"Population aging in terms of generational cohorts in the context of labor productivity in the Slovak Republic"

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POPULATION AGING IN TERMS OF GENERATIONAL COHORTS IN THE CONTEXT OF LABOR PRODUCTIVITY IN THE SLOVAK REPUBLIC

Abstract

The aging of the population is the main global demographic trend of the 21st century and one of the main factors in the formation of supply in the labor market. This study focuses on the aging of the population, which, in the context of the labor market, represents a problem for countries to sustain economic growth. The aim is to determine, based on the analysis of available statistical data, the impact of population aging on labor productivity and the labor market in the Slovak Republic. It also seeks to define how to mitigate the effects of population aging on maintaining economic growth and social stability without raising the retirement age. The study analyzed statistical indicators, utilizing OECD population projections and linking them to macroeconomic indicators (GDP, employment). Assuming GDP growth (3%) and labor productivity (2%) per year while maintaining 70% employment in comparison with population growth presented in the OECD forecasts, there will be approximately 367,000 unfilled jobs on the labor market in the Slovak Republic. Proposed solutions include pension reforms, investment in innovation and education for increased productivity, support for families to raise birth rates, simplified employment of workers from third countries, and improved working conditions for women. Addressing women's working conditions can help compensate for the shortage in the aging workforce when combined with other solutions.

Keywords	aging population, labor supply, demographic development, generational change, labor productivity, Slovakia
JEL Classification	J14, J21, J26

INTRODUCTION

Population aging is causing problems primarily in sustaining economic growth and ensuring healthcare. Many authors attribute this trend to the large size of the Baby Boomer cohort, increasing life expectancy, and declining birth rates. These three main factors gradually lead to global changes in the population's age distribution (Duxbury & Ormsbee, 2020). Negative demographic trends are not limited to developed countries alone but are gradually becoming a global issue requiring comprehensive solutions and changes (Nagarajan et al., 2021). The projections indicate a decline in European countries' total population and labor force (Rouzet et al., 2019; OECD, 2022). Moreover, a generational shift is occurring, leading to conflicts as different generations have experienced different circumstances during their upbringing and thus have distinct characteristics (Egerova et al., 2021; Mahmoud et al., 2021). Within the labor market, this historically results in the largest clash between working generations and generational conflicts.

From the point of view of the clash between labor supply and demand, this phenomenon will lead to an overhang of demand over labor supply.

The pace at which population aging occurs, particularly in Western and developed countries, can be considered unfavorable for economic growth, as negative demographic trends reduce labor force participation and productivity (Tan et al., 2022). The decline in population growth also leads to a decrease in the rate of new firms entering the labor market (Hopenhayn et al., 2022). As a result, the creation of new jobs will slow down. Labor productivity growth remains an issue, as this can be sustained by replacing human labor with technology or smart industry. On the other hand, a lower population will mean lower consumption of goods and services. Thus, one can expect a decrease in demand for labor, as it is derived from demand. As a result, lower GDP growth is expected, which will lead to lower revenue for the state budget and to the need to increase spending on healthcare in order to care for the generations that will be retiring.

Generational change brings a negative demographic development in the form of an aging population. Statistics and research show that this negative trend is only a beginning. This development has an impact on the labor market and labor productivity.

1. LITERATURE REVIEW

The aging of the country's population has a negative impact on the labor supply in connection with its decrease. Demographic changes in the context of a particular issue have been the subject of a number of studies at the international as well as regional levels – China, Croatia, Denmark, Italy, Sweden, and Germany (Battisti & Gravina, 2021; Evangelia & Pinelopi, 2020; Duxbury & Ormsbee, 2020; Greer et al., 2021; Tan et al., 2022; Hardy et al., 2018; Egerova et al., 2021; Brussig, 2015; Draskovic et al., 2021; Uygur et al., 2023; Azwardi et al., 2023). The mentioned studies complete the picture for other developed countries, especially Western countries where the population development trend is similar.

Evangelia and Pinelopi (2020) examined the impact of population aging in rich countries within the OECD. Their conclusions indicate that population aging can significantly impact macroeconomic indicators, and pension reforms, human capital investments, and technological investments must be taken into account. Tan et al. (2022) looked at the impact of an aging population on firm innovation in China. The authors argue that labor shortages can encourage labor-saving innovations to adapt to demographic changes. Overall, the findings suggest that firms in China can adapt their strategies to successfully innovate in the context of an aging population. The link between technological innovation and aging has also been discussed by Battisti and Gravina (2021). The authors found that robot-

ization has a higher complementarity with workers aged 50 and older, meaning that robots and older workers complement each other. On the other hand, younger cohorts have higher substitutability with robots. The results have important implications for policies aimed at improving employment and labor productivity, particularly concerning the issue of robotization and the older workforce. Similar findings with analysis of gender peculiarities along with the age of employees are obtained by Craiut and Iancu (2022).

Hardy et al. (2018) examined the rate of job retention in V4 countries with an emphasis on older workers aged 55-59. The results suggest that retaining people aged 60 and over in employment is particularly challenging, especially for women. In conclusion, it is essential to increase the employment of older workers due to the increase in the number of older people. Brussig (2015) states that companies must find ways to adapt the organization of work so that it is adapted to the needs of older workers in order to ensure their efficiency and health. For example, they may offer flexible working conditions and shorter working weeks or reduce physical requirements. It is also important for organizations to invest in the training and development of their workforce to contribute to innovation and increase their productivity even in old age. All these factors show that demographic changes significantly impact both the labor market and companies. Therefore, companies and policymakers must actively prepare for these changes and look for innovative solutions that will enable older

workers to remain employed and contribute to the success of businesses.

To mitigate the negative impacts of the current trend in demographic development, it is necessary to combine several measures in labor market policy, pension reform, and more investments in human and technological capital (Papapetrou & Tsalaporta, 2020; Bilan et al., 2023). Some authors are inclined toward an overly simple solution: to mitigate the effects of labor market dropout, it is vital to keep older age groups in the labor force for as long as possible by raising the retirement age. This solution seems very simple for several reasons. First of all, it is necessary to deal with the attrition of the workforce and its ability to stay in good shape on the labor market so that its physical, knowledge, and motivational potential meets the requirements of employers. According to Csoba and Ladancsik (2023), in the case of employment of older age groups, the problem is not age but not meeting the current needs and requirements of employment, especially educationally or health-wise.

Promoting employment among people aged 55 years and older is considered crucial (Hardy et al., 2018). Therefore, new trends in career development of older workers and especially older talents became obvious in face of ageing society (Vilčiauskaitė et al., 2020). However, this period of years starts to become critical in terms of workforce sustainability, as this is the period when people's performance starts to decline, either from a health or motivational perspective. In terms of class inclusion, employees from the working class have the most significant risk of early retirement (Qvist, 2021).

With life expectancy increasing over the last decades in Europe and Western countries, retirement needs to be adapted to keep people in the labor market for as long as possible, as current developments may threaten financial sustainability in several areas of social security systems (Weber & Loichinger, 2022). From the perspective of this issue, the creation of support and measures to keep the workforce in the labor market, which would mean prolonging working life, has been a long-standing topic of discussion at both national and European levels (European Commission & Eurostat, 2019). Extending the retirement age causes considerable opposition from the population. The most discussed issue is the workforce's ability to handle the work complexity.

Older age is also associated with considerable wear and tear on the workforce, not only physically but also psychologically, and the sustainability of the productivity of such a workforce. The recommendations for delaying retirement are based on a simple view of extending life expectancy. However, the time after the pandemic shows that the average life expectancy is stopping, and many working people will not live to retire, which creates financial reserves for the state because their pensions will not be paid. Thus, the ethical question of the state's actions also opens up here. In the context of raising the retirement age, various other options could mitigate the impact of an aging population. The decline in labor supply is irreversible from the established trend, and it will be essential to find adequate replacements for the missing workforce.

In the context of introducing innovations and replacing the human workforce, a long-term discussed topic is the taxation of work performed by machines and robots, the application of the so-called digital tax or the taxation of the profits of technological giants (Olbert & Spengel, 2019; Báez & Brauner, 2018; Agrawal & Fox, 2021). However, it is crucial to set the tax policy so that the development and use of new technologies and innovations are not threatened (Rukundo, 2020). The right combination of the above proposals could help to replace the missing workforce without raising the retirement age, which is currently set at a relatively high limit compared to other countries and also in comparison with the average median life expectancy of the different generational cohorts.

The aging of the population and the issue of current demographic development are the subject of numerous research. Thus, the aim of this study is to determine, based on the analysis of available statistical data, the impact of population aging on labor productivity and the labor market in the Slovak Republic.

2. METHOD

The analyzed statistical data can be divided into two basic categories. In the context of demographic development, the study considers the number of births, population, mortality rate, and life expectancy. In the context of macroeconomic indicators,

the study considers employment rate, number of workers, labor productivity, and gross domestic product. The data were taken from available national and international statistical databases. The analysis of the population size and inclusion in the different generational groups was based on the statistical assumption that persons aged 15-64 are in the labor market. Based on this, the development of the number of employees from individual generations was determined.

Furthermore, the average employment rate for the last 5 years for individual generational and age groups was included, and based on this average, the development of the number of employed people until 2040 was constructed. For future development statistics, the study used population projections (OECD, n.d.a) and mortality and life expectancy projections (United Nations Department of Economic and Social Affairs, Population Division, 2022). The data in these databases refer to medium-term estimates, and population forecasts generally refer to the "medium range."

The analysis focuses mainly on the results for Slovakia, but for comparison, it also analyzed data from selected countries (Germany, France, Italy, and the Czech Republic). The statistical data were processed based on OECD and UN methodology. The development of the number of employed people in terms of individual generational cohorts is processed based on population development forecast by age categories. The average employment rate for the given age group subsequently recalculates the individual category groups. The average employment rate has been determined based on the previous evolution of this indicator over the last 5 years. Figures and models work based on the expected development of the indicators mentioned.

The estimated number of employees is based on the average employment in the last period (70%) combined with the OECD population forecast (n.d.a). The number of necessary employees is established based on the relationship between GDP, labor productivity, and the number of employees. Based on the assumption of GDP growth of 3% and labor productivity growth of 2%, the study plotted the projected development of the number of employees needed to ensure GDP growth. The difference between these two lines represents the projected shortage of labor.

3. RESULTS

Between the different generational cohorts and their gradual development, there is a negative trend in certain demographic aspects, leading to an aging and intergenerational population decline (Table 1).

According to the latest available statistics (2021), the largest generational cohort is Generation Y, also referred to as millennials in some sources and whose members have a significant impact on labor market processes. These are mainly changes in the value orientation of the workforce, which will be more pronounced in the coming generations as well. The Boomers are leaving the labor market, and Generation X is preparing for retirement. These outgoing generations are expected to be replaced by Generation Z and Generation Alpha, which are significantly less numerous because of the annual or intergenerational decline in birth rates. The data are processed from the available database of the Slovak Statistical Office and divided based on the description in the methodologies.

Table 1. Division of the Slovak population into generational cohorts

Source: Slovakstatistic (2021).

Generation	Period	Current age	Men	Women	Total	% share
Alpha	2010 – up to now	0 to 11	359890	343514	703404	12.94
Z	1996 – 2009	12 to 25	391974	372571	764545	14.07
Y	1980 – 1995	26 to 41	651093	616481	1267574	23.32
X	1965 – 1979	42 to 56	605211	587720	1192931	21.95
Boomers	1946 – 1964	57 to 75	547703	651943	1199646	22.08
Silent	1924 – 1945	76 to 97	102032	204580	306612	5.64

Table 2. Comparison of demographic indicators of selected European countries

Generation	Period	Germany	France	Italy	Czech	Slovakia
Average number of births per year in thousands						
Beta	2025 – 2039	689,62	670,00	399,52	98,443	47,960
Alpha	2010 – 2025	744,13	718,99	451,64	106,469	56,915
Z	1996 – 2009	716,03	761,96	548,40	100,441	55,795
Y	1980 – 1995	835,40	753,48	574,02	129,146	82,624
X	1965 – 1979	985,94	812,79	856,27	163,974	89,243
Boomers	1946 – 1964	1206,88	829,60	895,49	155,222	93,974
Average birth rate						
Beta	2025 – 2039	8.36	10.20	7.00	9.368	8.68
Alpha	2010 – 2025	8.97	11.34	7.68	10.189	10.41
Z	1996 – 2009	8.84	12.76	9.50	9.654	10.32
Y	1980 – 1995	10.62	13.57	10.13	12.539	16.00
X	1965 – 1979	12.69	15.99	15.97	16.545	19.35
Boomers	1946 – 1964	16.71	18.75	18.47	16.695	24.39
Average life expectancy						
Beta	2025 – 2039	83.58	84.57	85.48	81.197	79.94
Alpha	2010 – 2025	81.08	82.52	83.10	78.715	76.87
Z	1996 – 2009	78.60	79.68	80.24	75.599	73.76
Y	1980 – 1995	74.97	76.09	76.24	71.593	71.08
X	1965 – 1979	71.38	72.42	72.11	70.226	70.29
Boomers	1946 – 1964	68.73	68.99	68.08	68.756	67.59

According to Table 2, significant declines in population and fertility rates are observed across all selected countries. As in the case of Slovakia, this trend is intergenerational, with each generation experiencing a relatively significant decline in both rates. The so-called "small generational boom" in the Alpha generation group, as in the case of Slovakia, is observed only in Germany and the Czech Republic. A comparison of these countries shows that the population decline trend is most pronounced in Italy. When comparing the average life expectancy, the increase is slower in the case of Slovakia, while the other selected countries have better results.

Regarding labor market exit, the average retirement age in the EU is 65 years. In the case of Germany, the current retirement age is 65 years, but by 2031, this age should be gradually increased to 67 years (Destatis, 2023). Such an increase in the retirement age is a debated topic across selected countries, but also in other countries where there is a problem with the aging of the population. From the point of view of raising the retirement age in the conditions of Slovakia, if take into account the slower growth of the average life expectancy or the high number of older workers leaving due to "attrition", the consideration of raising the retirement age is all the more debatable.

The development of the number of people employed in the Slovak Republic from each generational group has been divided into two parts to illustrate the significant difference between the "old" and "new" generations (Figure 1).

The total population of Generation Z is approximately 750,000. In 2040, the employed population of this generation was expected to be approximately 630,000, which, given the overall size of the population, may represent the peak of the number of employed in this cohort. As for the dominant position in 2021, the dominance of the labor market changes between Generation X and Generation Y. The change in dominance of the next generation Z due to its significantly low multitude is questionable. The Boomer generation is gradually reaching retirement age and leaving the labor market. Gradually, this trend is also seen with Generation X, and in the last monitored years, generation Y will also start to leave the labor market. Based on the above developments, there will be a significant decline in the labor force and a labor supply shortage in the labor market. However, it was assumed that there would be an increase in labor productivity due to the introduction of smart industry, and the sustainability of economic performance will thus depend on the speed of introduction and
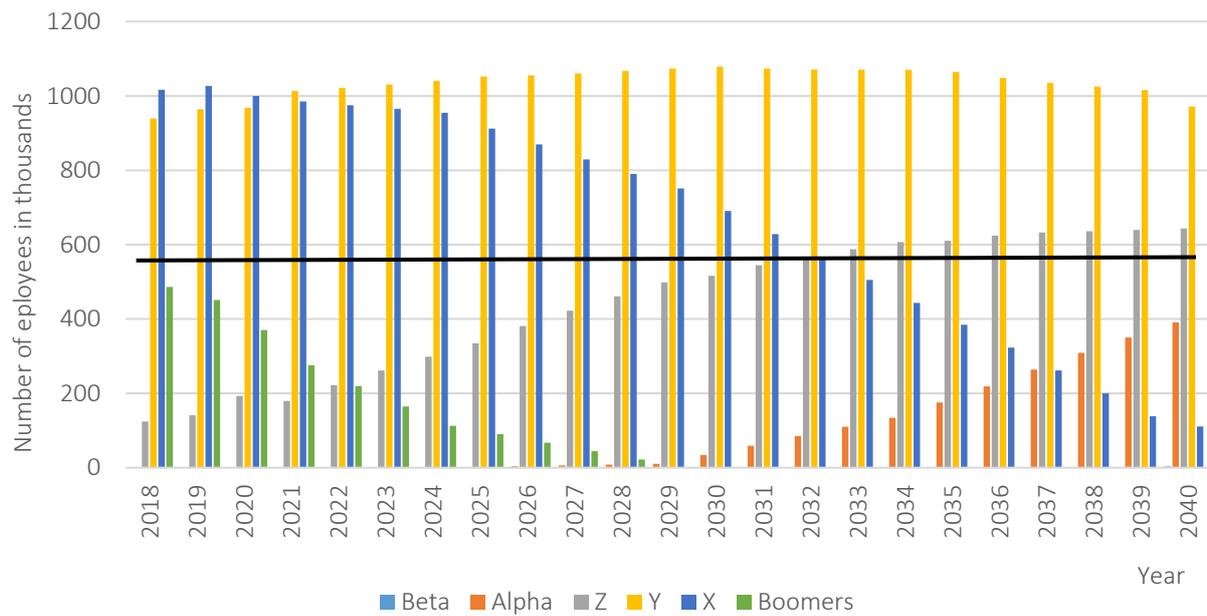
Figure 1. Prediction of the number of employees in generational cohorts

on the preparation of the workforce for new jobs that will require specific skills and competences different from previous generations.

According to Table 3, the trend of the dominant age group in terms of the peak of the highest employment rate changed in previous years, and the slightly higher employment rate was among the 45-49-year-olds. However, there is a relatively large drop in the employment rate as the 55-59 and 60-64 age groups move through the transition. The average retirement age is 64+, so a significant decrease in the number of employees in this group was not expected. This decline in the labor force may be due to rising mortality rates at older ages, early retirement, or disability pensions.

The comparison of employment rates between men and women (Figure 2) in terms of age groups shows a significant difference in labor market entry and retention and in the long-term trend of the given indicator (2000–2010–2020). Compared with men, improving working conditions for women, especially in terms of employment rates at the age of 20 to 40 years, where there is a significant difference with men, would increase the labor supply potential of the labor market. In order to improve and enable women to remain active

Table 3. Employment rate by age structure

Employment rate by age groups							
Age groups / Year	2015	2016	2017	2018	2019	2020	2021	Average in %
15 − 64	52.80	54.30	55.10	55.90	56.30	55.10	60.29	58.39
15 − 19	3.00	4.00	4.10	5.20	3.50	3.00	2.10	3.56
20 − 24	39.60	42.60	46.00	46.40	43.70	40.30	38.00	42.37
25 − 29	72.70	74.00	73.10	73.70	75.00	72.90	75.30	73.81
30 − 34	73.00	75.90	75.00	76.50	76.40	76.30	82.90	76.57
35 − 39	79.50	80.60	81.20	80.70	80.90	78.70	84.50	80.87
40 − 44	83.70	85.50	85.40	86.20	86.60	84.90	85.70	85.43
45 − 49	83.10	84.20	85.10	87.70	87.90	86.70	85.20	85.70
50 − 54	77.90	80.50	80.70	83.00	85.20	83.20	84.00	82.07
55 − 59	69.70	70.50	74.50	76.50	77.50	78.40	77.90	75.00
60 − 64	22.80	27.00	31.50	32.50	37.00	38.30	43.20	33.19
65 +	2.50	2.60	3.50	4.0	4.60	4.50	4.40	3.73

Source: Slovakstatistic (2021).

Men

age group	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 +
2000	5,1	50,7	76,9	81	81	81,3	80,5	76,2	56,1	9,9	1,8
2010	2,8	42,1	76,2	83,9	86,6	82	82,3	77,6	72,1	28,8	2,5
2020	3,8	50,8	85,2	89	86,4	88,6	87,2	83,9	80,7	42	6,3

Women

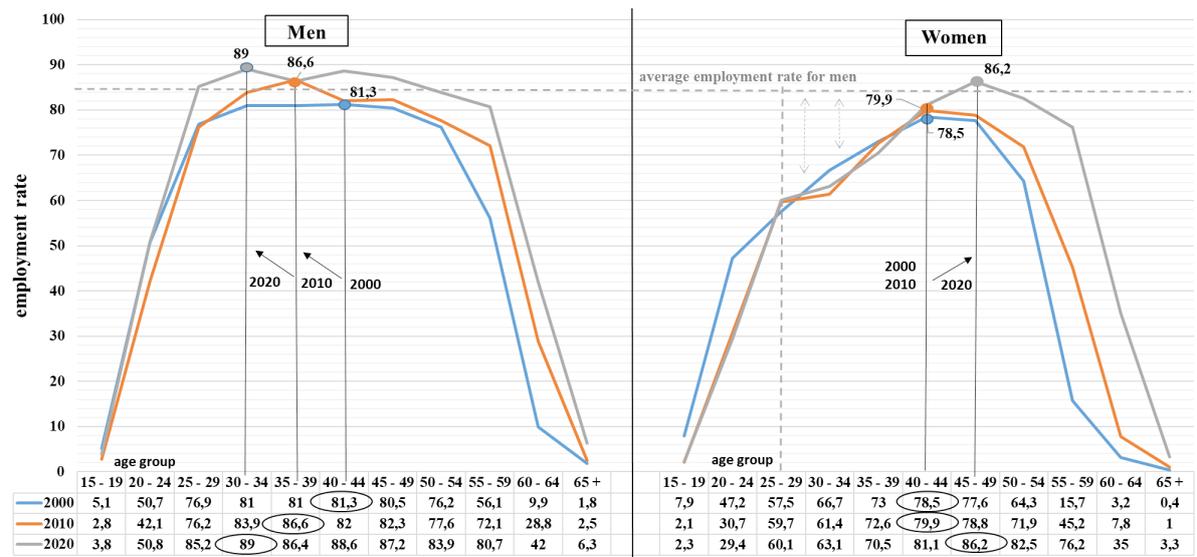| age group	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 +
2000	7,9	47,2	57,5	66,7	73	78,5	77,6	64,3	15,7	3,2	0,4
2010	2,1	30,7	59,7	61,4	72,6	79,9	78,8	71,9	45,2	7,8	1
2020	2,3	29,4	60,1	63,1	70,5	81,1	86,2	82,5	76,2	35	3,3

Figure 2. Employment rate for 2021 – Gender comparison

in the labor market during, for example, childcare, employers should consider other forms of working time, either in the form of reduced or flexible working hours or the possibility of working from home, which has become widely used in recent years. In conjunction with working from home, one other option for engaging women in work could be to support them in entrepreneurial activities.

Oladipo et al. (2023) dealt with the entrepreneurship and self-employment of women so that they could be competitive. This makes them significantly more flexible in relation to their time. By working from home, they achieve significant synergistic effects that allow them to narrow the performance gap compared to men. From the perspective of the overall economy, this productive behavior of women leads to higher economic performance. If the number of the possible workforce in case the development is similar to that of men, approximately 120,000 workers from these age groups will be added to the labor market. However, it is also necessary to consider productivity and added value because due to the required changes in the work format (shorter working hours, flexible forms of employment, home office), these indicators would decrease.
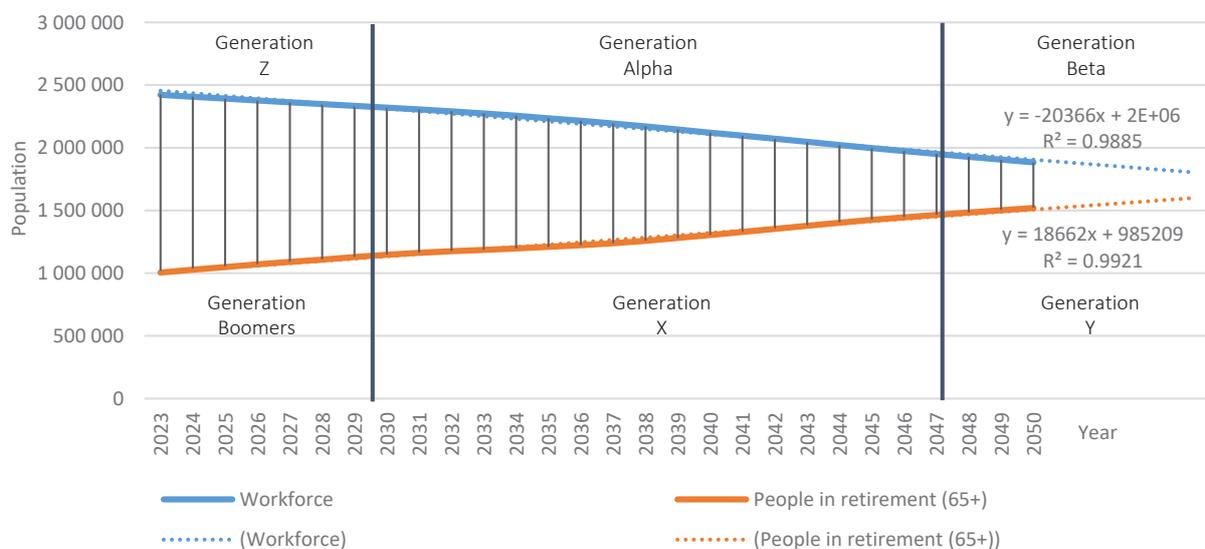
Source: OECD (n.d.b), Slovakstatistic (2021).

$$y = -20366x + 2E+06$$
$$R^2 = 0.9885$$

$$y = 18662x + 985209$$
$$R^2 = 0.9921$$

Figure 3. Comparison of the forecast of working people with the number of people in retirement age

Table 4. Number of workers per pensioner

Year	2023	2024	2025	2026	2027	2028	2029
Workforce/retirees	2.41	2.34	2.28	2.22	2.17	2.12	2.07
Year	2030	2031	2032	2033	2034	2035	2036
Workforce/ retirees	2.02	1.98	1.95	1.92	1.88	1.85	1.81
Year	2037	2038	2039	2040	2041	2042	2043
Workforce/ retirees	1.77	1.73	1.68	1.63	1.58	1.53	1.49
Year	2037	2038	2039	2040	2041	2042	2043
Workforce/ retirees	1.77	1.73	1.68	1.63	1.58	1.53	1.49
Year	2044	2045	2046	2047	2048	2049	2050
Workforce/ retirees	1.44	1.40	1.37	1.33	1.30	1.27	1.24

With the gradual exit from the labor market of the "strong" generational cohorts (Boomers, X and Y) and the entry of the "weak" generational cohorts, the number of people in retirement will increase at a relatively high rate (Figure 3). This increase will be almost directly proportional to the year-on-year decrease in the workforce because the new generation groups (generation Z, Alpha, Beta) entering the labor market are significantly smaller.

Table 4 shows that for every person of retirement age, 2.41 people are actively participating in the labor market. However, this trend will decrease significantly with the aging of the population. At the same time, in 2030 and 2031, there will be approximately only two workers, and by the end of the monitored period of the forecast, the labor force for one retired person will be at the level of

1.24 workers. This raises the question of financing the social and health system. As stated, it is crucial to focus on growth in innovation and technology, which will increase labor productivity even with a declining labor force trend.

With the departure of strong generational cohorts, economic growth will depend mainly on younger generational cohorts and workers from third countries (Figure 4).

Generation Y and X are the most significant contributors to GDP in terms of generational cohorts. These generations largely participate in Slovakia's overall economic growth. With their exit, further economic growth will be questionable because, as was already stated, the generations following them, based on how big they are, cannot sufficiently re-

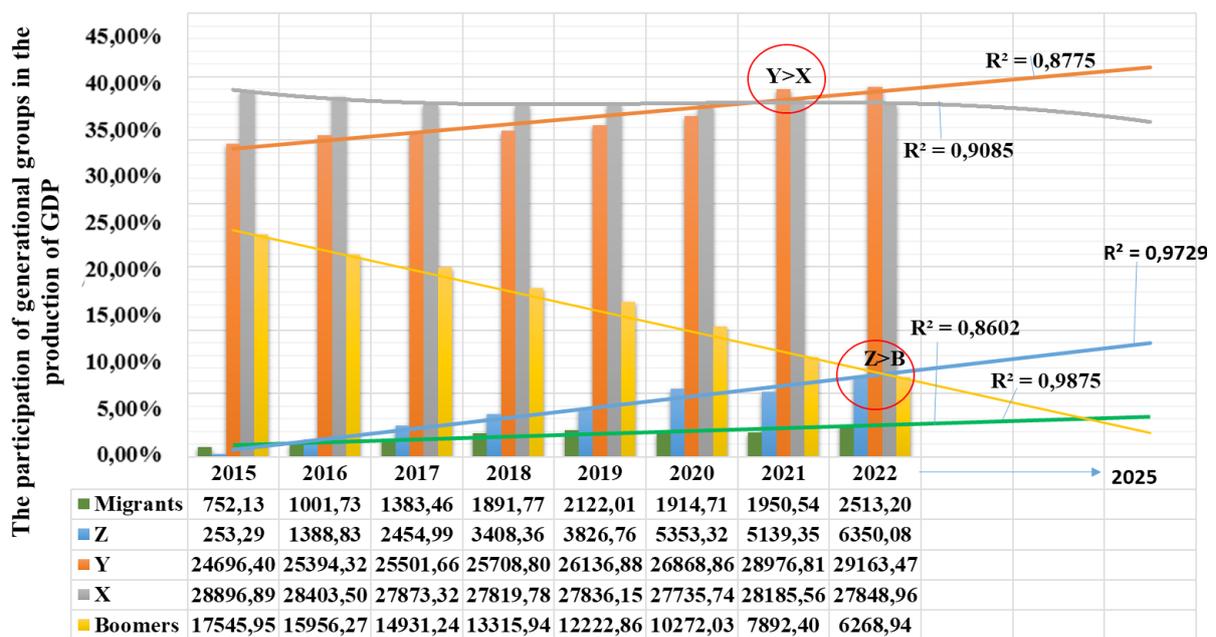|	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2025**
■ **Migrants**	752,13	1001,73	1383,46	1891,77	2122,01	1914,71	1950,54	2513,20	
■ **Z**	253,29	1388,83	2454,99	3408,36	3826,76	5353,32	5139,35	6350,08	
■ **Y**	24696,40	25394,32	25501,66	25708,80	26136,88	26868,86	28976,81	29163,47	
■ **X**	28896,89	28403,50	27873,32	27819,78	27836,15	27735,74	28185,56	27848,96	
■ **Boomers**	17545,95	15956,27	14931,24	13315,94	12222,86	10272,03	7892,40	6268,94	

Figure 4. The share in the creation of GDP of individual groups in Slovakia

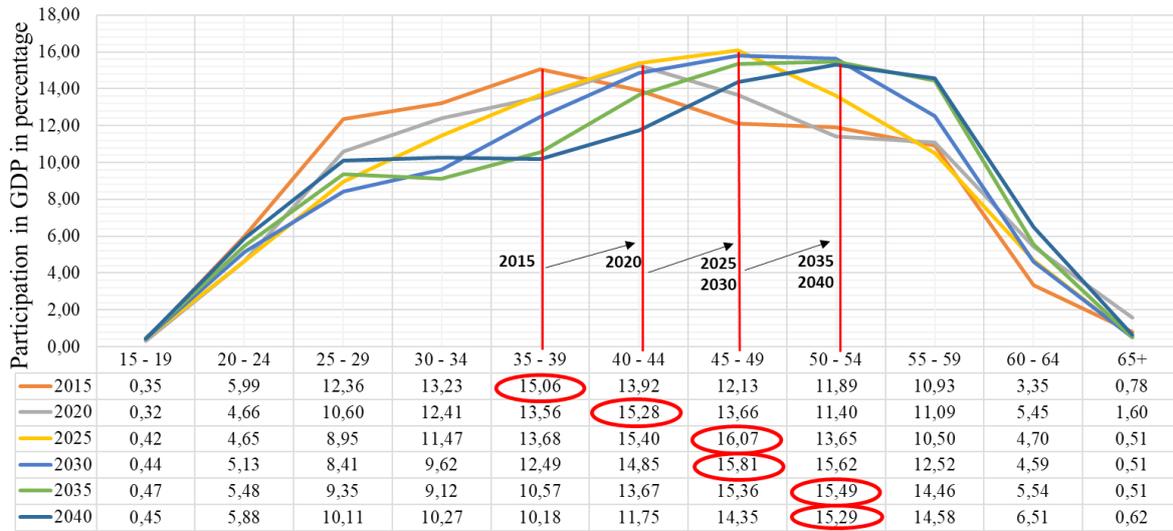|	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65+
2015	0,35	5,99	12,36	13,23	15,06	13,92	12,13	11,89	10,93	3,35	0,78
2020	0,32	4,66	10,60	12,41	13,56	15,28	13,66	11,40	11,09	5,45	1,60
2025	0,42	4,65	8,95	11,47	13,68	15,40	16,07	13,65	10,50	4,70	0,51
2030	0,44	5,13	8,41	9,62	12,49	14,85	15,81	15,62	12,52	4,59	0,51
2035	0,47	5,48	9,35	9,12	10,57	13,67	15,36	15,49	14,46	5,54	0,51
2040	0,45	5,88	10,11	10,27	10,18	11,75	14,35	15,29	14,58	6,51	0,62

Figure 5. Share of GDP of 5-year age groups

place these generations. What is important now is to focus on creating and introducing innovative processes that will increase labor productivity, and thus, the new generations, even with insufficient numbers, will cover the shortfall of the strong generational cohorts. However, a positive trend that is pointed out is the slight year-on-year increase in the number of workforce from abroad.

With the gradual aging of the "strong" generational cohorts, emphasis will be placed on older age groups from the point of view of GDP creation (Figure 5).

The groups 35-39 (15.54%) and 40-44 years old (15.6%) currently have the highest share in GDP creation. However, in the coming years, there

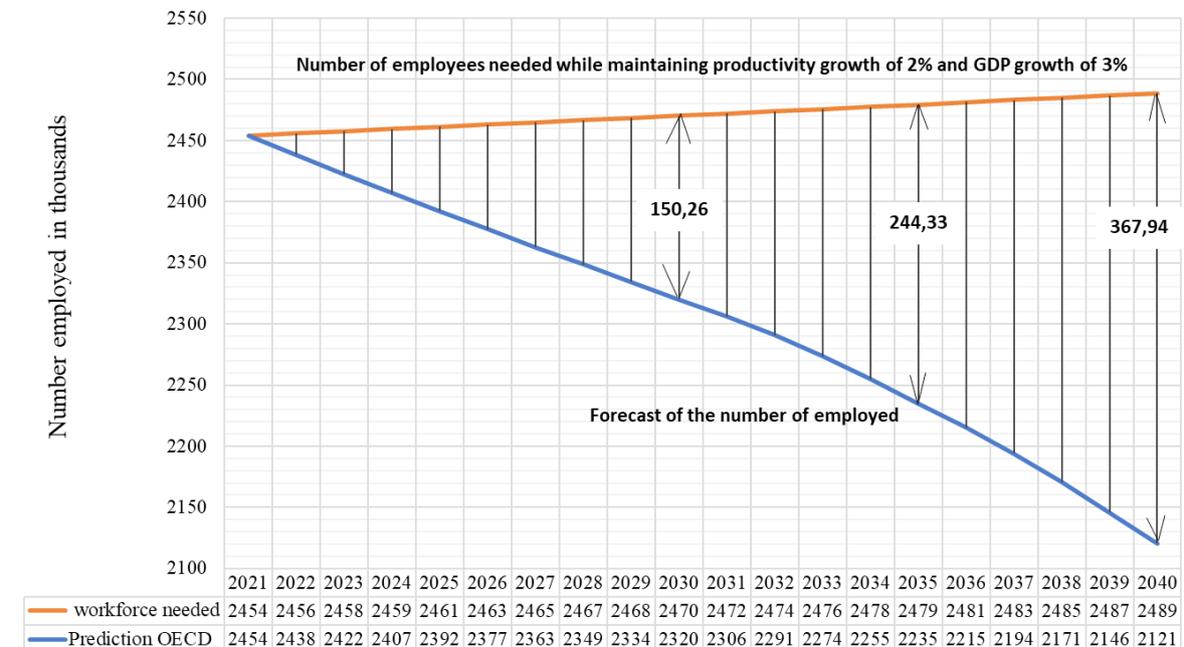|	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
workforce needed	2454	2456	2458	2459	2461	2463	2465	2467	2468	2470	2472	2474	2476	2478	2479	2481	2483	2485	2487	2489
Prediction OECD	2454	2438	2422	2407	2392	2377	2363	2349	2334	2320	2306	2291	2274	2255	2235	2215	2194	2171	2146	2121

Figure 6. Comparison of the population prediction to the expected development of the necessary population to maintain the current GDP growth in combination with the current labor productivity growth trend

will be a shift that will lead to a change in these groups, and in terms of GDP creation, emphasis will be placed on older age groups. They will represent the largest cohort in creating the country's economic growth. It should be noted, however, that these groups are closer to retirement age, and thus especially the 55-59 and 60-64 age groups, the shortfall from the point of view of employment is almost 50 percent, which is caused by an increase in deaths, early retirement, or disability pension.

According to Figure 6, the average GDP growth over the last 10 years is 3%, and the average increase in labor productivity is 2% (Slovakstatistic, 2022). In the case of maintaining this year-on-year GDP growth, based on the previous prediction of the number of employees, labor productivity would have to increase in 2040 by more than twice as compared to the initial period of 2021. If the trend of GDP growth of 3% and labor productivity of 2% is maintained, there will already be a shortage of 150,000 people on the labor market and, in 2040, up to 360,000 people. However, reaching this number is not realistic because, with declining fertility forecasts and the exit of "strong" generational cohorts from the labor market, there would have to be an increase in the employed population of almost 2 million, which is about a 100% increase compared to the present. It will thus be essential to replace the increase in the number of employed with migrants. However, from the point of view of the great need for a new workforce, it will also be necessary to increase labor productivity mainly by introducing innovations and innovative processes. In order to maintain stable GDP growth, it is essential to combine, in particular, measures in the area of productivity growth and the recruitment of workforce from third countries.

4. DISCUSSION

Demographic processes, namely population aging, are negatively affecting most countries. This leads to a labor shortage and, therefore, shifts in the retirement age. Such a decision to reform the pension system at the political level took place in France, which was difficult for the public to accept, and mass protests were held across France (Oxford Analytica, 2022, 2023). For this reason, it is crucial to look for other options to solve the labor shortage and maintain economic growth.

The proposed solutions aim to support the education of older people so that they meet the conditions set by employers and remain on the labor market for as long as possible. Another proposed measure is to increase investment in innovation to increase labor productivity and reduce the impact of work activities on the health and attrition of a workforce. In order to increase the number of the workforce and maintain economic growth, it is also important to implement measures that will help support and keep women in the labor market. In addition to looking for an opportunity in the home country, the last of the proposed solutions is to change the legislative conditions for the employment of workers from third countries so that the employment of such workers is significantly facilitated.

The results of this study are also identified with other authors who talk about the lack of labor force and the need to keep older people on the labor market (Urbancová & Vrabcová, 2020; Lorga & Dobre, 2018).

Keeping older cohorts active in private life but also in the labor market and voluntarily staying there is also referred to as active aging (Rudnicka et al., 2020; Walker & Maltby, 2012). Active aging has a significant positive impact on older people, leading to their active involvement in everyday life, which decreases the need for social security and public spending (Barbabella et al., 2022). Slovakia and other European countries are implementing national programs for active aging (NPAS). Currently, the NPAS is approved in Slovakia for 2021–2030 and focuses, for example, on healthcare, support for economic activity, and promotion of dignity, independence, and inclusion of older cohorts (NPAS SR, 2021). Rudnicka et al. (2020) claim that the presented national programs are not a sufficient solution. It is paramount to focus on the education of older cohorts and improving healthcare so that the consequences of the attrition of the workforce are addressed. Meng et al. (2023) dealt with the attrition of the workforce. They showed that it is essential to use a lifelong approach to healthcare to systemically improve and enhance the population's overall health. To prevent workforce

attrition and sustain and grow productivity, the introduction of new technologies and innovations should be promoted, and both the state and employers should invest in the development of scientific and technical progress. Within this trend, it is essential that Slovakia and the rest of the European Union can keep up with technological development.

One of the solutions to financially ensure the required level of innovation-technological progress, which could mitigate not only the effects of population aging, is the European Strategy until 2030. Su et al. (2022) dealt with the development of technologies and their impact on labor market and employment. The authors draw attention to the fact that technology can have a positive or a negative impact on the development of employment. In the current form and characteristics of the technologies used, the study considered them beneficial in several respects:

1. They facilitate work activities and thereby reduce attrition.

2. They increase productivity.

3. They allow using different forms of working time and other self-employed activities.

The last aspect is one way to address improving women's employment. With the help of technology, they can work from home or start their own business. The above issue has been addressed by Oladipo et al. (2023), who conclude that working from home allows women to narrow the performance gap compared to men. This solution mitigates the disadvantages arising from society's higher demands on their time in relation to housework.

Raising the retirement age to solve an aging population is not currently appropriate. On the contrary, the need to promote active and healthy aging through lifelong learning and improved health systems was stressed. This solution was outlined by Cristea et al. (2022), who refer to the conclusions of Nagarajan et al. (2021) and Kotschy and Sunde (2018). Together with the support of active aging, this involves the support and improvement of the position of women on the labor market, the increase of investments in new technologies and innovative processes, the support of the growth of productivity and the facilitation of work activities, legislative changes to facilitate the employment of workers from third countries.

It is also important to point out the limitations of these population projections. First, they do not anticipate unexpected events: the population projections are based on the assumption that current trends in fertility, migration, and mortality levels will be maintained. They do not view unexpected events like war, epidemics, or natural disasters. Second, they do not consider policy interventions: OECD population projections do not assess policy changes that could affect birth, migration, and death rates. Third, they do not take into account economic changes that may affect fertility or migration. Fourth, they do not provide accurate forecasts: Population projections are only estimates and not accurate forecasts and are, therefore, a possible development scenario. Finally, the results may be influenced by the data processing methodology.

CONCLUSION

The study of demographic processes that lead to the reduction and aging of the economically active population in today's conditions is an important aspect of the statistical study of the labor market. The purpose was to determine, based on the analysis of available statistical data, the impact of population aging on labor productivity and the labor market in the Slovak Republic. The study outlined the current demographic developments associated with the aging of the population and its impact on the labor market, mainly in the form of an analysis of labor supply.

The aging of the population poses a risk to the whole social system. Generational cohorts are being replaced in the labor market, and the new generational cohorts cannot replace the old ones regarding the number of workers. Assuming employment is at 70% and annual economic growth is maintained (GDP is at 3%, and labor productivity is at 2% – according to the current average trend), there will be a shortfall of up to 367,000 workers on the labor market in 2040.

Based on these findings, focusing on labor productivity and retention developments will be necessary. The study focused on some solutions, the combination of which would cover the negative developments. These solutions are legislative changes for the employment of migrants, better access to work for women, improving labor productivity through investment in technology development, and keeping older people in the labor market.

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