PAST AND FUTURE TRENDS IN NORTH MACEDONIA'S WORKING-AGE POPULATION

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ABSTRACT

Future demographic trends need to be identified in order to understand, prepare for, and address their consequences on the future economic and overall development, particularly in the Republic of North Macedonia and its eight statistical regions. This paper analyzes past and projected changes in the working-age population, with a focus on population aging within the working-age cohorts (15–64).
Population projections for North Macedonia and its regions were developed using the cohort-component model for the years 2031, 2041, and 2051. The analysis focuses on the population aged 15–64 and compares these projections with census data from 2002 and 2021 to assess long-term changes and future trends.
The results show a decline in the younger cohorts of the working-age population and an increase in the older cohorts, particularly in the East, Vardar, Pelagonia, Southeast and Northeastern regions, while regions such as Polog, Skopje and Southwest show the highest concentration in the middle-aged cohorts. At the national level, a comparison between the last census year and the final projection year of 2051 indicates a projected population decrease of 209,047 persons aged 15-64.
The results point to pronounced working-age population aging in at least half of the regions. Regions that currently have larger younger cohorts are projected to shift toward higher concentrations in middle-aged groups. Overall population decline is expected to affect all sectors, increasing the risk of labor shortages. These trends suggest a growing need for policy responses.

Keywords: Working-Age Population, Population Aging, Population Projections, North Macedonia

INTRODUCTION

This paper examines changes in the working age population of the Republic of North Macedonia and its eight statistical regions over the period 2002 to 2051. It analyses historical and projected trends in order to assess expected developments in the population aged 15 to 64.To understand these developments, it is necessary to consider the broader demographic context. North Macedonia has experienced population decline driven by negative net migration, low fertility, and negative natural increase. In 2021, the total fertility rate was 1.6, natural increase was -5.4, and net migration was -0.5. The aging index reached 1.01, indicating that the population aged 65 and over outnumbered the

population aged 0 to 14.[7] These indicators reflect a shift toward an increasingly aged population.Within this broader process, changes are also visible inside the working age population itself. Younger cohorts entering the labor market are smaller than older cohorts approaching retirement. As a result, the internal distribution of the population aged 15 to 64 is shifting toward older age groups. An increasing number of individuals are transitioning into retirement, which reduces the relative size of the economically active population and has implications for labor markets and pension systems.This shift in age structure is also reflected in the median age of the population. In 2021, the median age in North Macedonia was 40.89, meaning that half of the population was younger than this age and half was older. This represents an increase from 35.14 in 2002. Although North Macedonia remains below the European Union median age of 44.2, it follows a similar regional pattern. Serbia recorded a median age of 44, Croatia 45.3, Greece 45.5, and Bulgaria 46.4. Only Kosovo at 30.6, Albania at 37.6, and Montenegro at 39.3 had lower values.[8] Despite remaining below the EU average, the population of North Macedonia is both declining and aging.The labor force has been widely examined in domestic economic literature as a key factor of development. Early studies address the population as a source of labor, focusing on reserves, unemployment, and methodological issues [1]. Human potential, labor force circulation, unemployment, and past labor force trends are analyzed by Dimitrievska and Janeska [2,3,4,5], as well as Janeska [6]. Employment, unemployment, and activity rates are analyzed by Ristevski [7], while Ivanovska [8] focuses on the educational structure of the labor force. Population aging and the expected shortage of young working cohorts are examined by Ristevski [9]. More recent studies address the relationship between unemployment and economic development measured by GDP [10], youth labor market activity and inactivity, as well as employment and unemployment trends among young people [11], and the effects of the Covid 19 pandemic on the economy and the labor force [12] and the affects that labor force is expected to have on the economy of North Macedonia [13]Population aging has been examined in domestic demographic literature over several decades. Daskalovski [14] analyses the demographic dimensions of population aging in Macedonia. In 2001, several authors contribute to the topic from different perspectives, including Simovski [15] and Kartalov [16] on general demographic aspects, Gerasimovski [17] and Janeska [18] on regional characteristics, and Dimitrieva [19], Dimitrieva and Janeska [20], and Kjurciev [21] on the relationship between population aging and the workforce, including historical trends and projected changes expected by 2020. Broader demographic change and aging are further discussed by Grozdanovski and Noshpaloska [22]. More recent studies focus on structural and socioeconomic implications, including accelerated aging, population decline, and the reduction of young and working age cohorts [23], municipal differences between urban and rural areas [24], the impact of aging on unemployment in North Macedonia and the European Union [25], and long term population projections up to 2070, with emphasis on increasing dependency ratios and pressure on pension and healthcare systems [26].

[7]https://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat__Naselenie__ProcenkiNaselenie__ProcenkiPopis2021__Proceni2003_2020Revidirani/100_stapki_po_godini_ml.px/table/tableViewLayout2/
[8]https://ec.europa.eu/eurostat/databrowser/view/DEMO_PJANIND__custom_2132335/bookmark/table?lang=en&bookmarkId=04287bed-5283-4ece-b7b0-293802358ae7&c=1645435878840

METHODOLOGY

Data on past demographic trends were obtained from the State Statistical Office of North Macedonia, the official statistical institution of the country. The data includes the 2002 and 2021 population censuses, as well as yearly data on fertility, mortality, and migration used by the authors to produce the population projections.
The 2002 and 2021 census data were used to analyze historical trends on working age population and to compare them with projected values for 2031, 2041, and 2051. The population projections were developed using the Cohort Component Model, which projects the population forward by aging cohorts and applying assumptions on fertility, mortality, and migration. The projections were implemented using the software Spectrum and age-sex structure was used as the basis from the most recent census (2021), corresponding to the most recent census, while the projection horizon extends to 2051 in order to capture medium and long-term demographic developments.
The Cohort Component Model requires separate inputs for fertility, mortality, and migration. In this study, Total Fertility Rate (TFR), Life Expectancy (LE), and Net Migration Rates (NMR) were used. Consistent data for all three components are available only for the period 2014–2021 and earlier years were not included which may affect the results, particularly in the later years of the projection horizon.
Although projection studies often present multiple scenarios, this paper presents only the expected trajectory.

Fertility

Fertility projections are based on the Total Fertility Rate - TFR. Projected values are calculated as the average of linear and logarithmic extrapolations of the historical trend for the period 2014–2021. The linear function produced higher projected values which were too optimistic, while the logarithmic function produced lower values which were very pessimistic. The average of the two functions was therefore used as the projected trajectory. The projected TFR increases over the analyzed period; however, this does not imply that the absolute number of births will increase.
The mathematical specification used for the extrapolation is presented below.

$$TFRaverage = \frac{TFRlinear + TFRlogaritmic}{2}$$

Therefore;

$$TFRaverage = \frac{(a + bx) + (c + dln\,(x)\,)}{2}$$

In the equation, a and b are coefficients that describe the trend and are calculated separately for each region, since TFR values differ across regions. The variable x represents time in years, where the first year of the analysed period – 2014 is marked as 1 and the last year – 2051 is marked as 38.

Mortality

Mortality is represented through life expectancy - LE at birth. Life expectancy for males and females was projected using a linear extrapolation only on the national data of the historical trend for the period 2014–2021, while the regional values were later calculated using coefficients derived from the national average. Only the linear function was applied here since the linear extrapolation was more suitable to represent the extrapolated life expectancy over time. The projected values indicate an increase in life expectancy for both genders over the projection horizon.

$$LElinear = a + bx$$

In the equation, *a* and *b* are coefficients that describe the trend and are calculated separately for each region, since LE values differ across regions. The variable *x* represents time in years, where the first year of the analysed period – 2014 is marked as 1 and the last year – 2051 is marked as 38.

Migration

Migration is calculated separately for males and females and is expressed through net migration rates - NMR. Based on the historical trend for 2014–2021, both linear and logarithmic extrapolations were constructed. The linear function produced higher projected values which once again were very optimistic, while the logarithmic function produced lower values which were very pessimistic. The average of the two functions was used as the projected trajectory.

This approach was applied to all regions and both sexes, except for the Skopje region. Skopje is the only region with positive net migration and is expected to maintain positive values over the projection period. For this region, only the logarithmic function was applied, as it produced projected values that were more consistent with the observed trend. Based on this methodology, net migration rates are projected to decline in almost all regions for both sexes, with the exception of the Skopje, Polog, and Southwest Region, where positive trends are expected.

$$NMRaverage = \frac{NMRlinear + NMRlogaritmic}{2}$$

Therefore;

$$NMRaverage = \frac{(a + bx) + (c + dln\,(x)\,)}{2}$$

In the equation, *a* and *b* are coefficients that describe the trend and are calculated separately for each region, since NMR values differ across regions. The variable *x* represents time in years, where the first year of the analysed period – 2014 is marked as 1 and the last year – 2051 is marked as 38.

Regarding the working age population, there are several definitions. According to the International Labour Organization - ILO, the working-age population generally refers to people aged 15 years and older, although upper age limits may vary across definitions [27]. For the purposes of this research, the definition used by the Organization for Economic Co-operation and Development - OECD is applied, which defines the working age population as individuals aged 15 to 64 [28]. This measure can be expressed either as

an absolute number or as a percentage of the total population, depending on the context of the analysis.

Research Hypothesis

The fertility hypothesis

Fertility projections are uncertain, as fertility trends are influenced by social, economic, and political factors that are difficult to predict over the long term. As the projection horizon extends further from the jump-off year, the level of reliability decreases. For this reason, projected values for 2031 are expected to be closer to actual outcomes than those for 2051.

At the national level, the projected TFR reaches 2.05 in 2051, indicating an increase from 2031 with a recorded value of 1.81. In terms of regional differences, the Pelagonia region for example is the only region projected to record a decline in TFR, from 1.45 in 2031 to 1.42 in 2051. The remaining seven regions show increases over the same period. By 2051, the Skopje and Polog regions are projected to have the highest TFR values, while Pelagonia remains the lowest. The other regions also record increases during the projection period.

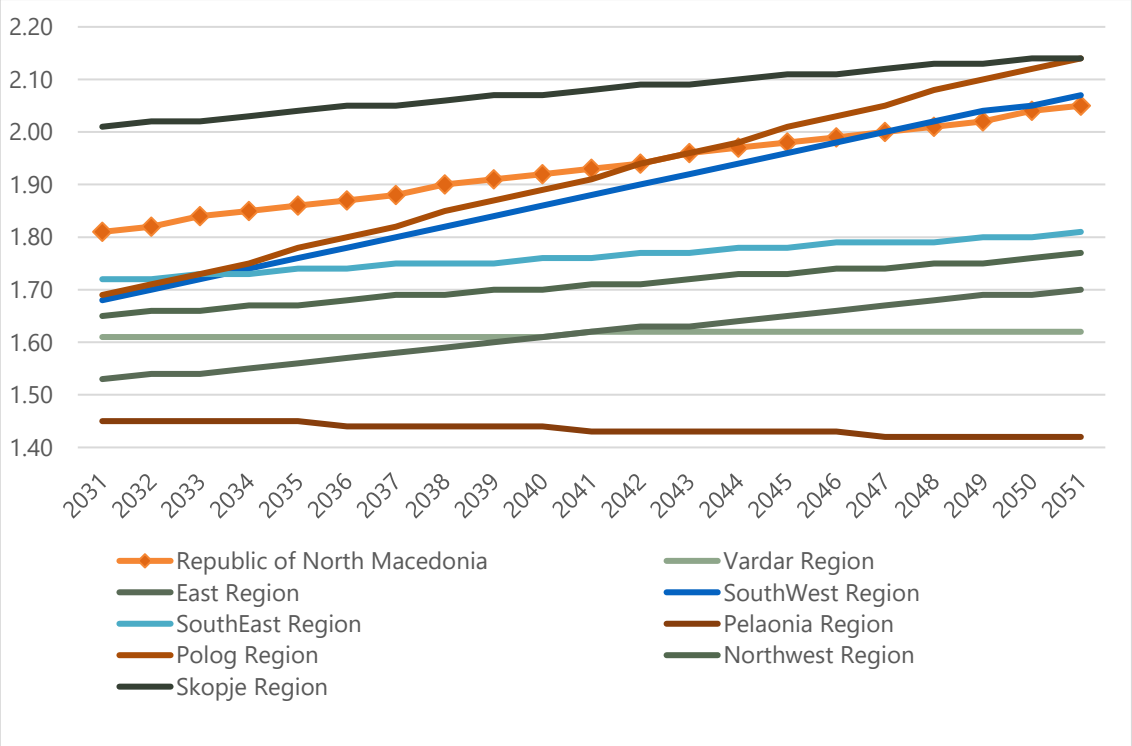


Figure 3. Projected TFR values for the period 2031–2051. Source: Author's own calculations

The mortality hypothesis

Between 2031 and 2051, life expectancy for men is projected to increase by approximately 2.5 years at the national level, rising from 73.19 years in 2031 to 75.61 years in 2051. These projections are based on a linear trend and do not account for potential external influences such as disasters, wars and epidemics.

At the regional level, male life expectancy is projected to be highest in the Skopje region and lowest in the Pelagonia region, with a difference of about 1.3 years. Women are projected to have higher life expectancy than men throughout the period. In 2031, the difference between female and male life expectancy is close to four years, while by 2051 it narrows slightly to around three and a half years.

For women, life expectancy is also projected to increase between 2031 and 2051, though the overall rise is slightly smaller than for men, at approximately 2 years. At the national level, life expectancy for women increases from 77.3 years in 2031 to 79.22 years in 2051, representing a gain of 1.92 years. Despite the smaller increase, women continue to have higher life expectancy than men throughout the projection period. At the regional level, the highest values are recorded in the Skopje region, while the Polog region has the lowest, with a difference of about two years.

The longer life expectancy of women is not related to North Macedonia only, but reflects a broader global pattern. The difference between male and female life expectancy is linked to a combination of biological, environmental, and lifestyle factors. While genetic and hormonal differences contribute to this gap, behavioral factors such as smoking, alcohol consumption, and occupational risks also play an important role [29].

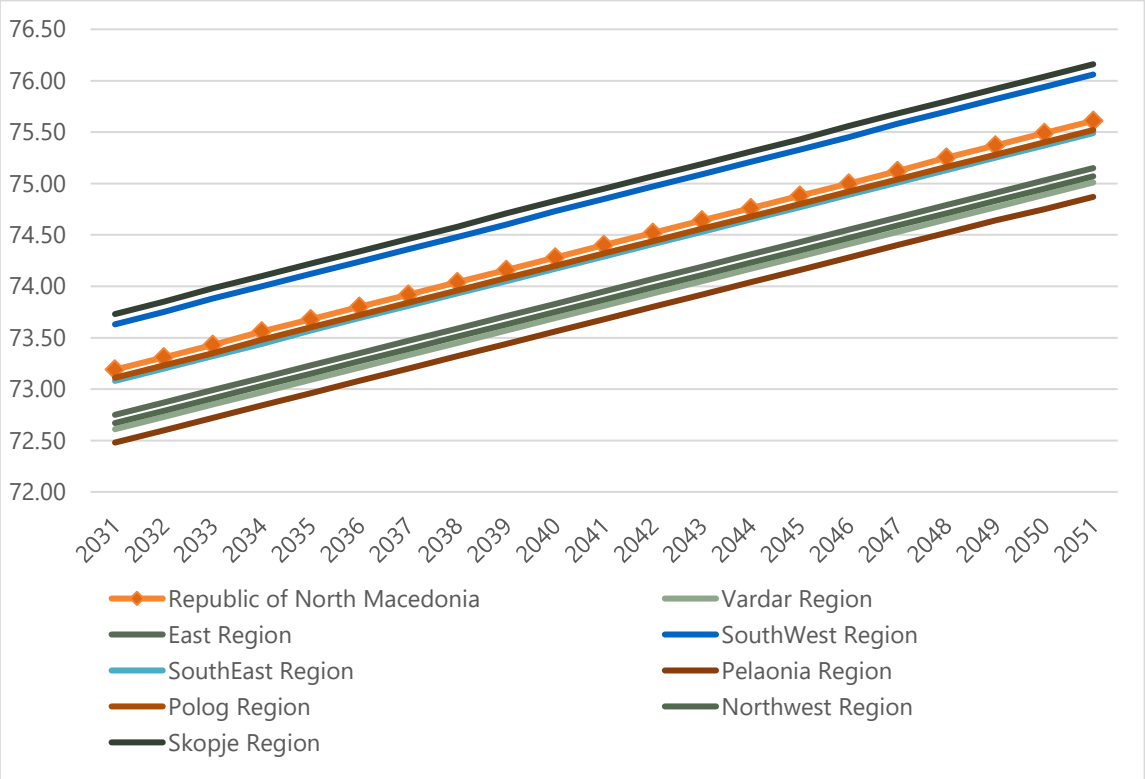


Figure 4. Projected LE values for males for the period 2031–2051
Source: Author's own calculations.

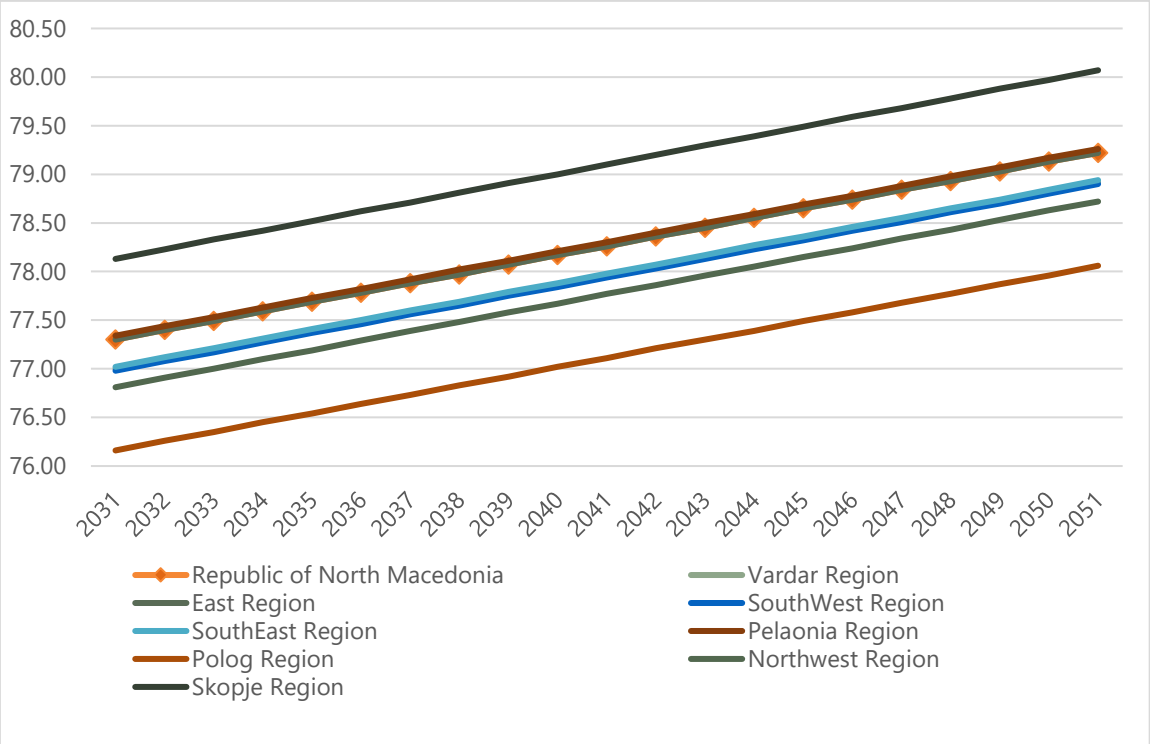


Figure 5. Projected LE values for females for the period 2031–2051
Source: Author's own calculations

The migration hypothesis

At the national level, the net migration rate for men remains negative throughout the projection period, declining from -0.02 in 2031 to -0.03 in 2051. The overall change between the first and last projected year is limited and reflects differences across regions. As with fertility and mortality, the Skopje region records the highest values. Its net migration rate is projected to increase slightly, from 1.93 in 2031 to 1.99 in 2051. The Polog and Southwest regions are the only regions projected to shift from negative to positive net migration rates, with the change being more pronounced in the Southwest region, where the rate moves from 0.2 in 2031 to 1.8 in 2051. All other regions maintain negative values throughout the period, with the Vardar region showing the lowest projected rates, declining from -3.3 in 2031 to -5.69 in 2051.

The analyzed data indicate that migration is more pronounced among women than men, as reflected in higher net migration rates. At the national level, the net migration rate for women remains negative, declining from -0.04 in 2031 to -0.08 in 2051. Skopje and Polog are the only two regions that are projected to have positive values in 2051, with the only difference being that, although Skopje shows higher values, the net migration rate in Skopje is projected to decline from 1.39 in 2031 to 1.24 in 2051, while the rate in Polog is expected to increase from -0.21 in 2031 to 0.46 in 2051.

All other regions have negative and decreasing values (except Southeast region that is expected to increase but still remain negative). The Vardar region is projected to experience the largest decline in its female population, with the net migration rate worsening from -3.26 in 2031 to -5.33 by 2051.

Differences between men and women are also evident within regions. The largest gap is observed in the Southwest region, where the male net migration rate in 2051 is projected to be positive with 1.8, while the rate for women remains slightly negative with -0.1. In

contrast, the Pelagonia region shows higher net migration values for women than for men, although both remain negative (-2.42 for men and -0.65 for women in 2051). Overall, the projections indicate continued immigration at the national level, with regional and gender differences in its intensity.

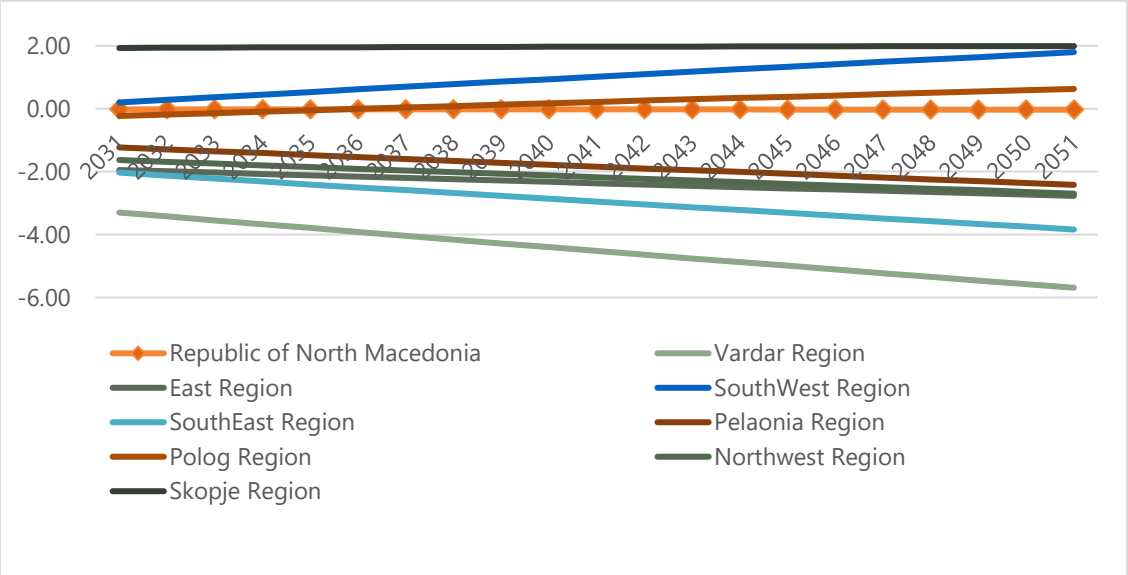


Figure 6. Projected NMR values for males for the period 2031–2051
Source: Author's own calculations

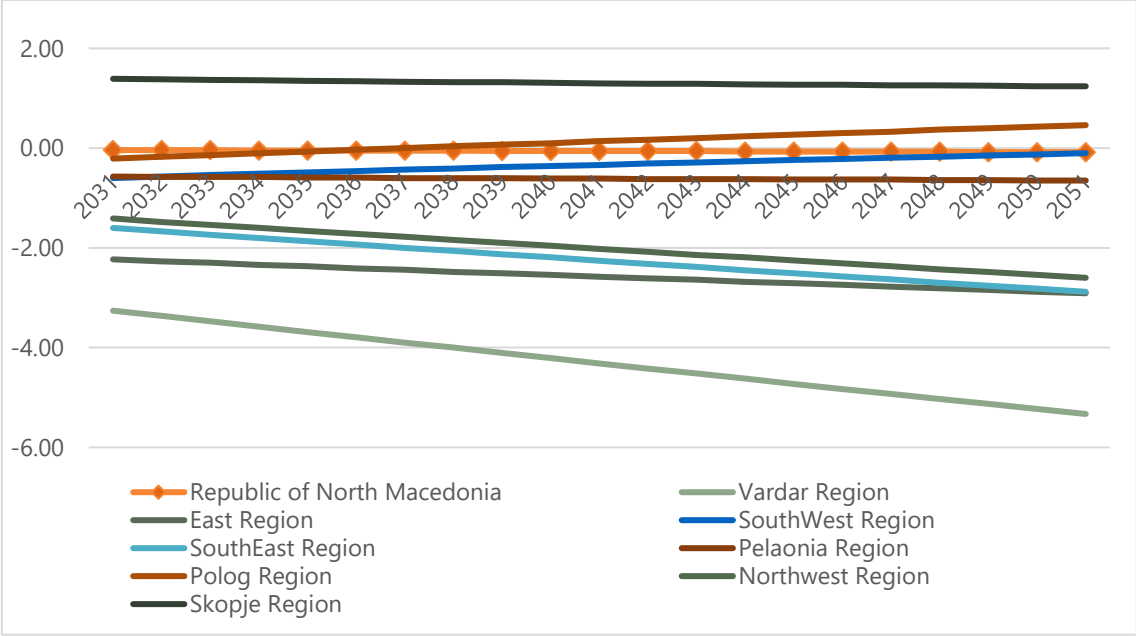


Figure 7. Projected NMR values for females for the period 2031–2051
Source: Author's own calculations

PAST TRENDS ON WORKING AGE POPULATION

In the analysis of the working age population, a decline has been observed between the last two censuses. In 2002, the number of people in this age group was 1,381,352, and by

2021, this number had decreased to 1,210,035. This corresponds to an absolute decrease of 171,317 people and a percentage change of -12.4%.

This declining trend is also present at the regional level. All regions, including the Skopje region, recorded a reduction in the number of working age individuals, although the magnitude of change differs across regions. For example, the East region shows the largest decline in both absolute numbers and percentage change of -23.56%. Substantial declines were also recorded in the Polog and Southwest regions. In the Polog region, the working age population decreased by 29,019 people (-14.4%), while in the Southwest region the decline amounted to 28,120 people (-19.1%).

The Skopje region, which has the highest population concentration with approximately one third of the total population residing in the capital, also recorded a decline in the working age population. However, this decrease was the smallest among all regions, amounting to 9,513 people, with a percentage change of -2.36%.

Changes are also visible when the working age population is examined by five-year age groups. In all regions except Skopje, the largest decline occurred in the youngest cohort (15–19), both in absolute and relative terms. At the national level, this group decreased by 61,387 persons between 2002 and 2021, representing a decline of 37.11%. In the East and Southwest regions, the reduction approached 50%, indicating a substantial contraction of this age group over the nineteen-year period. At the same time, the largest increase was recorded in the older working age cohorts, with those aged 60–64 in almost all regions. At the national level, this group increased by 34,973 people between 2002 and 2021, corresponding to a growth of 38.94%. The Eastern and Southeastern regions recorded the highest increases in this age group, with the number of persons aged 60–64 nearly doubling during the same period. The regional difference suggests an "urban pull" toward the capital, even as the country as a whole faces a "graying workforce" that points toward growing pressure on the pension and healthcare systems with fewer young workers to support them.

Table 1. Working age population in the 2002 and 2021

	Year	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	Total
Republic of North Macedonia	2002	165422	161945	153461	148281	149837	146902	142688	127760	95234	89822	1381352
	2021	104035	106553	116145	123101	127381	128186	126444	125643	127752	124795	1210035
	Absolute change	-61387	-55392	-37316	-25180	-22456	-18716	-16244	-2117	32518	34973	-171317
	Percentage change	-37.11	-34.20	-24.32	-16.98	-14.99	-12.74	-11.38	-1.66	34.15	38.94	-12.40
East Region	2002	14375	14187	13209	12621	13653	14592	14418	12917	9670	8457	128099
	2021	7447	7911	8297	9272	9691	10106	10236	10698	11711	12555	97924
	Absolute change	-6928	-6276	-4912	-3349	-3962	-4486	-4182	-2219	2041	4098	-30175
	Percentage change	-48.19	-44.24	-37.19	-26.54	-29.02	-30.74	-29.01	-17.18	21.11	48.46	-23.56
Northeastern	2002	14155	13868	13306	12419	12785	12342	11881	10334	7588	7297	115975
	2021	9537	9987	10074	9961	10082	10536	10606	10528	10764	10174	102249

	Absolute change	-4618	-3881	-3232	-2458	-2703	-1806	-1275	194	3176	2877	-13726
	Percentage change	-32.62	-27.99	-24.29	-19.79	-21.14	-14.63	-10.73	1.88	41.86	39.43	-11.84
Pelagonia Region	**2002**	17905	17500	15782	15378	16741	17826	18559	16063	11765	12226	159745
	2021	11063	11214	12419	13641	14710	14557	14086	14335	15359	16197	137581
	Absolute change	-6842	-6286	-3363	-1737	-2031	-3269	-4473	-1728	3594	3971	-22164
	Percentage change	-38.21	-35.92	-21.31	-11.30	-12.13	-18.34	-24.10	-10.76	30.55	32.48	-13.87
Polog Region	**2002**	28455	26001	24490	24262	23793	21167	17250	13954	10945	10608	200925
	2021	15700	16427	18645	18468	17799	17064	16889	17539	17705	15670	171906
	Absolute change	-12755	-9574	-5845	-5794	-5994	-4103	-361	3585	6760	5062	-29019
	Percentage change	-44.83	-36.82	-23.87	-23.88	-25.19	-19.38	-2.09	25.69	61.76	47.72	-14.44
Skopje Region	**2002**	44309	46394	46147	44443	41901	39625	41359	40752	30501	26967	402398
	2021	35092	34884	37917	41423	43507	44280	43017	40006	37646	35113	392885
	Absolute change	-9217	-11510	-8230	-3020	1606	4655	1658	-746	7145	8146	-9513
	Percentage change	-20.80	-24.81	-17.83	-6.80	3.83	11.75	4.01	-1.83	23.43	30.21	-2.36
Southeastern Region	**2002**	13975	13621	12706	12331	13089	13201	13015	10954	8396	7784	119072
	2021	7752	8019	8538	9096	9929	9975	10083	10420	11428	11674	96914
	Absolute change	-6223	-5602	-4168	-3235	-3160	-3226	-2932	-534	3032	3890	-22158
	Percentage change	-44.53	-41.13	-32.80	-26.23	-24.14	-24.44	-22.53	-4.87	36.11	49.97	-18.61
Southwestern region	**2002**	19865	18267	16812	15942	16336	16129	14381	12162	8607	8724	147225
	2021	10188	10657	12050	12203	12175	11955	12123	12182	12772	12800	119105
	Absolute change	-9677	-7610	-4762	-3739	-4161	-4174	-2258	20	4165	4076	-28120
	Percentage change	-48.71	-41.66	-28.33	-23.45	-25.47	-25.88	-15.70	0.16	48.39	46.72	-19.10
Vardar Region	**2002**	12383	12107	11009	10885	11539	12020	11825	10624	7762	7759	107913
	2021	7256	7454	8205	9037	9488	9713	9404	9935	10367	10612	91471
	Absolute change	-5127	-4653	-2804	-1848	-2051	-2307	-2421	-689	2605	2853	-16442
	Percentage change	-41.40	-38.43	-25.47	-16.98	-17.77	-19.19	-20.47	-6.49	33.56	36.77	-15.24

Source: State Statistical Office and author's own calculations

PAST TRENDS ON POPULATION AGING

The aging index represents the ratio between the population aged 65 and over and the younger population, usually defined as those under 15 or under 20 years of age. In this case, the population aged 0-14 was used as a reference group. The critical threshold value

of the aging index is 40.0% (or 0.40). When the index exceeds this value, the population is considered to have entered the stages of demographic aging [30].
Between 2002 and 2021, all regions in North Macedonia, i.e., the entire territory, recorded an increase in the aging index, indicating a shift toward older age groups. At the national level, the aging index doubled from 0.50 in 2002 to 1.01 in 2021. This means that by 2021, the population aged 65 and over outnumbered the population aged 0–14.
All regions follow this pattern. In the Eastern region, the aging index increased more than two and a half times, from 0.61 to 1.52. In the Pelagonia region, it rose from 0.85 in 2002 to 1.31 in 2021. Although the Polog region remains the youngest, the index also increased, from 0.30 to 0.70, indicating that the aging process is present in this region as well. A similar increase was observed in the Skopje region, where the aging index rose from 0.48 to 0.90.

Table 2. Population aging in 2002 and 2021

Year	Aging index	Republic of North Macedonia	East Region	Northeastern Region	Pelagonia Region	Polog Region	Skopje Region	Southeastern region	Southwestern region	Vardar Region
2002	Average age	35,14	36,71	34,32	38,49	31,41	35,44	35,74	33,70	36,63
	Young population (0-14) in %	21,08	18,40	22,62	17,83	26,05	20,31	19,83	23,38	18,71
	Young and mature population (0-39) in %	59,59	55,82	61,12	52,81	67,80	58,91	58,17	62,75	56,19
	Old population (60+) in %	10,63	11,16	10,26	15,09	7,89	10,09	10,71	10,17	11,46
	Aging index	0,50	0,61	0,45	0,85	0,30	0,50	0,54	0,44	0,61
	Stages of demographic aging (According to the aging index)	4	5	4	6	4	4	5	4	5
2021	Average age	40,89	44,13	40,24	42,96	38,31	39,83	42,49	41,10	42,29
	Young population (0-14) in %	16,95	13,80	16,98	14,97	18,64	18,59	15,80	15,99	15,60
	Young and mature population (0-39) in %	48,38	42,17	49,43	44,93	53,24	50,35	45,00	48,28	45,47
	Old population (60+) in %	17,17	21,02	16,18	19,65	13,03	16,69	18,89	16,87	18,47
	Aging index	1,01	1,52	0,95	1,31	0,70	0.9	1,20	1,06	1,18
	Stages of demographic aging (According to the aging index)	6	7	6	7	5	6	6	6	6

Source: State Statistical Office and author's own calculations

RESULTS AND DISCUSSION

This analysis examines how the working-age population (15-64) is expected to change over the next three decades (2031-2051) and more specifically the total size of the population and internal age structure across five-year cohorts.

The total working-age population in North Macedonia is projected to decline from 1,145,357 in 2031 to 1,000,988 in 2051. This is a decrease of 144,369 people over 20 years or 12.6%. The decline is present in all regions with different intensity.

In absolute numbers, the Pelagonia region is forecasted to have the largest loss with a reduction of 27,814 people, however the steepest percentage decline is projected in the Vardar Region, which is projected to contract by nearly one third (29.79%). In contrast, Skopje is forecasted to have the smallest decline, losing only 7,274 people or 1.83%. This reflects Skopje's role as the main economic center with the largest labor market which is projected to strengthen its dominance in the national workforce, holding about 34.7% of the total working-age population in the country in 2031, 36.8% in 2041 and nearly 39% by 2051. This concentration is likely to deepen regional disparities, driven by internal migration toward better employment opportunities and public services in the capital.
Beyond the overall decline, the age structure is also shifting. Most regions are set to transition towards older working-age cohorts, especially those that are going to experience deepest demographic aging like East, Pelagonia, Vardar Southeast and Northeastn region. This will create a workforce that is more rapidly shrinking and increasing the average worker age. In contrast to these regions, there are Skopje, Polog and Southwestern regions that are experiencing younger demographic profiles and different patterns. They are expected to maintain a stronger concentration in the middle working ages for much of the projected period. By 2051 however, Polog and Southwest Region are forecasted to shift toward older cohorts as its cohorts that were previously middle-aged, grow old.
Although almost all regions by 2051 are projected to have more people nearing retirement rather than young people entering the workforce, Skopje region is the only exception with its expected growth in younger workers, with age groups 25-29 recording an increase of 6.34% between 2031-2051 while age groups 30-34 and 35-39 recording an increase of 9.86% and 9.07% respectively.

Table 3. Working age population in 2031, 2041 and 2051

	Year	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	Total
Republic of North	2031	108,895	105,000	103,305	105,733	115,531	121,726	125,767	124,545	120,050	114,805	1,145,357
	2041	93,413	97,079	107,712	103,767	102,158	104,530	113,800	118,680	120,097	114,583	1,075,819
	2051	91,280	91,064	92,039	95,652	106,417	102,541	100,660	102,087	109,112	110,136	1,000,988
	Absolute change	-17615	-13936	-11266	-10081	-9114	-19185	-25107	-22458	-10938	-4669	-144369
	Percentage change	-16.18	-13.27	-10.91	-9.53	-7.89	-15.76	-19.96	-18.03	-9.11	-4.07	-12.60
East Region	2031	7,117	6,998	6,941	7,423	7,967	8,938	9,405	9,744	9,644	9,695	83,872
	2041	5,585	5,816	6,575	6,461	6,516	7,104	7,695	8,613	8,904	8,901	72,170
	2051	5,007	5,009	5,014	5,250	6,129	6,136	6,259	6,832	7,301	7,928	60,865
	Absolute change	-2110	-1989	-1927	-2173	-1838	-2802	-3146	-2912	-2343	-1767	-23007

	Percentage change	-29.65	-28.42	-27.76	-29.27	-23.07	-31.35	-33.45	-29.89	-24.29	-18.23	-27.43
Northeastern Region	**2031**	9,048	8,678	9,247	9,601	9,752	9,711	9,849	10,190	10,005	9,575	95,656
	2041	7,422	7,668	8,557	8,195	8,857	9,296	9,474	9,375	9,327	9,298	87,469
	2051	7,048	6,995	6,818	7,072	8,085	7,845	8,563	8,968	8,999	8,618	79,011
	Absolute change	-2000	-1683	-2429	-2529	-1667	-1866	-1286	-1222	-1006	-957	-16645
	Percentage change	-22.10	-19.39	-26.27	-26.34	-17.09	-19.22	-13.06	-11.99	-10.05	-9.99	-17.40
Pelagonia Region	**2031**	10,826	11,284	10,774	10,949	12,215	13,415	14,440	14,079	13,351	13,041	124,374
	2041	8,501	8,974	10,459	10,913	10,468	10,695	11,944	13,014	13,731	12,893	111,592
	2051	7,518	7,713	8,079	8,548	10,109	10,634	10,211	10,371	11,384	11,993	96,560
	Absolute change	-3308	-3571	-2695	-2401	-2106	-2781	-4229	-3708	-1967	-1048	-27814
	Percentage change	-30.56	-31.65	-25.01	-21.93	-17.24	-20.73	-29.29	-26.34	-14.73	-8.04	-22.36
Polog Region	**2031**	16,506	15,823	15,502	16,271	18,434	18,179	17,508	16,559	16,043	16,042	166,867
	2041	13,033	14,515	16,479	15,773	15,426	16,146	18,190	17,728	16,694	15,170	159,154
	2051	13,606	13,377	13,181	14,636	16,533	15,752	15,299	15,822	17,454	16,423	152,083
	Absolute change	-2900	-2446	-2321	-1635	-1901	-2427	-2209	-737	1411	381	-14784
	Percentage change	-17.57	-15.46	-14.97	-10.05	-10.31	-13.35	-12.62	-4.45	8.80	2.38	-8.86
Skopje Region	**2031**	39,994	37,713	36,837	36,529	39,256	41,982	43,648	43,592	41,154	36,793	397,498
	2041	37,524	38,533	41,659	39,331	38,014	37,194	39,382	41,434	42,096	40,521	395,688
	2051	38,004	38,058	39,171	40,131	42,816	39,997	38,200	36,829	38,157	38,851	390,214
	Absolute change	-1990	345	2334	3602	3560	-1985	-5448	-6763	-2997	2058	-7284
	Percentage change	-4.98	0.91	6.34	9.86	9.07	-4.73	-12.48	-15.51	-7.28	5.59	-1.83
Southeastern Region	**2031**	8,169	7,683	7,399	7,609	8,278	8,891	9,680	9,586	9,494	9,525	86,314
	2041	6,665	6,865	7,617	7,140	6,971	7,288	8,001	8,567	9,168	8,758	77,040
	2051	6,177	6,054	5,978	6,189	7,084	6,755	6,674	6,991	7,583	7,881	67,366
	Absolute change	-1992	-1629	-1421	-1420	-1194	-2136	-3006	-2595	-1911	-1644	-18948
	Percentage change	-24.38	-21.20	-19.21	-18.66	-14.42	-24.02	-31.05	-27.07	-20.13	-17.26	-21.95
Southwestern	**2031**	9,845	9,882	10,040	10,480	11,956	11,976	12,032	11,523	11,534	11,167	110,435
	2041	8,914	8,636	9,855	9,876	10,012	10,419	11,818	11,708	11,516	10,622	103,376
	2051	9,137	9,133	9,072	8,780	9,947	9,904	9,962	10,243	11,387	10,917	98,482
	Absolute change	-708	-749	-968	-1700	-2009	-2072	-2070	-1280	-147	-250	-11953

	Percentage change	-7.19	-7.58	-9.64	-16.22	-16.80	-17.30	-17.20	-11.11	-1.27	-2.24	-10.82
Vardar Region	**2031**	7,390	6,939	6,565	6,871	7,673	8,634	9,205	9,272	8,825	8,967	80,341
	2041	5,769	6,072	6,511	6,078	5,894	6,388	7,296	8,241	8,661	8,420	69,330
	2051	4,783	4,725	4,726	5,046	5,714	5,518	5,492	6,031	6,847	7,525	56,407
	Absolute change	-2607	-2214	-1839	-1825	-1959	-3116	-3713	-3241	-1978	-1442	-23934
	Percentage change	-35.28	-31.91	-28.01	-26.56	-25.53	-36.09	-40.34	-34.95	-22.41	-16.08	-29.79

Source: Author's own calculations

With regards to population aging, North Macedonia is projected to record a continued increase in the aging index, indicating a growing proportion of older individuals relative to younger ones. The national aging index is projected to rise from 1.15 in 2031 to 1.23 in 2051.

At the regional level, the Vardar region is projected to experience the largest increase, from 1.44 to 1.87. This implies that by 2051 the population aged 65 and over will be almost twice the size of the population aged 0–14. The Eastern region is forecasted to reach similarly high levels, with an aging index of 1.89, while the Pelagonia region follows closely with a projected value of 1.85.

In contrast, the Polog and Skopje regions are expected to remain relatively younger. Their aging index values are projected to remain close to 1, slightly below 1 in 2031 and slightly above 1 in 2051. This indicates a shift from a more balanced age structure toward a growing predominance of older age groups over time.

Table 4. Population aging in 2031, 2041 and 2051

	Aging index	**Republic of N.Macedonia**	**East Region**	**Northeastern Region**	**Pelagonia Region**	**Polog Region**	**Skopje Region**	**Southeastern region**	**Southwestern region**	**Vardar Region**
2031	**Average age**	41.50	44.94	41.23	43.68	40.10	39.90	43.10	41.83	43.37
	Young population (0-14) in %	16.16	13.11	15.91	13.54	16.47	18.25	15.17	15.68	14.61
	Young and mature population (0-39) in %	46.81	40.59	47.89	42.86	49.76	49.48	43.88	46.50	42.97
	Old population (60+) in %	18.65	23.66	18.05	21.41	16.23	16.53	21.51	19.13	21.11
	Aging index	1.15	1.80	1.13	1.58	0.99	0.91	1.42	1.22	1.44
	Stages of demographic aging (According to the aging index)	6	7	6	7	6	6	7	6	7
2041	**Average age**	41.99	45.53	42.15	44.51	41.01	40.21	43.48	42.11	44.54
	Young population (0-14) in %	16.43	13.40	15.94	13.33	16.82	18.34	15.50	16.76	13.99
	Young and mature population (0-39) in %	46.39	40.04	45.94	41.92	47.76	49.89	43.98	45.76	41.63

	Old population (60+) in %	19.62	24.49	19.58	21.98	17.72	17.66	22.26	19.85	22.82
	Aging index	1.19	1.83	1.23	1.65	1.05	0.96	1.44	1.18	1.63
	Stages of demographic aging (According to the aging index)	6	7	6	7	6	6	7	6	7
2051	**Average age**	42.20	45.92	43.07	45.46	41.15	40.32	43.66	42.01	45.72
	Young population (0-14) in %	17.13	13.92	15.76	13.28	18.11	19.05	16.11	17.53	13.96
	Young and mature population (0-39) in %	46.52	39.86	44.44	40.27	47.76	50.38	44.23	46.47	40.50
	Old population (60+) in %	21.13	26.29	21.34	24.62	18.67	19.27	23.72	20.60	26.14
	Aging index	1.23	1.89	1.35	1.85	1.03	1.01	1.47	1.18	1.87
	Stages of demographic aging (According to the aging index)	6	7	7	7	6	6	7	6	7

Source: Author's own calculations

The following section compared changes in the working-age population over two periods: 2002-2051, which captures demographic changes for a half-century, and 2021-2051, which reflects projected developments from the most recent census year to the end of the projected horizon.

At a national level, the working-age population is projected to decline by 380,364 people between 2002 and 2051, which represents a reduction of 27.54%. This change indicates that in the first half of the 21st century, North Macedonia is projected to lose more than a quarter of its working-age population. This decline is present in all regions, with different intensity.

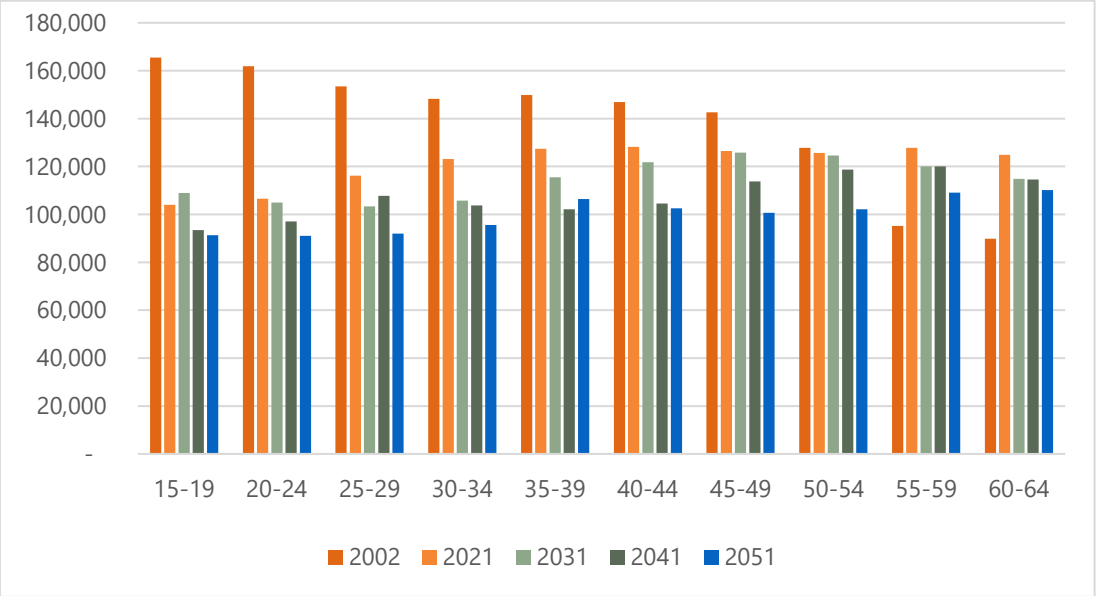


Figure 8. Working-age population in North Macedonia for the period 2002-2051
Source: Author's calculations

The East region is forecasted to record the largest decrease with a projected decline of 52.49% which amounts to 67,234 people, followed by Vardar region with an expected decline of 47.73%. It is worth noting that Pelagonia, the Northeast, and Southeast regions are also projected to record substantial declines, with losses ranging from 22% to 40% over the fifty-year period. In contrast, regions with a more balanced old people to young people ratio such as Polog and the Southwest region, experience smaller long-term declines while the Skopje region is projected to have the smallest reduction over the fifty-year period with only 3.03%. This is a result of a high concentration of economic activity and bigger opportunities in the capital.

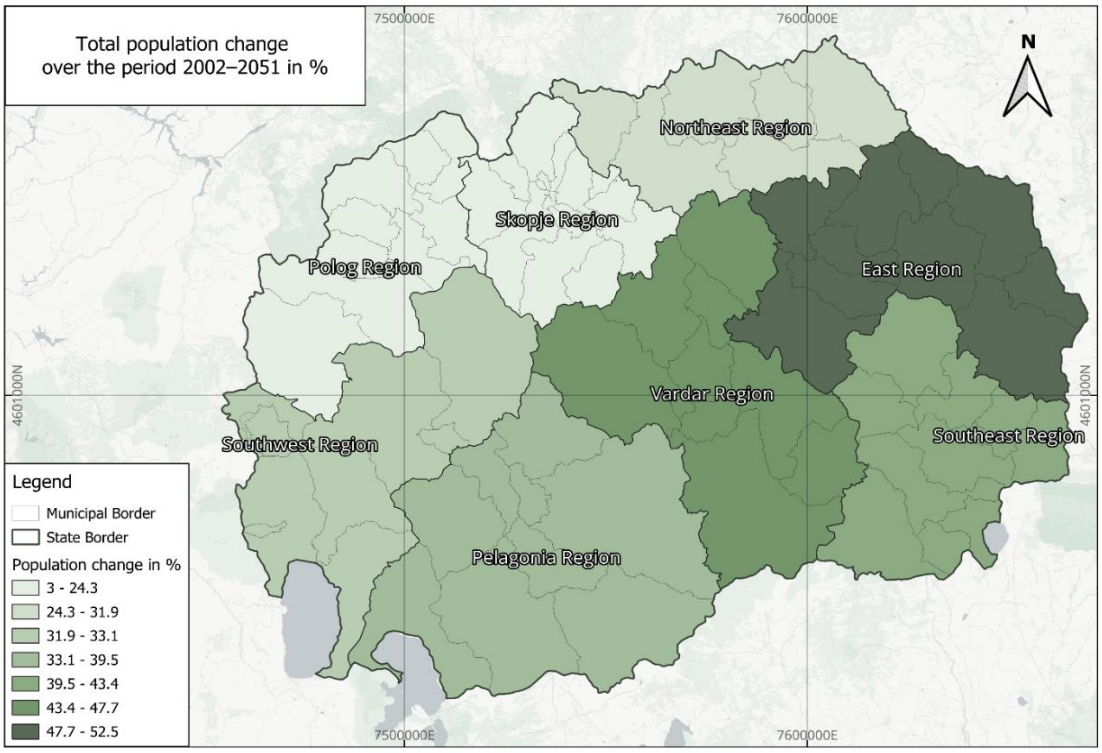


Figure 9. Total population change over the period 2002-2051 in %
Source: Author's calculations

When analyzing the shorter period 2021-2051, the projected national decline is 209,047 or 17.29%. In this period, the Vardar region is forecasted to record the largest decline with 38.33% while Pelagonia is expected to have the largest absolute decrease with 41,021 persons. Once again, all regions are projected to decline with Polog region and Southwest region showing more moderate reduction. Skopje is once again set to have the smallest decline with 0.68% or 2,671 persons.

The age structure analysis further illustrates the depth of demographic change. Over the period 2002-2051, all regions except Skopje are projected to lose more than half of their youngest working-age cohorts (15-19 and 20-24). At the national level, the decline is 44.82% for the 15-19 cohort and 43.77% for the 20-24 cohort. At the same time, older working-age cohorts (55-59 and 60-64) are forecasted to increase nationally by 14.57% and 22.62%, respectively, although this pattern differs across regions.

For the period 2021-2051, the national average shows that the most noticeable changes occur among middle-aged cohorts, particularly those aged 25-49 with projected decline

of around 20%. The regions with the highest levels of demographic aging, like Vardar and East regions, this decline is more than 30% across most age groups, with Pelagonia following with a decline of more than 25% and the Southeast region with an expected decrease above 20%. For comparison, the Polog region shows uneven changes, with increases in some younger cohorts and positive values in the 60-64 group. The Skopje region in projected to increase in several young age groups, while experiencing reduction in some middle-aged cohorts.

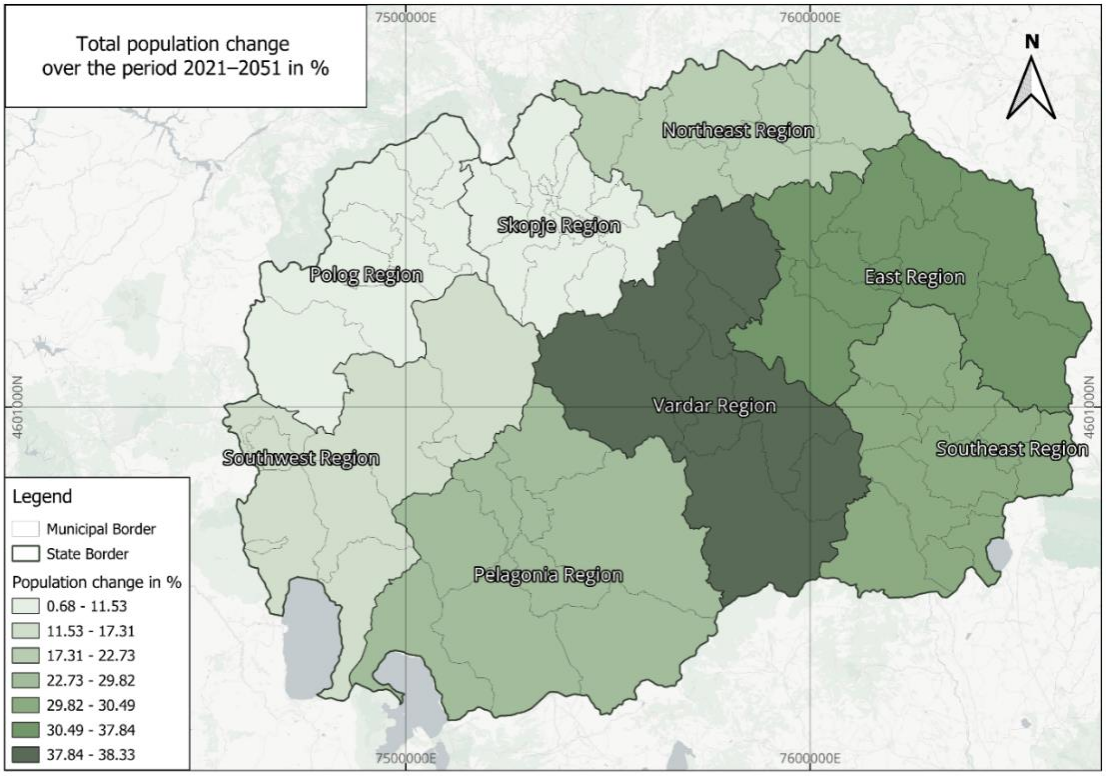


Figure 10. Total population change over the period 2021-2051 in %
Source: Author's calculations

When comparing the two periods, we notice that the most significant structural shift occurred between 2002 and 2021. During this 19-year period, the working-age population declined sharply, and the aging index doubled from 0.5 to 1.01, showing a transition from relatively young to older population. This also means that the young cohorts outnumbered the older cohorts nearing retirement. Although the most drastic change occurred in this nineteen-year period, 2021-2051 is projected to deepen the imbalance. Even though the projected decline is forecasted to be 17.29% the structural change already occurred by 2021. The aging index continues to increase but at a slower rate (from 1.01 to 1.23), which suggests a consolidation of an already aged population rather than a new phase of demographic transition so it's safe to assume that the projected period will reflect continuation and not a new demographic transition.

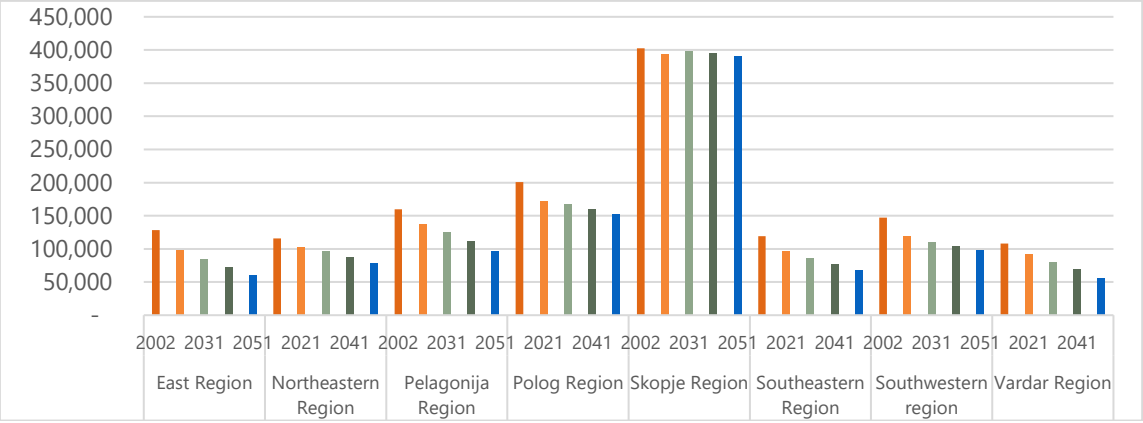


Figure 10. Changes in the working-age population for the period 2002-2051
Source: Author's calculations

The regional differences analyzed here are the same structural factors that existed long before the study period. One noticeable trend is that the Vardar and Eastern region already had an older age structure in 2002 which means that the aging in these two regions had happened even earlier. This is a result of weaker regional economy and high emigration rate towards Skopje and abroad.
The Polog and Southwestern regions had a younger population, especially in 2002, which slowed the aging but it did not prevent long-term decline. By 2051, even these regions are projected to follow the aging trends as the other regions, while their younger cohorts move towards retirement. Both regions have a higher share of Albanian population, whose demographic behavior differs than the national average, since they follow more traditional values and have higher fertility rates, lower female labor-force participation rate etc, which helps explaining their slower aging.
Skopje shows a completely different pattern. Being the only region with a positive net migration rate with the largest concentration of economic activity along with better access to public services, it retains larger share of the working-age population, which as a result creates regional disparities. While the other regions are experiencing workforce decline, Skopje is projected to have nearly 39% of the national working-age population by 2051.

Table 5. Total Population Change (Absolute and Percentage), 2002–2051 and 2021–2051

	Republic of North Macedonia	East Region	Northeastern Region	Pelagonia Region	Polog Region	Skopje Region	Southeastern Region	Southwestern region	Vardar Region
Absolute change 2002-2051	-380364	-67234	-36964	-63185	-48842	-12184	-51706	-48743	-51506
Absolute change 2021-2051	-209047	-37059	-23238	-41021	-19823	-2671	-29548	-20623	-35064
Percentage change 2002-2051	-27.54	-52.49	-31.87	-39.55	-24.31	-3.03	-43.42	-33.11	-47.73
Percentage change 2021-2051	-17.28	-37.84	-22.73	-29.82	-11.53	-0.68	-30.49	-17.31	-38.33

Source: Author's own calculations

CONCLUSION

Based on the analysis of both historical and projected data, three distinct structural patterns emerge across the fifty-year period 2002–2051.

Regions that are projected to lose more than half of their youngest working-age cohorts (15–19 and 20–24), without compensatory growth in other age groups over the fifty-year period, are also the regions that record the highest population aging. This applies to the Vardar, Eastern, and Pelagonia regions, and to a certain extent the Southeastern region. These regions are experiencing the most severe long-term contraction and are projected to lose between 20% and 30% of their working-age population across most cohorts in the period 2021-2051.

The Northeastern region follows a slightly different pattern. Although it also has a sharp decline in younger cohorts of around 50% over the fifty-year period, it shows some increase in older working-age cohorts (55–64). This reflects continued population aging. However, these changes are less pronounced than in the previously mentioned regions.

The Polog and Southwest regions show another distinct trajectory. While they also experience a decline of approximately half of their youngest cohorts, they record increases in older working-age groups (55–64) and maintain stronger middle-aged concentrations in 2031 and 2041. By 2051, however, these middle cohorts age into the upper working-age groups, leading to a structure that increasingly resembles the more aged regions.

The Skopje region stands out. Unlike the other regions, it shows projected growth in younger cohorts and maintains a large concentration of middle-aged individuals. This suggests greater workforce stability compared to the rest of the regions and a continued concentration of working-age population in the capital, thus creating regional disparities.

There trends suggest that there is a need for policies that focus on increasing labor force participation, especially in woman and older workers, while also supporting economic measures that are targeting regional development especially in the regions that are facing significant labor shortages. Over time, continued population aging will also put pressure on the pension and healthcare system in North Macedonia.

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