Impact of intelligent industry on labor productivity under the conditions of population aging: The case of Slovakia

Richard Rigó

Faculty of Social and Economic Relations
Alexander Dubček University in Trenčín,
Slovak Republic
richard.rigo@tnuni.sk
ORCID 0009-0007-8056-2538

Adriana Grenčíková

Faculty of Social and Economic Relations
Alexander Dubček University in Trenčín,
Slovak Republic
adriana.grencikova@tnuni.sk
ORCID0000-0003-1077-1127

Jana Španková

Faculty of Social and Economic Relations
Alexander Dubček University in Trenčín,
Slovak Republic
jana.spankova@tnuni.sk
ORCID 0000-0002-9951-4890

Abstract. Population aging impacts labor supply and creates economic and social challenges, in particular due to a growing number of retirees and a shrinking workforce. This study examines the potential effects of intelligent industry on the Slovak labor market, focusing on labor supply and demand through analysis of statistical data from sources such as McKinsey, PWC, and the OECD. By modeling scenarios based on varying levels of intelligent industry adoption, labor productivity growth, and workforce trends, this study projects labor market shifts in Slovakia up to 2033. Key findings suggest that increased labor productivity and technological advancements could alleviate some workforce shortages, potentially substituting approximately 70,000 jobs while maintaining economic stability. Despite these advances, the Slovak labor market is expected to face a shortage of roughly 220,000 workers by 2033 due to demographic shifts. Thus, the study demonstrates that while intelligent industry could offset some labor demand and increase productivity by around 6%, it remains a partial solution.

These insights underscore the need for strategic policy measures to mitigate the impacts of population aging and to adapt to evolving labor demands effectively.

Keywords: aging workforce, intelligent industry, Slovakia

JEL Classification: J21, J26, O33

1. INTRODUCTION

Current demographic trends in the Slovak Republic and the European Union are indicative of an irreversible process of population aging. In terms of the labor market, this means that as a high number of generational cohorts will be retiring, the incoming generations will not be able to replace them in terms of numbers (Brucker Juricic et al., 2021). According to OECD population projections, Slovakia's senior population is expected to rise by 50% by 2050, resulting in a significant labor force deficit. The pace at which population aging is occurring, especially in Western and developed countries, is considered unfavorable for economic growth because negative demographic trends reduce workforce participation and productivity (Tan et al., 2022). The resulting population deficit will have a negative impact on GDP and will require an increase in expenditures from the state budget for the social pension and healthcare system. Due to a less numerous working group, incomes will be lower. As a result, states have been enacting controversial policies, for instance raising the retirement age. According to Maestas (2023), every ten percent rise in the population over 60 lowers GDP per capita by 5.5 percent. This decline is attributed to lower employment growth and, to a larger extent, lower labor productivity growth.

One way to counteract the anticipated trend brought on by population aging is to boost worker productivity. The advancement of technology and inventions has the potential to enhance labor productivity and sustain national economies. Information and communication technologies have positive impacts on work productivity, which makes investing in these technologies essential (Laddha et al., 2022; Bencsik, & Juhasz, 2023). Currently, the utilization of artificial intelligence comes to the forefront. It becomes a key factor that can influence the future of work. Artificial intelligence has the potential to significantly increase work productivity and automate various types of tasks, helping to compensate for the labor shortage (Acemoglu and Restrepo, 2020). Referring to statements from technological giants such as Google, Amazon, and Microsoft, Dauvergne (2022) mentions that artificial intelligence can help strengthen and improve every business or organization, enhancing their social and societal impact and sustainability. According to the analysis of the highly cited study by Rao and Verweij (2017), artificial intelligence could contribute up to 16 trillion USD annually by 2030, with the advent of more advanced technologies expected to result in even higher capital growth.

This study will focus on changes in work productivity due to the development of the intelligent industry, coupled with the implementation of generative artificial intelligence, as a potential solution to the workforce shortage caused by population aging.

2. LITERATURE REVIEW

The aging population in some countries worldwide represents a growing proportion of elderly individuals in society, signifying significant economic challenges that require intervention from the state. This issue arises due to a declining birth rate coupled with an increasing life expectancy (Ali & Kamraju, 2023; Yang, 2021). Economic models typically function under the assumption of a stable or expanding population; however, declining fertility rates in high-income nations make this assumption untrue (Jones, 2022). The population ages as a result of declining fertility and rising life expectancy. Population aging has a profound impact, particularly on the sustainability of economic growth and ensuring social and healthcare

for the population. Japan, European and Western nations are thought to be experiencing the most noticeable population aging globally (Tsutsui et al., 2024; Cicero, 2023; Xi et al., 2022; Lau et al., 2022).

Population aging is a problem that manifests in various spheres. As the older population continues to grow, there is an increasing burden on the shrinking working population, which plays a significant role in providing social and economic support contributing to the well-being of the elderly in later life (Nagarajan and Sixsmith, 2023). The growing number of people in retirement age leads to an increase in state expenditures on the social and healthcare system (Cristea, 2020; Zeka &Veri, 2022; Bednarczyk et al., 2023). The author highlights the need of reintegrating older adults into the workforce, noting that the EU's labor market performance is significantly impacted by how public health spending is managed. Maintaining older individuals in the workforce appears to be a possible solution to the problem, but the reality of retaining these workers presents significant challenges and comes with several issues, including health problems associated with work activities and outdated technological skills required by current technological advancements (Nagarajan et al., 2019).

Several authors reflect on this issue, stating that increasing the retirement age and the aging process result in a substantial portion of the workforce experiencing "wear and tear," leading to an increase in health complications and a change in work productivity (Hernæs et al., 2023; d'Errico et al., 2022). In the context of the increasing retirement age, there is a risk of a rise in the number of people opting for early retirement, particularly in demanding manual jobs, leading to workforce depletion (Zwick et al., 2022). Given that a significant portion of jobs in Slovakia consists of manual labor, the wear and tear of this workforce are even riskier. From this perspective, raising the retirement age cannot be considered a fully sufficient and suitable solution, and it will be important to focus on a combination of measures that can address the missing workforce. This combination of measures should be directed towards areas such as labor market policy, pension reforms, and increased investments in human and technological capital (Papapetrou & Tsalaporta, 2020).

Among specific solutions falling into the set of measures to mitigate the impacts of population aging and cover the workforce shortage, considerations include improving working conditions for older people to keep them in the workforce for as long as possible and voluntarily, without compromising their health. Improving women's access to the labor market, given their lower employment rate compared to men. Enhancing legislative changes for employing migrant workers from other countries and increasing work productivity through job automation. Automation and the introduction of generative artificial intelligence have significant potential for mitigating the impacts of population aging. According to the latest OECD report (2023) focusing on this issue from the perspective of Slovakia, there is a 70 percent probability that up to 33 percent of jobs will be transformed and fully automated by 2040.

In order to address the issues brought on by the aging of the population, technological advancements, the entry of intelligent industry into the labor market, and the automation of job duties seem to be essential steps. According to Acemoglu and Restrepo (2022), population aging leads to increased automation in the industry. The authors contend that there is support for the expansion of intelligent industry since there is a dearth of middle-aged workers with a focus on manual labor. The possibilities of intelligent industry will gradually respond to the labor market's demands through demographic development, leading to improved productivity even with a decline in the working-age population.

3. METHODOLOGY

The presented issue poses a problem on several levels. High numbers of generational cohorts are gradually exiting the labor market, and the generations entering the workforce cannot sufficiently replace the needed workforce. The significant increase in the number of people in retirement age represents higher

expenditures from the state budget for the social and healthcare system. However, due to the decreasing number of workers, the income into the state budget will be lower. One possible solution to this problem is the development of innovations and technologies, which could help increase labor productivity.

The aim of the presented study is to determine the impact of introducing intelligent industry on the labor market in the context of labor supply and demand in the Slovak Republic, based on the analysis of available statistical data.

The statistical data used in this study are sourced from the Slovak Statistical Office and OECD databases. The research draws on preexisting data and hypotheses regarding the impact of automation and generative artificial intelligence on labor productivity and employment, as documented in reports by the OECD, McKinsey, and PwC within the context of the Slovak Republic.

For forecasts of the required workforce, the research is based on a simple relationship described by authors Mankiw and Taylor (2020).

$$Y = A \times L$$

Y = Gross domestic product
A = Labor productivity
L = Number of workers

The relationship between the indicators contained in the formula can be interpreted as GDP being dependent on labor productivity and the number of workers. An increase in labor productivity, for example, due to the development of intelligent industry, leads to GDP growth. An increase in the number of workers also leads to GDP growth. Based on the provided interpretation, this relationship of macroeconomic variables, supplemented with assumptions or scenarios about the expected developments, for identifying the workforce needs, can be formulated as follows:

$$NL = pY/pA$$
$$Ml = NL - DL$$

NL = Necessary workforce
pY = Estimated total gross domestic product
pA = projected labor productivity per employee
ML = labor shortage
NL = labor required
DL = labor force projected by demographic trend

The mentioned modification of the formula can be interpreted as follows: (1) The formula indicates that the number of required employees depends on the assumed values of GDP and labor productivity; (2) If there is an assumed growth in GDP and labor productivity, the required number of employees decreases; (3) The missing workforce is equal to the difference between the required number of employees and the expected number of employees based on demographic trends; (4) If the expected number of employees is lower than the required number, there is a risk of a labor shortage.

The processed forecasts are based on the average long-term trend of the employment rate (Slovak Statistical Office, 2023) and OECD population projections. It is important to note the limitations associated with these projections, which may not be accurate due to current dynamic changes in areas such as politics, economics, technology, or global environmental changes that can impact current and future demographic developments. Scenarios for the development of the labor shortage are derived from the relationship

between labor productivity per capita, GDP, and the labor force. These scenarios are coupled with population forecasts that assume an average employment rate of 70% based on the long-term trend. Through applied statistical-mathematical methods and deduction, a perspective on the issue is presented, based on which the conclusions are derived.

4. EMPIRICAL RESULTS AND DISCUSSION

The According to the OECD population projections combined with labor market data from the Slovak Statistical Office, it can be assumed that the demographic development in the Slovak labor market, in terms of the number of workers and retirees, will be unfavorable.
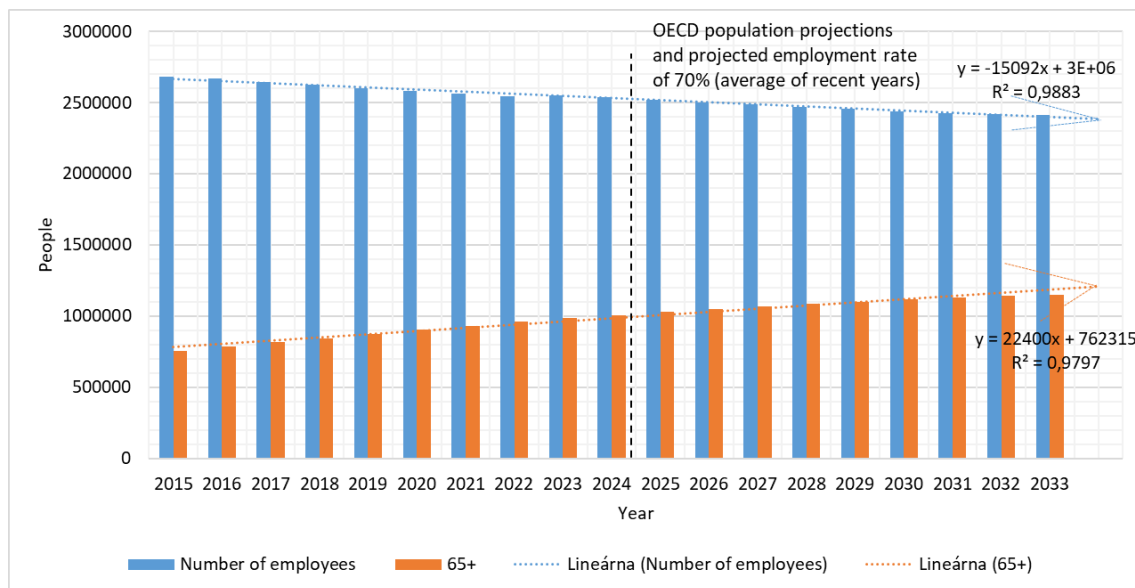

Figure 1. Comparison of the forecasted development of workers and retirees
Source: own elaboration

The illustrated trend suggests a decreasing gap between the number of retirees and the number of workers. In the long term, given the current state of the labor market, such a development would be unsustainable from the perspective of public finances. Therefore, various measures are being taken, such as increasing the retirement age or facilitating the entry of workers from third countries into the country. Technological advancement, particularly in artificial intelligence, is a factor that could take the place of the retiring worker force and influence the type of occupations and the present labor market structure.
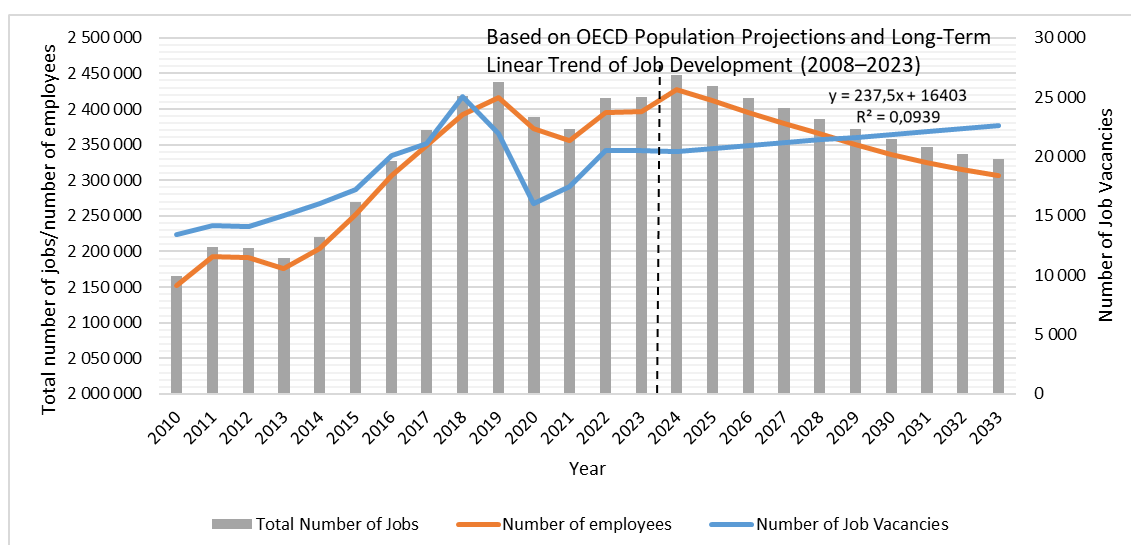
Figure 2. Development of the number of jobs
Source: own elaboration

The number of vacant and unfilled job positions averages around 20,000. Since 2022, this indicator has been depicted using a long-term linear trend. The development of employment numbers is determined based on population projections (OECD) and the assumption of an average employment rate of 70 percent. The illustrated job trend is influenced by automation, especially in the form of the introduction of generative artificial intelligence. According to several studies, jobs are expected to gradually automate between 30% and 45% by 2030 to 2040 (McKinsey, 2023; Squicciarini and Staccioli, 2022; PWC, 2020). As per scenarios, automation is anticipated to lead to a significant decline in job positions. In a report presented by the OECD (2022), the most likely scenario is that up to 33% of jobs in Slovakia will be automated, representing the highest percentage among all European countries. Automation of jobs could partially replace the outgoing older workforce, requiring the new workforce to adapt to new job positions. According to the mentioned report, a loss of up to a third of jobs is expected. But it's important to remember that the studies cited before also predict the emergence of new job positions. Therefore, state measures are needed, focusing on the creation of new jobs that will not be threatened by automation, and supporting education or requalification of the workforce affected by these changes.

According to McKinsey (2023), generative artificial intelligence and automation, at the current pace of productivity, can increase the growth by up to 3.4 percent. The current average growth in labor productivity over the last observed period is approximately 2 percent, and the GDP growth is approximately 3 percent. Sustaining this expansion while taking into account the issue of an aging population creates a labor shortage.
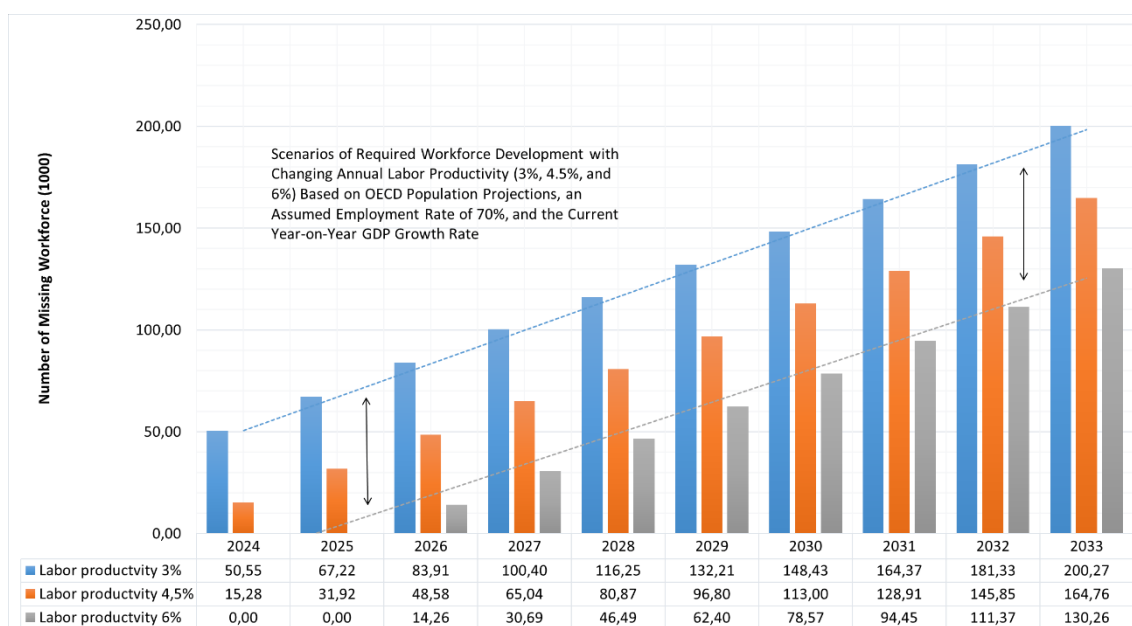
Figure 3. Scenarios for the development of the labor shortage
Source: own elaboration

With the current average productivity growth of 2% per year, the labor shortage by 2033 would represent approximately 224,000 workers. If productivity increased by one percent, the estimated labor shortage in the labor market in 2033 would be 200,000. According to presented studies, productivity could increase due to automation by 3.4%, representing a doubling of the current trend. In the case of a 6% annual increase in productivity, the projected labor shortage would be almost 130,000. Automation of jobs and the growth in labor productivity should be able to cover part of the missing workforce. With a 6% increase in labor productivity, based on the findings, it can be assumed that artificial intelligence and automation could replace approximately 70,000 jobs. Automation and the increase in labor productivity can partially address the missing workforce. However, automation cannot fully replace the outgoing workforce, and other solutions need to be explored.
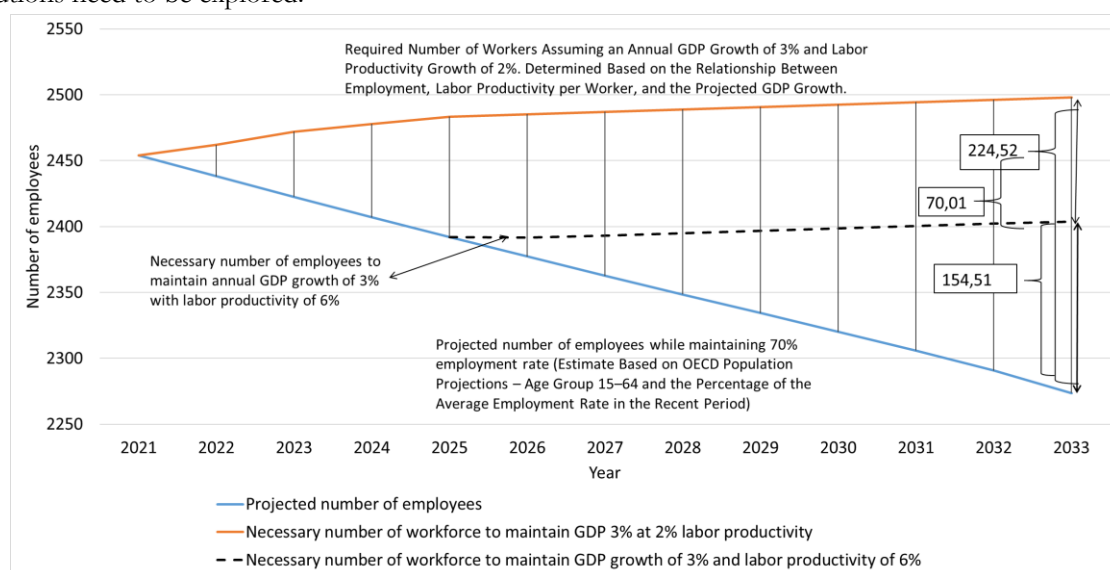

Figure 4. Comparison of workforce requirements based on labor productivity
Source: own elaboration

The current labor productivity per employee is growing by an average of 2.2 percent annually, and the current average GDP growth over the last period was 3 percent (Slovakstatistic, 2023). With the current labor productivity, more employees are required to maintain this GDP growth. Assuming a 70% employment rate and OECD demographic forecasts, it is projected that by 2033, there will be a 224,000 worker deficit in the labor market. According to reports (McKinsey, PWC) addressing the issue of automation, the most optimistic estimates suggest an increase in productivity by 3.4 percent compared to the current growth. Based on this estimate, the current productivity growth would reach approximately 6%. To sustain consistent growth in the economy (3% annual GDP growth) and higher labor productivity as a result of automation, estimates suggest a shortage of 154,000 workers in the labor market. Automation could thus cover approximately 70,000 jobs, reducing the labor shortage by about 25 – 30 percent.

5. DISCUSSION

Simultaneous demographic trends associated with population aging and their potential negative impacts on the economy, society, and the labor market are becoming essential for most European countries. Several solutions are available, with one of the simplest yet most debated being the increase in the retirement age. Other possible solutions, supported by research and studies, include improving the employment of women, adjusting legislation to simplify the employment of workers from third countries, encouraging older people to voluntarily stay in the labor market, and increasing labor productivity through the introduction of smart industry and job modifications (Oladipo et al., 2023; Oxford Analytica, 2023; Angelini, 2023; Barbabella et al., 2022; Cristea et al., 2022; Rudnicka et al., 2020). From a societal perspective, an ideal solution may involve a combination of these approaches, avoiding an increase in the retirement age. The forefront among these possible solutions is the development of technologies and innovations and their impact on job modifications due to the introduction of smart industry. The findings of this study indicate that smart industry and the development of technologies represent a positive trend concerning population aging, capable of partially replacing the shortage of labor. These findings are supported by the results of Su et al. (2022), where the authors explored the development of technologies and their impact on the labor market. The data presented by the authors demonstrate that, despite potential drawbacks in specific situations, technologies generally have a favorable effect on the labor market. Smart industry increasingly influences the labor market and work activities. Interest in this area has significantly increased, especially with the accessibility of generative artificial intelligence and its widespread use in the labor market. The development of generative artificial intelligence is considered a potential tool expected to lead to significant changes in the job market. Several significant institutions (OECD, McKinsey, and PWC) have addressed the identified problems and possible impacts. From the perspective of the reports presented in the studies, there will be a gradual introduction of smart industry in the form of generative artificial intelligence. According to McKinsey (2023), Slovakia will be most affected, with up to 33 percent of jobs being modified. The development of smart industries and generative artificial intelligence can be seen favorably in terms of maintaining economic growth and addressing labor shortages, given the demographic trend towards a shrinking workforce. However, some authors in their studies do not consider smart industry, especially generative artificial intelligence, as a positive tool and approach the issue from an ethical standpoint. Wach et al. (2023) identified several ethical problems associated with generative artificial intelligence. According to the findings presented in the studies, the implementation of smart industry, characterized by generative artificial intelligence, will be introduced progressively. Additionally, the author points out the inherent shortcomings of this tool, including insufficient control and regulation of the artificial intelligence market, as well as the high levels of misinformation and false information prevalent in current artificial intelligence models. Another issue highlighted in the OECD report (2023) is the lack of trust and even fear among

people, particularly regarding job loss due to the replacement of jobs by artificial intelligence. According to the results, up to 60 percent of people are concerned about their job security. However, it is important to realize that, like any invention or new technology, the introduction of smart industry brings not only modifications to existing jobs but also entirely new job opportunities. State intervention is necessary to regulate certain aspects of generative artificial intelligence. Simultaneously, from the state's perspective, it is crucial to support education and the acquisition of new skills for people who may be influenced by job modifications (Lorenz et al., 2024). Generative artificial intelligence, even considering its currently not fully utilized potential and potential ethical issues, represents, from the perspective of current demographic processes, one of the necessary tools to alleviate the impacts of the labor shortage.

6. CONCLUSION

Based on the analysis of available statistical data and relevant studies, it can be stated that the aging population poses a critical issue for the labor market in the Slovak Republic. Demographic trends indicate that in the coming years, there will be a significant decline in the workforce and an increase in the number of retirees.

Smart industry leads to an increase in labor productivity. The use of generative artificial intelligence seems to offer a potential remedy for the issue. Based on available population projections and the relationship between the number of workers, GDP, and labor productivity, it can be assumed that, with the current economic development and its sustainability, there will be a shortage of more than 220,000 workers in the labor market by 2033. The analyses refer to findings from reputable institutions, suggesting that the introduction of smart industry in the conditions of the Slovak Republic could affect up to 33% of jobs, representing a possible transformation of up to 792,000 jobs by 2040. It is important to note that, despite job modifications and loss, the creation of new jobs is expected. At the same time, an increase in labor productivity is anticipated, aligning with the current trend by 3.4 percent. According to our projections, automation alone has the potential to automate up to 70,000 jobs that could be automated by 2033 compared to current economic growth, potentially alleviating the anticipated labor gap by as much as 30%.

However, smart industry cannot fully replace the outgoing workforce, and according to the anticipated development, approximately 150,000 workers will be needed to maintain stable GDP growth. Therefore, a comprehensive set of policies is required to address the labor shortage issue. Based on literary analysis, these measures should focus on facilitating the access of older people and women to the job market, investing in innovation, supporting the development of automation and associated labor productivity, promoting education and qualifications for new jobs, and simplifying and supporting the employment of migrant workers. Solving the issues of an aging population and its impacts on the labor market requires a coordinated approach from the government, employers, trade unions, and educational institutions.

The research results need to be interpreted considering the limits and constraints arising from the methods and data sources used. Population projections are based on the OECD methodology, but several unpredictable factors contribute to these projections. Another limitation is the unavailability or insufficient amount of statistical data on the impact of smart industry and generative artificial intelligence on the labor market. In conclusion, from the perspective of the analyzed data results, it can be stated that job automation and increased labor productivity through artificial intelligence offer a partial solution to the challenges of an aging population and labor shortage. However, achieving a sustainable solution requires a comprehensive strategy that includes various measures in the areas of education, employment, migration, and social policy.

ACKNOWLEDGEMENT

REFERENCES

Acemoglu, D., & Restrepo, P. (2020). The wrong kind of AI? Artificial intelligence and the future of labour demand. *Cambridge Journal of Regions, Economy and Society*, 13(1), 25–35. https://doi.org/10.1093/cjres/rsz022

Acemoglu, D., & Restrepo, P. (2022). Demographics and Automation. *The Review of Economic Studies*, 89(1), 1–44. https://doi.org/10.1093/restud/rdab031

Ali, M. A., & Kamraju, M. (2023). The Economic Consequences of Population Aging Challenges and Policy Implications. *ASEAN Journal of Economic and Economic Education*, 2(2), Article 2.

Angelini, D. (2023). *Aging Population and Technology Adoption*. Working Paper Series of the Department of Economics, University of Konstanz, Article 2023–01. https://ideas.repec.org/p/knz/dpteco/2301.html

Barbabella, F., Cela, E., Socci, M., Lucantoni, D., Zannella, M., & Principi, A. (2022). Active Ageing in Italy: A Systematic Review of National and Regional Policies. *International Journal of Environmental Research and Public Health*, 19(1), 600. https://doi.org/10.3390/ijerph19010600

Bednarczyk, T. H., Szymańska, A., Ostrowska-Dankiewicz, A., & Silva, P. (2023). Life insurance with insurance capital funds as a form retirement savings: Determinants for the self-employed. *Journal of International Studies*, 16(3), 127-143.doi:10.14254/2071-8330.2023/16-3/7

Bencsik, A., & Juhasz, T. (2023). Impact of technostress on work-life balance. *Human Technology*, 19(1), 41–61. https://doi.org/10.14254/1795-6889.2023.19-1.4

Brucker Juricic, B., Galic, M., & Marenjak, S. (2021). Review of the Construction Labour Demand and Shortages in the EU. *Buildings*, 11(1), 17. https://doi.org/10.3390/buildings11010017

Cristea, M., Noja, G. G., Stefea, P., & Sala, A. L. (2020). The Impact of Population Aging and Public Health Support on EU Labor Markets. *International Journal of Environmental Research and Public Health*, 17(4), 1439. https://doi.org/10.3390/ijerph17041439

Cristea, M. S., Pirtea, M. G., Suciu, M. C., & Noja, G. G. (2022). Workforce Participation, Ageing, and Economic Welfare: New Empirical Evidence on Complex Patterns across the European Union. *Complexity*, 2022, 1–13. https://doi.org/10.1155/2022/7313452

d'Errico, A., Ardito, C., Leombruni, R., Ricceri, F., Costa, G., Sacerdote, C., Odone, A., the "Italian Working Group on Retirement and Health", Amerio, A., Ardito, C., Carioli, G., Costa, G., d'Errico, A., Fontana, D., Frascella, B., Gaetti, G., Gentile, L., Gianfredi, V., Leombruni, R., … Zengarini, N. (2022). Working Conditions and Health Among Italian Ageing Workers. *Social Indicators Research*, 162(3), 1043–1067. https://doi.org/10.1007/s11205-021-02862-w

Dauvergne, P. (2022). Is artificial intelligence greening global supply chains? Exposing the political economy of environmental costs. *Review of International Political Economy*, 29(3), 696–718. https://doi.org/10.1080/09692290.2020.1814381

Hernæs, E., Kornstad, T., Markussen, S., & Røed, K. (2023). Ageing and labor productivity. *Labour Economics*, 82, 102347. https://doi.org/10.1016/j.labeco.2023.102347

Jones, C. I. (2022). The End of Economic Growth? Unintended Consequences of a Declining Population. *American Economic Review*, 112(11), 3489–3527. https://doi.org/10.1257/aer.20201605

Kicior, A. (2023). *Map of the Week: World Median Ages by Country*. UBIQUE. https://ubique.americangeo.org/map-of-the-week/map-of-the-week-world-median-ages-by-country/

Laddha, Y., Tiwari, A., Kasperowicz, R., Bilan, Y., & Streimikiene, D. (2022). Impact of Information Communication Technology on labor productivity: A panel and cross-sectional analysis. *Technology in Society*, 68, 101878. https://doi.org/10.1016/j.techsoc.2022.101878

Lau, E., Moll de Alba, J., & Liew, K.-H. (2022). Debt and economic growth in Asian developing countries. *Economic Analysis and Policy*, 76, 599–612. https://doi.org/10.1016/j.eap.2022.09.011

Lorenz, P., Perset, K., & Berryhill, J. (2024). *Collective action for responsible AI in health* (OECD Artificial Intelligence Papers 10; OECD Artificial Intelligence Papers, No. 10). https://doi.org/10.1787/f2050177-en

Maestas, N., Mullen, K. J., & Powell, D. (2023). The Effect of Population Aging on Economic Growth, the Labor Force, and Productivity. *American Economic Journal: Macroeconomics*, 15(2), 306–332. https://doi.org/10.1257/mac.20190196

Mankiw, N. G., & Taylor, M. P. (2020). *Economics*. Cengage Learning EMEA. https://thuvienso.hoasen.edu.vn/handle/123456789/11992

McKinsey. (2023). *Economic potential of generative AI*. McKinsey. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier#introduction

Nagarajan, N. R., & Sixsmith, A. (2023). Policy Initiatives to Address the Challenges of an Older Population in the Workforce. *Ageing International*, 48(1), 41–77. https://doi.org/10.1007/s12126-021-09442-w

Nagarajan, N. R., Wada, M., Fang, M. L., & Sixsmith, A. (2019). Defining organizational contributions to sustaining an ageing workforce: A bibliometric review. *European Journal of Ageing*, 16(3), 337–361. https://doi.org/10.1007/s10433-019-00499-w

OECD. (2023). *OECD Employment Outlook 2023: Artificial Intelligence and the Labour Market*. OECD. https://doi.org/10.1787/08785bba-en

OECD. (N/A). *Population projections*. https://stats.oecd.org/Index.aspx?DataSetCode=POPPROJ#

Oladipo, O., Platt, K., & Shim, H. S. (2023). *Female entrepreneurs managing from home*. Small Business Economics. https://doi.org/10.1007/s11187-022-00713-7

Oxford Analytica. (2023). *Emerald Expert Briefings* (Emerald Expert Briefings) [Emerald Expert Briefings].

Papapetrou, E., & Tsalaporta, P. (2020). The impact of population aging in rich countries: What's the future? *Journal of Policy Modeling*, 42(1), 77–95. https://doi.org/10.1016/j.jpolmod.2019.12.002

Rao, A. S., & Verweij, G. (2017). *Sizing the prize: What's the real value of AI for your business and how can you capitalise?* https://policycommons.net/artifacts/10771878/sizing-the-prize/11649558/

Rudnicka, E., Napierala, P., Podfigurna, A., Męczekalski, B., Smolarczyk, R., & Grymowicz, M. (2020). The World Health Organization (WHO) approach to healthy ageing. *Maturitas*, 139, 6–11. https://doi.org/10.1016/j.maturitas.2020.05.018

Squicciarini, M., & Staccioli, J. (2022). Labour-saving technologies and employment levels: Are robots really making workers redundant? *OECD*. https://doi.org/10.1787/9ce86ca5-en

Statistical Office of the Slovak Republic. (N/Aa). *Employed persons in the economy*. [pr3112qr]—DATAcube. https://datacube.statistics.sk/#!/view/sk/VBD_SK_WIN/pr3112qr/v_pr3112qr_00_00_00_sk

Statistical Office of the Slovak Republic. (N/Ab). *Job vacancies*. [pr3109qr]—DATAcube. https://datacube.statistics.sk/#!/view/sk/VBD_SK_WIN/pr3109qr/v_pr3109qr_00_00_00_sk

Tsutsui, K., Ukita, S., Kondo, M., Toshima, G., Miyazaki, N., Nagashima, K., Ohmura, M., Tsuchihashi, S., Tsuji, Y., Katoh, M. et al. (2024). Synergistic Effect of Motivation for the Elderly and Support for Going Out II: Measures to Induce Elderly Men to Go Out. *Geriatrics*, 9(1), Article 1. https://doi.org/10.3390/geriatrics9010021

Wach, K. et al. (2023). The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT. *Entrepreneurial Business and Economics Review*, 11(2), 7–30.

Xi, J.-Y., Lin, X., & Hao, Y.-T. (2022). Measurement and projection of the burden of disease attributable to population aging in 188 countries, 1990-2050: A population-based study. *Journal of Global Health*, 12, 04093. https://doi.org/10.7189/jogh.12.04093

Yang, L., Liu, J., Liang, Y., Lu, Y., & Yang, H. (2021). Spatially varying effects of street greenery on walking time of older adults. ISPRS *International Journal of Geo-Information*, 10(9), 596. https://doi.org/10.3390/ijgi10090596

Zeka, B., & Veri, F. (2022). The necessary and sufficient conditions for retirement funding adequacy: A fuzzy set analysis. *Economics and Sociology*, 15(1), 109-124. doi:10.14254/2071-789X.2022/15-1/7

Zwick, T., Bruns, M., Geyer, J., & Lorenz, S. (2022). Early retirement of employees in demanding jobs: Evidence from a German pension reform. *The Journal of the Economics of Ageing*, 22, 100387. https://doi.org/10.1016/j.jeoa.2022.100387