and north-western Slovakia, the internationalisation of tertiary education is often considered due to good transport links to the Czech Republic.

As shown by several demographic analyses (e.g. Bleha et al., 2014; Mládek et al., 2006; Šprocha et al., 2019), there have been relatively significant demographic differences in Slovakia for a long time, which, in the sense of Rodríguez-Pose and Tselios (2011b), can also significantly contribute to the formation of educational inequalities. It is important to note that many identified districts with a worse educational profile are characterised by higher fertility, a greater tendency towards families with a larger number of children, and the beginning of reproductive paths at a very young age (up to 20 years). This can significantly affect not only the volume of potential resources that a family can allocate to the education of its children (Rodríguez-Pose & Tselios, 2011b), but early pregnancy can be an important factor in the interruption or even the termination of educational paths. This, together with more frequent births outside of marriage, higher divorce rates and the presence of one-parent families (Bleha et al., 2014; Šprocha et al., 2014, 2019), may, in the sense of some foreign analyses (Rodríguez-Pose & Tselios, 2011b; Sandefur & Wells, 1999), also represent an important determinant of poorer prospects for higher-quality education for children growing up in such an environment. Several of these characteristics are cumulative among people living in marginalised Roma communities, whose educational paths end very early, and the educational structure lags significantly behind the Slovak average in terms of quality in the long term (Šprocha, 2014; Šprocha & Ďurček, 2017). Moreover, some analyses (Šprocha, 2017; Šprocha & Ďurček, 2017) indicate that the population in this environment has not been affected by the tertiary educational expansion, and, on the contrary, we identify in their case even stagnation or a slight deterioration in the educational profile of younger cohorts. The higher representation of these people in some districts of central and eastern Slovakia may represent another important factor in their lagging behind.

On the contrary, the urban environment, the districts of the largest cities and economic centres of Slovakia are characterised by a shift of maternal trajectories to an older age, non-family transitions, and therefore also the completion of education is implemented in them preferentially over family ones (Šprocha, 2018). Likewise, in terms of the stability and character of family households, these are areas where children are more often raised in complete (married) families (Šprocha et al., 2014). This only highlights the emphasis placed on tertiary education in this environment. Moreover, the results of our analysis, in line with other works (Pregi & Novotný, 2019; Novotný & Pregi, 2017, 2019; Šprocha, 2011b, 2011c), confirmed that especially the areas of the capital and its hinterland clearly benefit from migration selectivity, when they have become important migration targets for more educated people. On the other hand, many of the districts with the worst educational characteristics belong to the source areas from which more educated people leave (compare also Novotný & Pregi, 2017, 2019; Šprocha 2011b, 2011c).

5 CONCLUSION

The analysis of Slovakia’s educational structure between 1991 and 2021 demonstrates a profound quantitative and qualitative transformation that has fundamentally reshaped the country’s human capital profile. The most striking finding is the unprecedented expansion of tertiary education, particularly among women, who for the first time in modern history have surpassed men in educational attainment. While this expansion has contributed to an overall rise in the average length of education (ALE) and education expectancy (EE), the process has not unfolded uniformly across space or population groups. On the contrary, regional disparities remain pronounced and, in some cases, have even deepened.

Urban centres such as Bratislava, Košice, and selected district capitals have consistently maintained their leading position in educational attainment, benefiting from a dense network of secondary schools, universities, and diversified labour markets. These districts show not only higher levels of tertiary attainment but also a stronger intergenerational improvement in ALE, indicating the capacity of metropolitan environments to both attract and retain highly educated individuals. Conversely, rural and peripheral districts - particularly in southern central Slovakia and parts of the east - continue to exhibit lagging educational profiles. These regions are characterized by a lower share of tertiary graduates, higher proportions of persons with only primary education, and in some cases, even stagnation or regression in inter-cohort improvements.

The results also highlight the significant role of selective migration in shaping spatial inequalities. Districts with vibrant economies and educational centres attract young, highly educated migrants, while peripheral and economically weaker districts experience persistent brain drain. Migration losses are particularly visible in eastern Slovakia and selected central regions, where the outflow of graduates further reinforces structural disadvantages. This pattern confirms that educational attainment is not only a reflection of local schooling opportunities but also an outcome of broader socio-economic dynamics that link education, labour markets, and migration trajectories.

Gendered dynamics add another important layer. Women have benefitted most from the expansion of tertiary education, displaying faster inter-cohort improvements and higher EE values. Nevertheless, in disadvantaged districts, significant subgroups of women still end their educational careers prematurely, often at the primary or vocational level. This points to

the persistence of structural barriers rooted in family background, socio-economic constraints, and local opportunity structures. While national-level statistics may suggest convergence, the district-level picture reveals the persistence of strong educational cleavages.

Taken together, the findings underline that Slovakia's educational modernization since 1989 has been both an achievement and a challenge. On the one hand, the general rise in education levels has improved the country's human capital base, aligned it more closely with European trends, and opened opportunities for upward social mobility. On the other hand, spatial inequalities in educational attainment have become entrenched, shaped by the interplay of historical legacies, socio-economic structures, institutional accessibility, and migration selectivity. Addressing these disparities requires targeted policies aimed at improving access to quality education in peripheral areas, mitigating brain drain through regional labour-market development, and reinforcing equal opportunities across social backgrounds.

Ultimately, the Slovak case demonstrates that educational expansion does not automatically translate into convergence. Without proactive strategies, regional inequalities risk perpetuating cycles of disadvantage, undermining both social cohesion and long-term economic competitiveness. Future research and policy interventions should thus focus not only on national averages but also on the differentiated trajectories of districts, recognizing that the geography of education remains a decisive factor in shaping opportunities in contemporary Slovakia.

Footnotes

[1] In the 1991 census, the number of people aged 25–64 with unreported education was less than 0.9%. In the 2021 census, it was approximately 5%.

[2] Although people without education can potentially spend several years in the education system, we do not have any information that would allow us to estimate this potential length of education. Moreover, the representation of people aged 25–64 without education in the 1991 (0,5%) and especially 2021 censuses (0.3%) was so low that it cannot significantly affect the ALE values, even if we apply the number of years (5 years) corresponding to the 1st level of primary education.

[3] In the 2021 census, it was possible to distinguish between people with 1st and 2nd levels of primary education. We ultimately used this for the purposes of our analysis, when the standard length of study for the first group was set at 5 years and for the second at 9 years.

[4] In the case of the results from the 2021 population census, we used the availability of more detailed classification and applied the standard length of education at 16 years for persons with a 1st degree of tertiary education, 18 years for persons with a 2nd degree, and 21 years for third-level of tertiary education.

[5] A certain limitation of this approach is the fact that it expresses the average length of study only for persons aged 16. It does not allow for taking into account possible differences in early completion of educational paths already in primary school, or non-participation in formal education at a younger age due to health reasons.

[6] Statistical Office of the Slovak Republic (1996–2024). Statistical Report on Migration (Obyv 5–12). Anonymised databased.

[7] The spatial distribution of districts in Slovakia with their names is presented in Fig. 15 in the Appendix.

[8] This group also included Germany, Switzerland, Canada and the USA

[9] These countries exceeded 90% according to 2021 data, while Spain, Italy and Portugal, for example, only reached around 63%. The EU27 average was 79%.

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Appendix



Fig. 12. List of Slovak districts and their names

Tab. 3. Basic statistical analysis of selected indicators of the educational structure of men in the districts of Slovakia, 1991 and 2021

Indicator		Minimum	Maximum	Range	Average	Standard deviation
		1991				
Average length of education (years)		11.1	15.0	3.9	12.2	0.73
Share of persons aged 20–64 with (%)	primary and with no education	8.4	42.8	34.4	23.7	7.18
	secondary without certificate	15.5	52.3	36.8	42.3	6.18
	secondary with certificate	13.3	31.2	17.9	22.1	3.98
	higher technical	0.0	0.6	0.6	0.2	0.10
	tertiary	4.7	50.5	45.8	11.7	8.18
Education expectancy (years)		1.9	4.7	2.7	2.6	0.44
Studying person aged 20–24 (%)		4.8	33.0	28.2	10.4	4.66
Inter-cohort differences in average length of education (years)		-0.2	2.1	2.3	1.1	0.45
		2021				
Average length of education (years)		12.1	16.4	4.2	13.4	0.79
Share of persons aged 20–64 with (%)	primary and with no education	2.3	24.0	21.7	8.9	4.99
	secondary without certificate	6.3	42.5	36.2	30.3	7.05
	secondary with certificate	18.8	39.1	20.3	31.8	3.12
	higher technical	4.7	8.2	3.5	6.5	0.80
	tertiary	11.3	68.0	56.6	22.4	10.29
Education expectancy (years)		3.4	5.8	2.4	4.7	0.59
Studying person aged 20–24 (%)		13.0	38.4	25.3	24.1	5.73
Inter-cohort differences in average length of education (years)		-0.1	1.1	1.2	0.6	0.26

Tab. 4. Basic statistical analysis of selected indicators of the educational structure of women in the districts of Slovakia, 1991 and 2021

Indicator		Minimum	Maximum	Range	Average	Standard deviation
		1991				
Average length of education (years)		12.2	16.8	4.4	13.9	0.79
Share of persons aged 20–64 with (%)	primary and with no education	1.5	27.2	25.8	9.7	5.81
	secondary without certificate	3.8	27.5	23.7	19.9	4.83
	secondary with certificate	15.9	37.4	21.6	31.8	3.52
	higher technical	4.5	9.2	4.7	7.3	0.85
	tertiary	17.8	74.4	56.5	31.2	10.19
Education expectancy (years)		3.5	6.1	2.6	5.3	0.62
Studying person aged 20–24 (%)		19.1	44.9	25.8	34.3	5.92
Inter-cohort differences in average length of education (years)		0.3	2.3	2.0	1.4	0.40
		2021				
Average length of education (years)		12.4	16.8	4.4	13.9	0.79
Share of persons aged 20–64 with (%)	primary and with no education	1.5	27.2	25.8	9.7	5.81
	secondary without certificate	3.8	27.5	23.7	19.9	4.83
	secondary with certificate	15.9	37.4	21.6	31.8	3.52
	higher technical	4.5	9.2	4.7	7.3	0.85
	tertiary	17.8	74.4	56.5	31.2	10.19
Education expectancy (years)		3.5	6.1	2.6	5.3	0.62
Studying person aged 20–24 (%)		19.1	44.9	25.8	34.3	5.92
Inter-cohort differences in average length of education (years)		0.3	2.3	2.0	1.4	0.40