

WORK EARNINGS OF CZECH PENSIONERS

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Abstract

Seniors are both employees and entrepreneurs on the course. The aging of the population is currently increasingly becoming the focus of society. The number of elderly and old people, demographic development, and the costs associated with the aging of the population are often addressed, which include, in particular, the costs of health care and the payment of pensions. This paper deals with the analysis of the income of seniors aged 60+ from work. The aim is to capture the development of the level of pensioners' earnings in the period from the global economic crisis that began in the autumn of 2008, the consequences of which fully affected the Czech economy in 2009, to the coronavirus crisis. Attention is paid to the models of the distribution of earnings and the prediction of the development of their level for the next period. Three-parameter lognormal curves are used as the basis of earnings distribution models, the parameters of which are estimated using the moment method. Exponential smoothing is used in the construction of predictions of the development of the level of pensioners' earnings.

Key words: Seniors 60+, age of employees, entire wage models, probability density function, exponential smoothing.

JEL Code: E24, E27, C21

Introduction

The age of the population, especially in recent years, has become one of the most important demographic variables, which is the subject matter of many discussions. Seniors are a very dynamically developing segment that also significantly affects the entire Czech economy. However, it is not a homogeneous segment that can be defined only on the basis of biological age, as there are a number of factors that show that it is a highly heterogeneous segment with enormous potential, but also with many economic, psychological, biological and social aspects influencing personal consumption. In today's modern age, which is mainly focused on youth, success, fitness and performance, one should not forget about seniors and their experience, composure and wisdom. Even older people can successfully educate themselves and learn new

things, hold high positions and have a full-fledged social life. Health and financial resources are understandably an extremely important phenomenon for this group.

Retirement pensions, income from the work of seniors and their overall standard of living are the subject matter of various discussions, especially in periods of various economic crises and high inflation. A number of researchers have been therefore dealing with this topic for many years, for example Hatfield, Favreault, McGuire & Chernew (2018), Kaymak & Poschke (2016), McIntyre, Dutton, Kwok. & Emery (2016), Schirle (2013), Levin-Waldman (2012), Preston, Kim, Hudyma, Mandell, Luxton & Hemphill (2012), MacDonald, Moore, Chen & Brown (2011), Tsutsui & Muramatsu (2007), DeSimone (2006), Lee & Gibler (2004), Campbell (2002), Fleischer & Seiler (2002), Myles (2000), Battle (1998) or Smith & Powell (1990).

The data for this research come from the official website of the Czech Statistical Office (CSO). The wage is paid to the employee for work done in the private (business) sphere, the salary in the budget (state, public, non-business) sector. In terms of data presented on the CSO website, both wages in the business sphere and salaries in the non-business sphere are included under the wage term. There is annual data and the gross (nominal) monthly wage in the Czech Republic is the main surveyed variable. The data was processed using the SAS and Statgraphics statistical packets and the Microsoft Excel spreadsheet.

The main aim of this paper is to capture the development of the wage level of seniors 60+ in the period from the last economic crisis, which broke out in the autumn of 2008 and the consequences of which fully affected the Czech economy in 2009, to the crisis caused by the Covid-19 pandemic, which broke out at the end of the year 2020, while Dovid-19 was first diagnosed on the Czech territory on March 1, 2020, and the period affected by this pandemic basically stretched until 2021.

An important objective is not only the analysis of the development of the wage level of Czech seniors, but the analysis of the development of the entire wage distribution. The examined period is 2009–2021. Based on the analysis of the wage level and the entire wage distribution of seniors, predictions of the development of the wage level and the entire wage distribution for the period 2022–2026 are constructed. An equally important objective is to compare the development of the wage level and entire wage distributions with the development of the wage level and entire wage distributions, including predictions of the two age intervals of 30–34 years and 35–39 years, in which employees achieve the highest wages in the long term.

Three-parameter lognormal curves represent the basis of wage models. The beginning of these curves represents the minimum monthly wage valid on January 1 of the given year. The remaining two parameters of these curves are estimated by the method of moments. Exponential smoothing is used to construct the predictions.

1 Theory and methodology

1.1 Three-parameter lognormal distribution and moment method of parameter estimation

Three-parameter lognormal distribution of the random variable X with parameters θ , μ a σ^2 , where $-\infty < \theta < \infty$, $-\infty < \mu < \infty$ and $\sigma^2 > 0$, is governed by the probability density function

$$f(x) = \frac{1}{\sigma \cdot (x - \theta) \cdot \sqrt{2\pi}} \cdot \exp\left[-\frac{[\ln(x - \theta) - \mu]^2}{2\sigma^2}\right], \quad x > \theta, \quad (1)$$

$$= 0, \quad \text{else.}$$

The parameter θ is the beginning of the distribution, i.e. the theoretical minimum of the random variable X . The parameter μ represents the expected value of the random variable $Y = \ln(X - \theta)$ and the parameter σ^2 is the variance of this random variable.

The amount of the minimum monthly wage valid on January 1 of the corresponding year represents the parameter θ . The remaining two parameters of the lognormal curves were estimated by the method of moments.

The heart of the moment method of parameter estimation is that the sample and relevant theoretical moments of the given probability distribution are equated. Common and central moments can be combined. Although this method of parameter estimation is very simple to use, it is nevertheless very imprecise. An estimate of the theoretical variance of the random variable X is especially highly imprecise estimate using its sample counterpart. However, in the case of wage distribution, we are working with large-scale samples, and therefore the use of the moment method of parameter estimation may not be a problem from the point of view of the efficiency of the estimates.

We obtain a system of two moment equations with two unknown parameters μ and σ^2

$$\bar{x} = \theta + \exp\left(\tilde{\mu} + \frac{\tilde{\sigma}^2}{2}\right), \quad (2)$$

$$s_x^2 = \exp(2\tilde{\mu} + \tilde{\sigma}^2) \cdot [\exp(\tilde{\sigma}^2) - 1], \quad (3)$$

where the sample average and sample variance are on the left side of these equations. Solving of the system of equations (2) and (3), we obtain estimates of the remaining two parameters of the lognormal curves

$$\tilde{\sigma}^2 = \ln \left[\left(\frac{s_x}{\bar{x} - \theta} \right)^2 + 1 \right], \quad (4)$$

$$\tilde{\mu} = \frac{\ln(\bar{x} - \theta)^2 - \tilde{\sigma}^2}{2}. \quad (5)$$

Table 1 presents the development of monthly minimum wage amounts in the period 2009–2023, including forecasts for 2024–2026 constructed using exponential smoothing (marked with a gray background in the table), see Figure 1.

Tab. 1: Development of monthly minimum wage amounts valid on January 1 of the given year in the period 2009–2023 and forecasts of this development for the period 2024–2026 in CZK (forecasts rounded to whole hundreds of CZK)

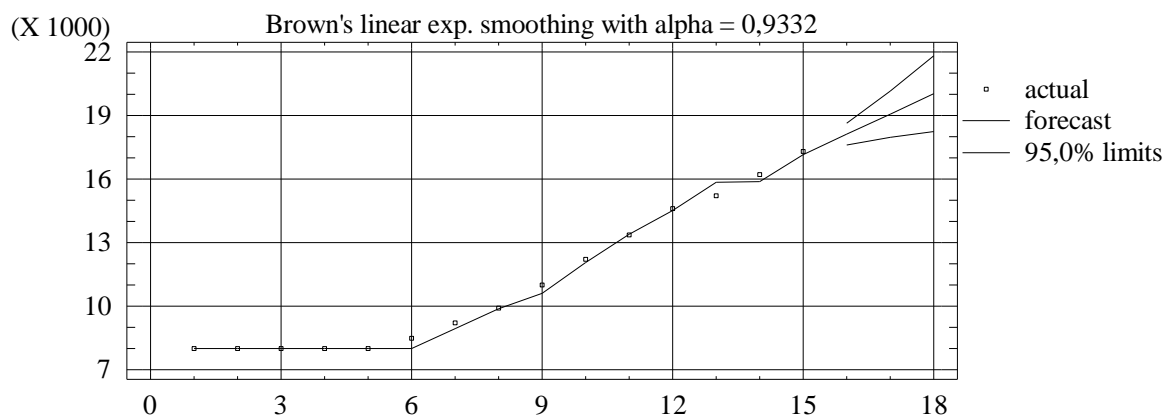
Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Minimum wage	8000	8000	8000	8000	8000	8500	9200	9900	11000
Year	2018	2019	2020	2021	2022	2023	2024	2025	2026
Minimum wage	12200	13350	14600	15200	16200	17300	18100	19100	20000

Source: www.mpsv.cz; own calculation

1.2 Exponential smoothing

Exponential smoothing is standardly assigned to adaptive approaches to the trend component of the time series. Exponential smoothing provides more accurate results when constructing time series predictions, as the most recent observations of the time series have the highest weight. A modified least squares method is used to estimate the parameters of the time series trend, where individual squares in the minimized sum are assigned weights that decrease exponentially towards the past.

Fig. 1: Exponential smoothing of development of monthly minimum wage amounts valid on January 1 of a given year in the period 2009–2023 and forecasts of this development for the period 2024–2026 in CZK (rounded to whole hundreds of CZK)



Source: Own calculation; own construction

The construction of predictions of the entire wage distribution is carried out using the moment method of parameter estimation based on the obtained predictions of the sample average, sample standard deviation and the beginning of the three-parameter lognormal curves.

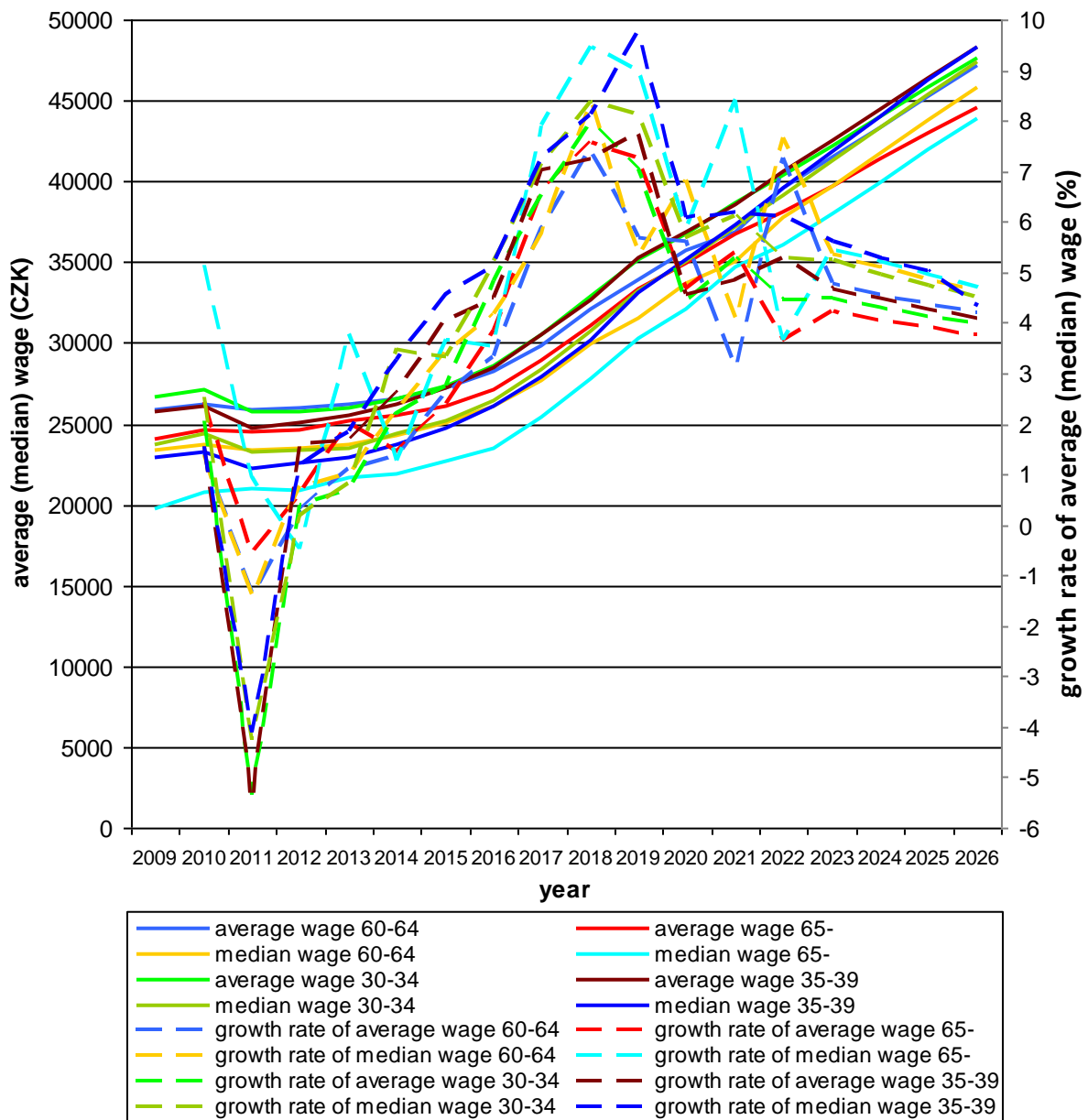
2 Results

Figure 2 demonstrates the development of the wage level and the rate of growth of the wage level of employees in the two senior age intervals of 60–64 years and 65– years, and in addition, it allows a comparison with the development of the wage level and the rate of growth of the wage level of the two age intervals in which employees reach consistently the highest wages, namely 30–34 years and 35–39 years (including predictions up to 2026). This figure shows the huge drop in the growth rate of the wage level in 2011, when wages in the Czech economy were fully affected by the consequences of the then economic crisis. Simultaneously, the high growth rate of the wage level during the period of economic conjuncture between 2016–2019 is obvious. The lowest solid line in Figure 2 shows the development of the median wage of pensioners in the age interval of 60– years. However, they are already recipients of an old-age pension and income from work only represents additional earnings in less attractive jobs.

Figures 3–6 demonstrate the development of models of the entire wage distribution in the period 2009–2021, including predictions for the period 2022–2026. These figures show a different shape of wage distributions in the age interval of pensioners 65– years, i.e. in the age interval with the lowest wage level. Wage distributions in this age interval are characterized

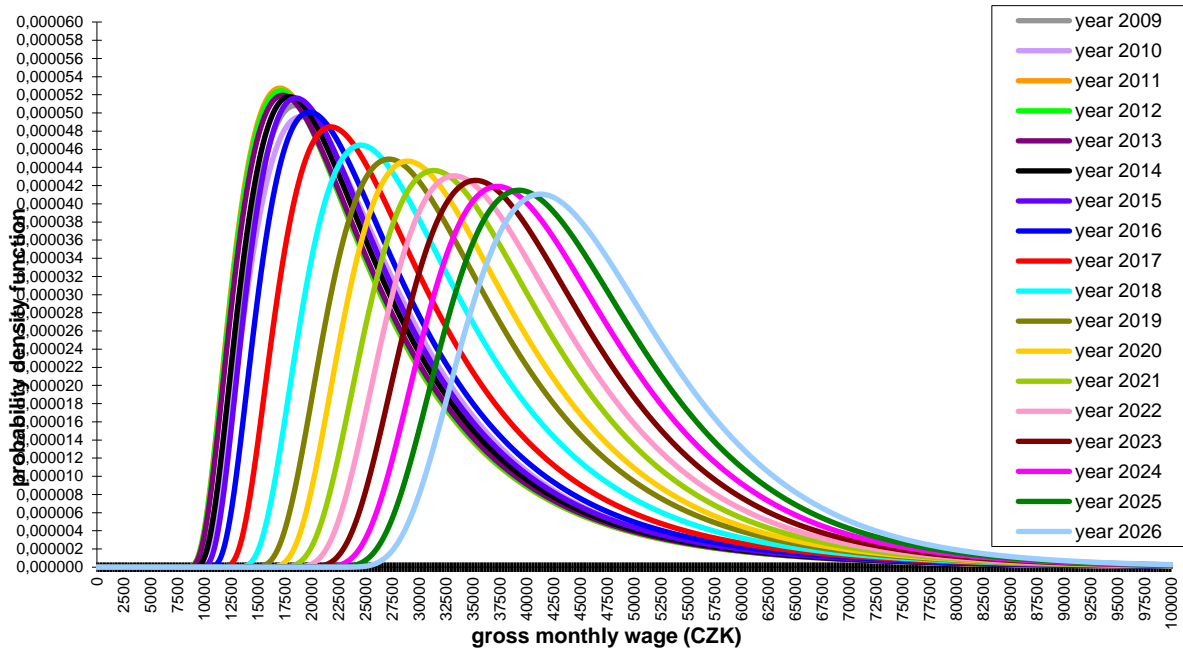
by higher skewness and kurtosis with lower levels and variability compared to the other three analyzed wage intervals.

Fig. 2: Comparison of the development of the average and median gross monthly wage (CZK) and the growth rate of the average and median gross monthly wage (%) in the period 2009–2021 and predictions of this development for the period 2022–2026 for the age intervals of 60–64 years and 65– years with age intervals of 30–34 years and 35–39 years



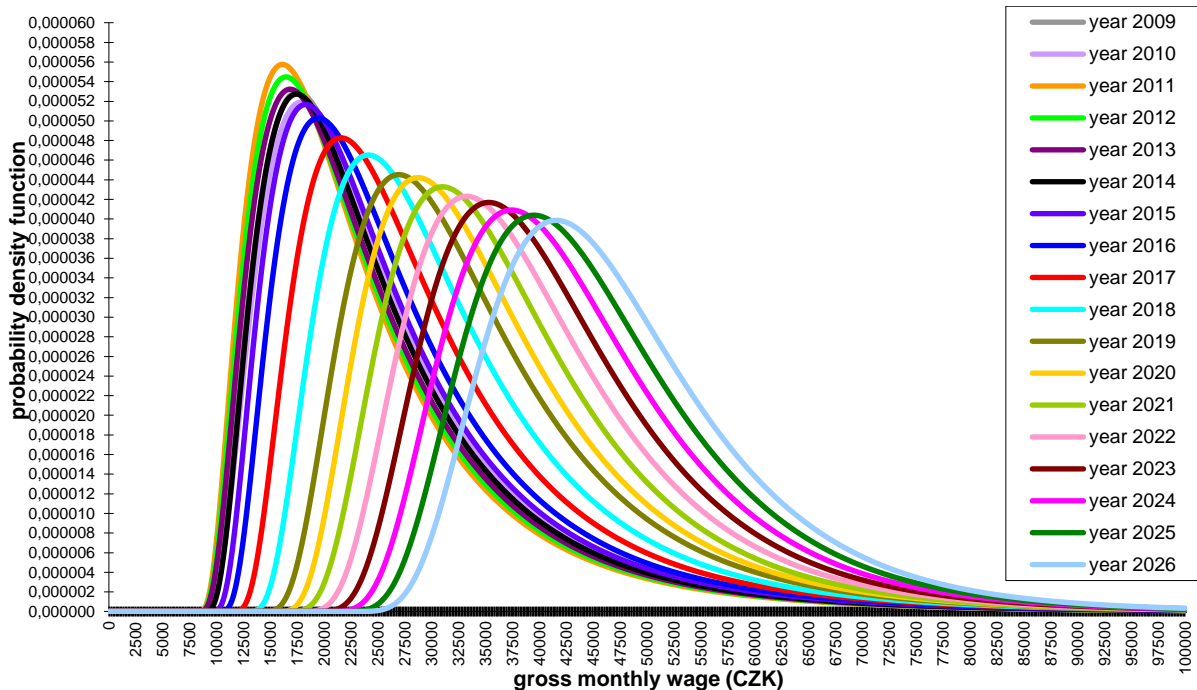
Source: Own calculation, own construction

Fig. 3: The development of the entire distribution of wages in the period 2009–2021 and the prediction of this development for the period 2022–2026 for the age interval of employees 30–34 years



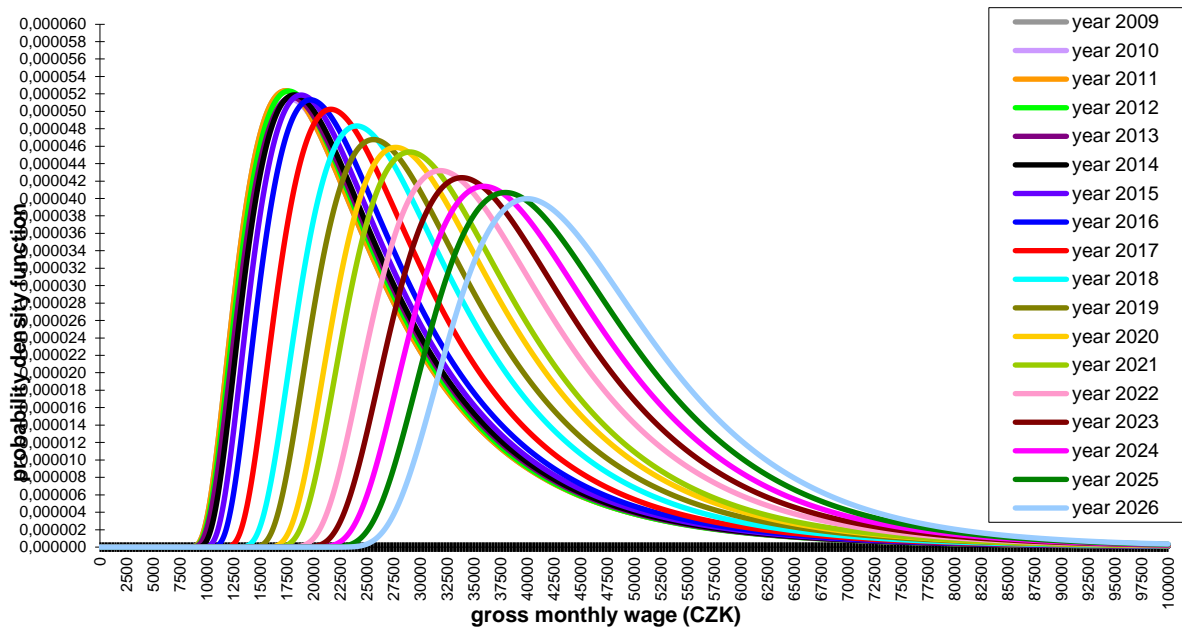
Source: Own calculation, own construction

Fig. 4: The development of the entire distribution of wages in the period 2009–2021 and the prediction of this development for the period 2022–2026 for the age interval of employees 35–39 years



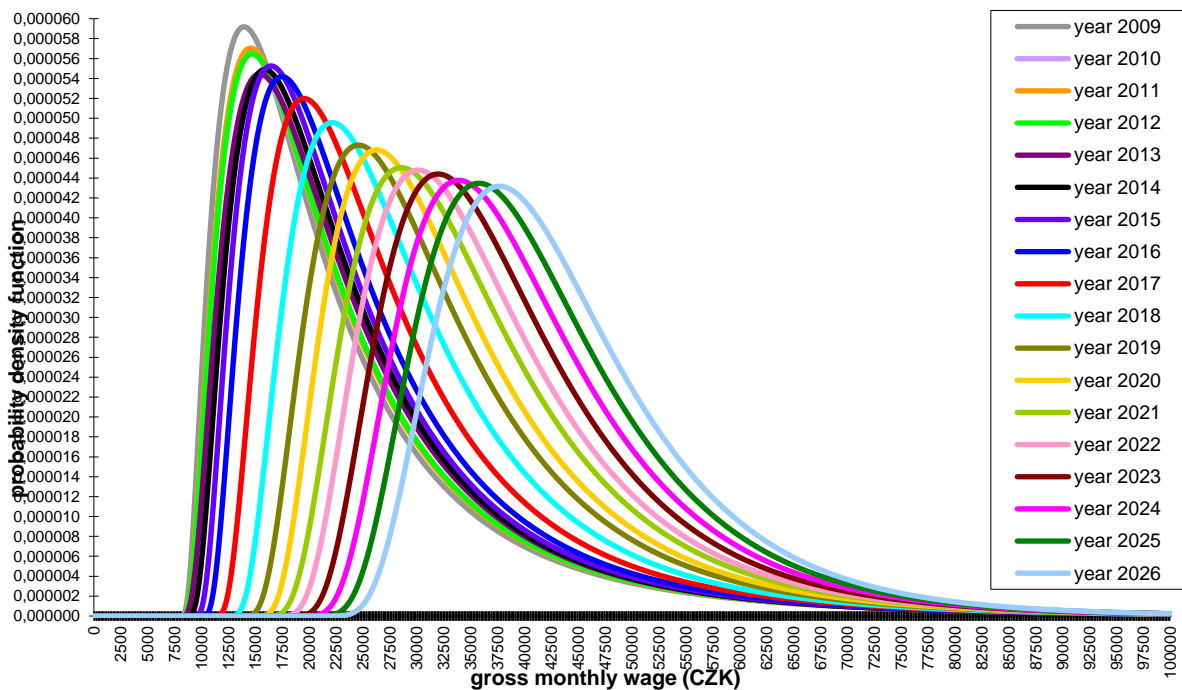
Source: Own calculation, own construction

Fig. 5: The development of the entire distribution of wages in the period 2009–2021 and the prediction of this development for the period 2022–2026 for the age interval of employees 60–64 years



Source: Own calculation, own construction

Fig. 6: The development of the entire distribution of wages in the period 2009–2021 and the prediction of this development for the period 2022–2026 for the age interval of employees 65+ years



Source: Own calculation, own construction

Conclusion

We note a considerably lower level of wages in the wage interval of pensioners of 65– years, which may be caused by the fact that in this age interval all seniors are practically already recipients of the old-age pension and their income from work represents only additional income from less attractive jobs. The results show a substantial increase in the growth rate of wage levels during the period of economic boom between 2016–2019 for all four considered age intervals and a well-market decrease in the growth rate of wage levels in 2011 as a result of the economic crisis at that time.

The shape of the wage distribution models of pensioners in the age interval of 65– years is considerably different from the shapes of the wage distribution models of the other three considered wage intervals.

References

- Battle, K. (1998). Transformation: Canadian Social Policy since 1985. *Social Policy & Administration*, 32(4), 321–340. DOI: <https://doi.org/10.1111/1467-9515.00119>
- Campbell, A. L. (2002). Self-Interest, Social Security, and the Distinctive Participation Patterns of Senior Citizens. *American Political Science Review*, 96(3), 565–574. DOI: <https://doi.org/10.1017/S0003055402000333>
- DeSimone, J. (2006). Academic Performance and Part-Time Employment among High School Seniors. *Topics in Economic Analysis & Policy*, 6(1), DOI: <https://doi.org/10.2202/1538-0653.1466>
- Fleischer, A. & Seiler, E. (2002). Determinants of Vacation Travel among Israeli Seniors: Theory and Evidence. *Applied Economics*, 34(4), 421–430. DOI: <https://doi.org/10.1080/00036840110046476>
- Hatfield, L. A., Favreault, M. M., McGuire, T. G. & Chernew, M. E. (2018). Modeling Health Care Spending Growth of Older Adults. *Health Services Research*, 53(1), 138–155. DOI: <https://doi.org/10.1111/1475-6773.12640>
- Kaymak, B. & Poschke, M. (2016). The Evolution of Wealth Inequality Over Half a Century: The Role of Taxes, Transfers and Technology. *Journal of Monetary Economics*, 77, 1–25. DOI: <https://doi.org/10.1016/j.jmoneco.2015.10.004>
- Lee, E. & Gibler, K. M. (2004). Preference for Korean Senior Housing. *Journal of Property Investment & Finance*, 22(1), 112–135. DOI: <https://doi.org/10.1108/14635780410525171>

- Levin-Waldman, O. (2012). Rising Income Inequality and Declining Civic Participation. *Challenge*, 55(3), 51–70. DOI: <https://doi.org/10.2753/0577-5132550303>
- MacDonald, B. J., Moore, K. D., Chen, H. & Brown, R. L. (2011). The Canadian National Retirement Risk Index: Employing Statistics Canada's Life Paths to Measure the Financial Security of Future Canadian Seniors. *Canadian Public Policy*, 37(1), S73–S94. DOI: [10.3138/cpp.37.suppl.s73](https://doi.org/10.3138/cpp.37.suppl.s73)
- McIntyre, L., Dutton, D. J., Kwok, C. & Emery, J. C. H. (2016). Reduction of Food Insecurity among Low-Income Canadian Seniors as a Likely Impact of a Guaranteed Annual Income. *Canadian Public Policy*, 42(3), 274–286. DOI: <https://doi.org/10.3138/cpp.2015-069>
- Myles, J. (2000). The Maturation of Canada's Retirement Income System: Income Levels, Income Inequality and Low Income Among Older Persons. *Canadian Journal on Aging/La Revue canadienne du vieillissement*, 19(3), 287–316. DOI: <https://doi.org/10.1017/S0714980800015014>
- Preston, V., Kim, A., Hudyma, S., Mandell, N., Luxton, M. & Hemphill, J. (2012). Gender, Race, and Immigration. *Canadian Review of Social Policy*, 68/69, 90–106. DOI: <https://www.jstor.org/stable/48670659>
- Schirle, T. (2013). Senior Poverty in Canada: A Decomposition Analysis. *Canadian Public Policy*, 39(4), 517–540. DOI: <https://doi.org/10.3138/CP.39.4.517>
- Smith, H. L. & Powell, B. (1990). Great Expectations: Variations in Income Expectations among College Seniors. *Sociology of Education*, 63(3), 194–207. DOI: <https://doi.org/10.2307/2112837>
- Tsutsui, T. & Muramatsu, N. (2007). Japan's Universal Long-Term Care System Reform of 2005: Containing Costs and Realizing a Vision. *Journal of the American Geriatrics Society*, 55(9), 1458–1463. DOI: <https://doi.org/10.1111/j.1532-5415.2007.01281.x>

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