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# Factors Affecting the Sustainability of Pension Systems

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### ABSTRACT

*The article is focused on the sustainability of pension systems and the factors that influence it. Due to the unfavourable demographic curve and low birth rate, there is a decrease in the economically active population that can finance future pensions. The aim of this article is to compare the individual pension models that we can distinguish within the OECD countries, and to identify factors that have a statistically significant effect on the sustainability of these pension models. Based on the information found, recommendations for the Czech pension system will be established. To achieve the goal, individual pension models are first compared and then a correlation and regression analysis is carried out to identify factors that influence the final ranking within the API and Mercer international pension indexes. Based on the results achieved, several recommendations for the Czech pension system were formulated. One of them is the division of the first pension pillar into a solidarity and meritorious part. Another recommendation is focused on the valorisation of pensions. Based on our analyses, it emerges as a significant influence of GDP growth on the evaluation of pension systems, therefore our next recommendation is to take GDP growth into account while determining the valorisation. Another step to make our national pension system more financially sustainable is linking the retirement age to life expectancy. This could also stabilise the ratio of working life to life in retirement.*

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## INTRODUCTION

The issue of the sustainability of pension systems is a current and important topic, because the setting of current pension systems does not consider the development of the demographic curve and the aging population (Li et al., 2022). If these systems do not establish a fundamental revision of the parameters, they will face significant deficits and unsustainability in the long run. However, one-off changes could significantly affect an entire generation, so it is more appropriate to proceed with the revision step by step, so that the consequences of the pension system reforms are not carried by only one generation.

International pension indexes deal with the sustainability of pension system. These indexes are based on various factors when evaluating pension systems. Considering these factors, as part of discussions of

pension reforms, is a good assumption for changes that will bring about a more stable and sustainable pension system. The aim of this contribution is to precisely identify these parameters, which can have a fundamental influence on the ongoing reform of pension systems. The research question is also based on the objectives of this article: "Which factors significantly influence the achieved evaluation within the international pension indexes API and Mercer Global Pension Index".

First, the current findings in scientific practice are presented with the identification of a potential research gap. Subsequently, the methodology of the contribution is presented, which will lead to the fulfilment of the objective and the answer to the research question. The achieved results are discussed within the framework of the current development of pension systems, and based on these results, recommendations are established for the Czech pension system leading to long-term sustainability.

## 1. LITERATURE SEARCH

The issue of pensions and the sustainability of the pension system is a very discussed and important topic across different countries not only in Europe. It is the pensions that are one of the largest transfers of the state budget. In 2020, 411 billion CZK was paid out in old-age pensions. This amount rose to 432 billion CZK in 2021, with a steady year-on-year increase (MPSV, 2021). Holý (2020) adds that when we compare gross expenditure per GDP with other European countries the Czech Republic is close to the average values, which are, however, considerably variable (4–13%). In 2021, expenditure on pensions accounted for 8.8% of GDP. A major problem appears to be the increasing age and also the lower fertility rate, which in turn means a small number of economically active population that would be able to finance pension payments. As reported by the Association of Pension Companies, the pension of the current retiree is financed by 2.2 active employees, but this number is to decrease in the future.

According to Hlaváček and Lakotová (2019), pensions in the Czech Republic are around the average for the entire European Union. However, it is necessary to consider the fact that Czech pensions are not taxed or subject to social security contributions, which is not the case in all EU countries (Ibid.). Before comparing between country differences in pensions, it is necessary to take into account gross and net pensions (Halaskova et al., 2021). The OECD (2021) compared the incomes of people over 65 and concluded that in the Czech Republic there are only about 2% of poor seniors, compared to, for example, Germany (9.4%) and Switzerland (23.4%). If we accept the statistical definition of poverty as income below 60% of median equivalent income after social contribution payments, then the least poverty-stricken pensioners are in Slovakia and France (Marek and France, 2019). However, as Potůček (2019) explains in more detail, the results of the study are somewhat biased due to the use of the national median household income. Poverty takes a different form in Switzerland and in Slovakia (Marek and France, 2019). According to Potůček (2019) the national median income is inappropriate for this study because it does not take into account the purchasing power of money, which varies considerably across countries. According to Potůček (2019), it is more appropriate to use the Eurostat methodology, which focuses on equivalized net disposable income that takes into account the purchasing power of money. Here, the results are markedly different and show that seniors are better off in about 23 countries out of the 33 countries surveyed than in the Czech Republic.

In addition to the above-mentioned aspects, important for the comparison between countries, it is necessary to take into account individual pension models. Several types of welfare models have evolved around the world and their current status has been influenced to some extent by the history of individual countries. Esping-Andersen (2019) divided welfare regimes into three groups (Matznetter, 2002). These are the social democratic model, the conservative model and the liberal model. Another model that can be added is the neoliberal model (Holub et al., 2019). Esping-Andersen's (1990) original typology is based on the degree of decommodification in terms of the degree of independence from the market and market products in providing pensions, the degree of social stratification, and on whether the social model is private or public (Ibid.). According to Esping-Andersen (Ibid.), a high degree of decommodification is typical of the social democratic model. In contrast, a low to no degree of decommodification, i.e., a relatively high dependence on the market and market products, is typical of the liberal model. The conservative model lies between these two models (Matznetter, 2002).

These three models evolved from the original Bismarck and Beveridge models (Holub et al., 2019). The Bismarck model operated on the principles of different insurance rates for different occupational groups and benefits paid out varied according to the earnings and also social contributions of the person. The Beveridge model introduced flat rate benefits where the main source of finance in the system was the so-called national insurance. Thus, redistribution occurred through the tax system (Whiteside, 2014). The liberal and social-democratic models have their roots in the original Beveridge system, while the conservative model evolved from the Bismarck welfare model (Holub et al., 2019). Welfare models can also be divided according to the dependency of the person receiving benefits – in the social democratic model they rely the most on the state, in the conservative model on the family (León and Migliavacca, 2013) and in the liberal model on the market and market products.

Within the social model, each country has its own pension system. The liberal pension model is based on voluntary provision according to the person's individual needs, whereas in the social democratic model the mandatory universal basis of public pension provision is considered to be optimal. The conservative model is based on selective pension provision, which is however compulsory, whereas the neoliberal model is characterized by a universal model based on voluntary pension savings (Holub et al., 2019). Another model that could be added to the pension models is the communist pension model (Ibid.). Although not suitable for modern capitalism, it has partly become the basis of the social systems of post-communist countries. A considerable influence of this system can be seen in the fact that the current social models of post-communist countries cannot be easily categorized into one of the existing models. Therefore, experts created another model that combines the elements of the liberal and the conservative model. An example of this could be the Czech Republic, which has a universal public pension system financed from the state budget. This system combines the elements of solidarity with insurance pillars. As such it does not fit into any of the social systems described above (Vostatek, 2015).

## **1.2 The modern liberal model**

The classical liberal model does not include public pensions, it promotes occupational pension models and encourages people to take out private pension insurance (Vostatek, 2015). However, private insurance must only be on a voluntary basis. This system does not support mandatory private pensions or government subsidies on pensions and other financial products. (Holub et al., 2019). It is clear that at present the classical liberal model in its purest form cannot exist.

Unlike the classical liberal model, the modern version already includes government intervention in the form of the provision of a universal (flat-rate) pension or a means-tested pension that depends on the wealth and income of the taxpayer (Vostatek, 2015; Okulicz-Kozaryn & Morawski, 2021). These were the two most common forms of the liberal pension model. The liberal pension model providing a means-tested retirement benefit was introduced at the turn of the 20th century in Denmark, Australia, Great Britain, Ireland and New Zealand (Holub et al., 2019). Of all these countries it has only been retained in Australia. Relatively soon it was in all these countries replaced by the Beveridge flat rate contribution, which is characterized by its universality (Whiteside, 2014). The Beveridge flat-rate system means a uniform pension of all people which is based on the level of the minimum wage or the subsistence minimum.

## **1.3 The conservative model**

The conservative pension model encompasses several different concepts of pension provision for different social groups according to their specific life situation and needs (Vostatek, 2015). Ideologically, the conservative pension system places a strong emphasis on performance and equivalence. The conservative model was always characterized by strict segmentation. In the German pension system, there are about ten subsystems with separate systems for farmers, railwaymen, civil servants and others (Holub et al., 2019). This social model thus contributes to the maintenance of status differences (Matznetter, 2002).

Austria had a very similar pension system, but the pension reform of 2005 unified all subsystems into one pension system of the NDC (Nationally Defined Contribution) type, which as one of the few takes into account the actual amounts of contributions made for a given person (Felderer et al., 2006).

## 1.4 The social-democratic model

The social-democratic model evolved from the liberal model but it has a solidarity pillar as its essential component (Vostatek, 2015). Unlike the original liberal model, the role of state and government is very important in this model. The modern social-democratic pension model can be viewed as a combination of the universal pension insurance and a social pension, which is either universal or means-tested (Holub et al., 2019; Vuckovic & Skufli, 2021). In the social-democratic model most benefits are characterized by universality in the sense that they cover all population (but most of them are somewhat linked to past employment). Benefits and services redistributed by this system do not only target people without resources but also cover the middle class. The system uses income replacement rather than flat-rate benefits.

The social-democratic model is often criticized for fostering the dependence of citizens on the state, which then leads to zero contribution to economic growth. The excessive generosity of the system thus causes its own unsustainability (Lindbeck, 1997). At least in the long run, these conclusions about the social-democratic model cannot be confirmed. This model is typically associated with the Scandinavian countries. Their results such as egalitarian income distribution, low poverty rates, political stability and economic development speak clearly in favour of this model. The recent pension reform in Sweden has moved their pension system towards a more liberal and conservative direction, however, a strong universal pay-as-you-go pillar has been maintained as well as a guaranteed minimum pension (Eriksen and Palmer, 2017). Thus, Sweden continues to be among the countries that recognize the social-democratic social model.

## 1.5 The neoliberal model

The neoliberal model supports mandatory private pension savings regulated by the government (Vostatek, 2015) and calls for the privatisation of public insurance pensions and other social security benefits. The thoroughgoing privatisation is to reduce government intervention in the pension system, which is considered ineffective by neoliberals. According to neoliberals, the role of government is only to create conditions for functioning pension markets (Holub et al., 2019). This solution to the pension system seems to be effective because capital funded pension systems provide investment returns, whereas pay-as-you-go pension systems do not provide anything extra. This indisputable advantage also includes the biggest pitfall of the neoliberal pension model, which is the fact that the investment risk is borne by the client. It is this aspect that relegates the neoliberal pension policy in the Western world to a rather second-rate pension pillar.

In its 1994 report, the World Bank identified possible ways to reform pension systems of its member countries. A proposal by Estelle James adopts in many aspects features of the neoliberal pension policy which includes three pillars of a reformed pension system (James, 1995). The first pillar is a mandatory publicly managed pillar, which should be primarily funded from taxes and other levies. From its incomes the minimum or flat-rate pension should be paid out (state social programme). The second pillar is a mandatory privately managed pillar, which should be fully financed from funds that would be subject to state regulation (private fund programme). The third pillar is a voluntary, privately managed pillar, which should also be financed from funds. These funds are entirely voluntary and not subject to any regulation (voluntary programme).

The second and the third pillar are meant as personal savings or employee plans. The third pillar is intended as an additional protection for those who wish to participate and already participate in the second pillar. The proposed pension reform, however, brought a few serious problems and was criticized even by economists working in the World Bank Group. One of the criticisms is that it is impossible to establish one universal model that would fit all countries.

## 1.6 The model of post-communist countries

An analysis of the Baltic states reveals some characteristic features of this model. These include, for example, relatively low benefits with regard to high coverage leading to a tendency not to declare the whole income for taxation. The system of social protection is based on the principle of insurance but this insurance applies to everyone. Universal benefits still prevail over those tested in relation to previous income. During the transition years, many benefits paid out from the social system considerably changed. For example, it was necessary to incorporate unemployment benefits into the model (Fajth, 1999).

Despite any attempts to privatise pension systems or any other reform changes, these systems remain more or less the same. The only ongoing changes are required by inflation increases, so the existing pension requirements are merely indexed. Decisions about major changes to the existing pay-as-you-go pension system or a complete shift from this system towards voluntary pension savings are still postponed (Fajth, 1999).

Pension reforms in the Baltic and V4 countries are undertaken more or less in line with the recommendation of the World Bank Group (above) to divide the pension system into three pillars. The division of one pillar into three pillars (of which the second and the third were to be contribution defined and individual) was accompanied by a drop in the income of the first pillar, which remained pay-as-you-go, whether of the NDC type as in Poland or Latvia or of the PAYG type as in the other countries. It is the transition costs that caused a gradual shift from the pension reform (Klepárník et al., 2017).

## 1.7 Assessment of pension systems

For the international comparison of pension models, the Allianz Pension Index (API index) and Mercer Global Pension Index (Mercer Index) are the most commonly used indices, as they assess pension models from different aspects and thus provide a comprehensive view. The API index consists of three sub-indices taking into account 30 parameters. For each index a country can receive a score on a scale of 1 to 7 (a score of 1 being the best). The final value is determined as a ratio of all three sub-areas.

This index seeks to comprehensively analyse the sustainability and adequacy of pension systems, but above all to provide a comprehensive view on the preparedness of pension systems for demographic changes in society (Grimm and Holzhausen, 2020). The first sub-index assesses demographic changes and the state of public finances which are crucial for taking measures leading to pension reform. The second sub-index assesses the response of pension systems to demographic changes. The third sub-index assesses the adequacy of systems and living standards in old age. A survey of 70 countries shows that most countries take more account of current pensioners than future generations, trying to ensure a good quality of life in old age.

Generous state pensions are provided in Austria and Italy and strongly funded second and third pillars are in New Zealand and Austria. The overall scores for all three sub-indices range from the best in Sweden to Lebanon. Czech Republic is criticized for the lack of job opportunities for seniors and the lack of retirement pensions for particular professions.

The second index used for comparison is the Mercer Index. This index, like the API index, uses three sub-indices (adequacy, sustainability and integrity) to assess pension systems in 43 countries covering 65% of the total world population (Knox and Franklin, 2021). The sub-indices comprise about 50 indicators on a 0–100 rating scale (the more points the country scores, the better-quality pension system it has). The best pension systems in the world according to the Mercer Global Pension Index are in Denmark, the Netherlands and Iceland (highest rated, A rating). High-quality pension systems with potential for improvement are in Norway, Israel and Australia (B+ rating). Knox and Franklin (2021) also mention that every country has its own specifics and despite being ranked as best, these countries may have their own shortcomings. For this reason, the results cannot be accepted as dogma. The limitations of this index include the fact that among 50 indicators in each sub-index there may be areas that are difficult to compare. Therefore, it is impossible to say unequivocally that one system is better than another. The authors mention, however, that if the difference of index scores is more than 5 points, we can justly say which system is better or worse.

Table 1 shows the API and the Mercer index for the countries studied for the years 2021 and 2018, ranked according to the results achieved in 2021. For each country we present the index value for the year 2018 to show the year-on-year evolution.

**Table 1.** API and Mercer index in selected countries in 2018 and 2021

| Allianz Pension Index |             |            |              |            | Mercer Global Pension index |             |               |               |            |
|-----------------------|-------------|------------|--------------|------------|-----------------------------|-------------|---------------|---------------|------------|
| Ranking 2021          | Country     | Index 2021 | Ranking 2018 | Index 2018 | Ranking 2021                | Country     | Index 2021    | Ranking 2018  | Index 2018 |
| 1                     | Sweden      | 2.91       | 2            | 2.99       | 1                           | Iceland     | 84.2          | not available |            |
| 2                     | Belgium     | 2.92       | 1            | 2.95       | 2                           | Netherlands | 83.5          | 1             | 80.3       |
| 3                     | Denmark     | 2.96       | 3            | 2.99       | 3                           | Denmark     | 82            | 2             | 80.2       |
| 4                     | New Zealand | 3          | 4            | 3.09       | 4                           | Israel      | 77.1          | not available |            |
| 5                     | USA         | 3.04       | 5            | 3.12       | 5                           | Norway      | 75.2          | 6             | 71.5       |
| 6                     | Australia   | 3.13       | 8            | 3.19       | 6                           | Australia   | 75            | 4             | 72.6       |
| 7                     | Netherlands | 3.16       | 6            | 3.19       | 7                           | Finland     | 73.3          | 3             | 74.5       |
| 8                     | Norway      | 3.16       | 7            | 3.19       | 8                           | Sweden      | 72.9          | 5             | 72.5       |
| 9                     | Canada      | 3.25       | 9            | 3.28       | 9                           | UK          | 71.6          | 12            | 62.5       |
| 10                    | Czechia     | 3.27       | 10           | 3.35       | 10                          | Switzerland | 70            | 9             | 67.6       |
| 11                    | Latvia      | 3.31       | 11           | 3.35       | 11                          | Canada      | 69.8          | 8             | 68         |
| 12                    | Ireland     | 3.35       | 13           | 3.39       | 12                          | Ireland     | 68.3          | 11            | 66.8       |
| 13                    | Luxembourg  | 3.36       | 12           | 3.38       | 13                          | Germany     | 67.9          | 10            | 66.8       |
| 14                    | UK          | 3.36       | 16           | 3.5        | 14                          | New Zealand | 67.4          | 7             | 68.5       |
| 15                    | Slovakia    | 3.39       | 14           | 3.39       | 15                          | Belgium     | 64.5          | 22            | 0          |
| 16                    | Italy       | 3.43       | 15           | 3.46       | 16                          | USA         | 61.4          | 14            | 58.8       |
| 17                    | Finland     | 3.51       | 17           | 3.56       | 17                          | France      | 60.5          | 13            | 60.7       |
| 18                    | Israel      | 3.52       | 19           | 3.58       | 18                          | Spain       | 58.6          | 15            | 54.4       |
| 19                    | Switzerland | 3.53       | 20           | 3.59       | 19                          | Poland      | 55.2          | 16            | 54.3       |
| 20                    | Japan       | 3.56       | 24           | 3.89       | 20                          | Italy       | 53.4          | 18            | 52.8       |
| 21                    | Estonia     | 3.57       | 18           | 3.57       | 21                          | Austria     | 53            | 17            | 54         |
| 22                    | Germany     | 3.59       | 21           | 3.61       | 22                          | Japan       | 49.8          | 19            | 48.2       |
| 23                    | Lithuania   | 3.59       | 22           | 3.87       | 23                          | Mexico      | 49            | 21            | 45.3       |
| 24                    | Korea       | 3.72       | 23           | 3.89       | 24                          | Korea       | 48.3          | 20            | 47.3       |
| 25                    | Austria     | 3.88       | 25           | 3.92       |                             | Greece      | not available |               |            |
| 26                    | Mexico      | 3.91       | 27           | 3.99       |                             | Luxembourg  | not available |               |            |
| 27                    | Türkiye     | 3.98       | 26           | 3.99       |                             | Portugal    | not available |               |            |
| 28                    | Spain       | 4.07       | 29           | 4.09       |                             | Turkey      | not available |               |            |
| 29                    | Hungary     | 4.08       | 28           | 4.08       |                             | Czechia     | not available |               |            |
| 30                    | Slovenia    | 4.12       | 30           | 4.19       |                             | Hungary     | not available |               |            |
| 31                    | Portugal    | 4.18       | 31           | 4.2        |                             | Slovakia    | not available |               |            |
| 32                    | France      | 4.27       | 32           | 4.33       |                             | Estonia     | not available |               |            |
| 33                    | Poland      | 4.36       | 33           | 4.36       |                             | Slovenia    | not available |               |            |
| 34                    | Greece      | 4.47       | 34           | 4.55       |                             | Latvia      | not available |               |            |

Source: Author's own work based on data from Grimm and Holzhausen, 2020, Knox and Franklin, 2021.

## 2. METHODOLOGY

For comparison of pension systems, the API index and the Mercer index were used as they assess pension systems by means of several sub-indices focusing on adequacy, sustainability and integrity.

### 2.1 Comparison of pension models

A comparison of the API index and the Mercer index values disaggregated according to pension models was performed using analysis of variance. Post-hoc pairwise comparisons using the Tukey test were carried out. The ordinal statistics of the compared groups were displayed using a categorical box plot. In the evaluation of the pairs the key element was their median followed by the upper and lower quartiles.

### 2.2 Correlation analysis

In order to meet the objective of the paper, a wide range of factors that have a potential influence on the evolution of the API and the Mercer index was selected. For each of these factors, data from 2018 and 2021 were retrieved from Eurostat and the OECD database. This range of the observation period was chosen with regard to the period before and during the COVID-19 pandemic.

**Table 2.** Variable used in correlation and regression analysis

|                                                              |                                                         |                                                         |
|--------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|
| Effective labour market exit age, men (1)                    | Effective labour market exit age, women (2)             | Expected years in retirement, men (3)                   |
| Expected years in retirement, women (4)                      | Income of older people aged over 65 (5)                 | Income of older people aged 66-75 (6)                   |
| Income of older people aged over 75 (7)                      | Income source of older people, public transfers (8)     | Income source of older people, capital (9)              |
| Income source of older people, work (10)                     | Current retirement ages at age 22, men (11)             | Current retirement ages at age 22, women (12)           |
| Future retirement ages at age 22, men (13)                   | Future retirement ages at age 22, women (14)            | Employment rate of older workers, 55-59 (15)            |
| Employment rate of older workers, 60-64 (16)                 | Employment rate of older workers, 65-69 (17)            | Economic growth (%) (18)                                |
| Public debt (%) (19)                                         | Gross pension replacement rate, male, 0.50 of AW (20)   | Gross pension replacement rate, male, 1.00 of AW (21)   |
| Gross pension replacement rate, male, 1.50 of AW (22)        | Gross pension replacement rate, female, 0.50 of AW (23) | Gross pension replacement rate, female, 1.00 of AW (24) |
| Gross pension replacement rate, female, 1.50 of AW (25)      | Net pension replacement rate, male, 0.50 of AW (26)     | Net pension replacement rate, male, 1.00 of AW (27)     |
| Net pension replacement rate, male, 1.50 of AW (28)          | Net pension replacement rate, female, 0.50 of AW (29)   | Net pension replacement rate, female, 1.00 of AW (30)   |
| Net pension replacement rate, female, 1.50 of AW (31)        | Net pension replacement rate, mandatory (32)            | GDP per capita (33)                                     |
| State spending on pensions (% GDP) (34)                      | Ratio of workers to people over 65 (%) (35)             | Employment rate (36)                                    |
| Fertility rate, natality – number of children per woman (37) |                                                         |                                                         |

Source: Author's own work

The influence of the above potential factors on the evolution of the API and the Mercer index was assessed by the Pearson correlation coefficient, which indicates the strength of the dependence of each factor separately. In assessing correlation coefficients, the focus was mainly on the strength of the correlation (coefficients greater than 0.5 or less than -0.5).

## 2.3 General linear model

A general linear model for the API index and a model for the Mercer index were performed to analyse the interdependencies between the factors.

In the input data, the number of variables exceeds the number of states examined in the pension models, therefore it was not possible to use all variables in the model. Since some groups of variables were strongly correlated with each other, only one best representative was always chosen from these groups in terms of the strength of correlation with the variable of interest (API, Mercer).

Factors 1; 2; 3 and 4 were strongly correlated with each other and therefore only one factor was chosen for each model on the basis of the correlation coefficients. The factor with the strongest correlation was included in the model. For the API index model factor 4 was selected and for the Mercer index model factor 3.

The same procedure was applied to the group of factors 20–31, where factor 23 was selected for the API index and factor 20 for the Mercer. From the pair of factors 11 and 12, factor 11 was chosen for the API index model and factor 12 for the Mercer index model.

A group of factors 13–16 was also evaluated, factor 16 was included in the API index model and factor 15 in the Mercer index model.

The other factors did not form strongly correlated groups, so those with the strongest correlations with the variable of interest were selected (API, Mercer):

- 33 GDP per capita (API and Mercer models),
- 36 Employment rate (API and Mercer models),
- 37 Fertility rate, natality – number of children per woman (API and Mercer models),
- 7 Income of older people over 75 (API only),
- 10 Income source of older people, work (Mercer only).

These factors were tested through a model with interactions for differences in their effects in different types of pension models.

Factors 19 and 34 were not included in the model because their correlations with the dependent variables were *not strong enough to offset the limitations arising from the missing values for these factors for some countries*.

All the calculations were made using TIBCO STATISTICA 13 software, significance was assessed at the 0.05 level.

## 3. RESULTS

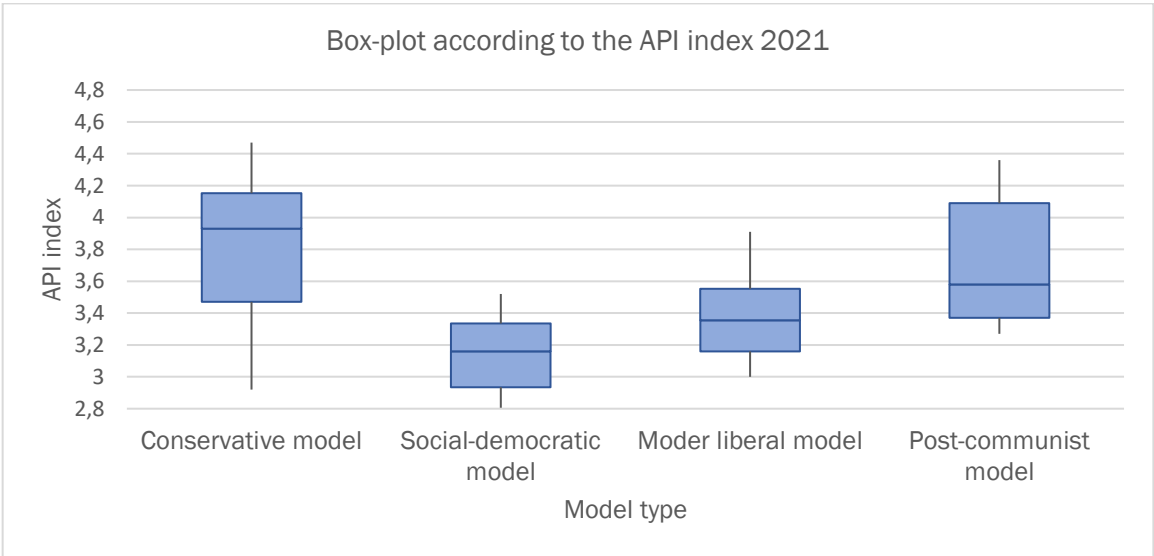
### 3.1 Comparison of pension models

First, analysis of variance showed at the 0.05 significance level that the performance of individual types of pension models according to the API 2018 index is not the same. Further investigation was carried out using the Tukey test, which always examines a pair of pension models where it is able to determine whether the pension index used can assess the performance of that pair of models. This test shows that in the social democratic and the conservative model there are statistically significant differences at the 0.05 significance level in terms of the performance of the pension models in relation to the API index. If we want to find out which of these models is more advantageous, it is necessary to follow a graphical analysis in the form of box plots, as this information cannot be provided by the Tukey test.

The graph below shows that the social democratic model performs better than the conservative model. The same principle could be used for the comparison of the other models but the Tukey test showed that

only between these two models (social democratic, conservative) the difference is statistically significant. As for the API, the results between 2018 and 2021 did not change significantly.

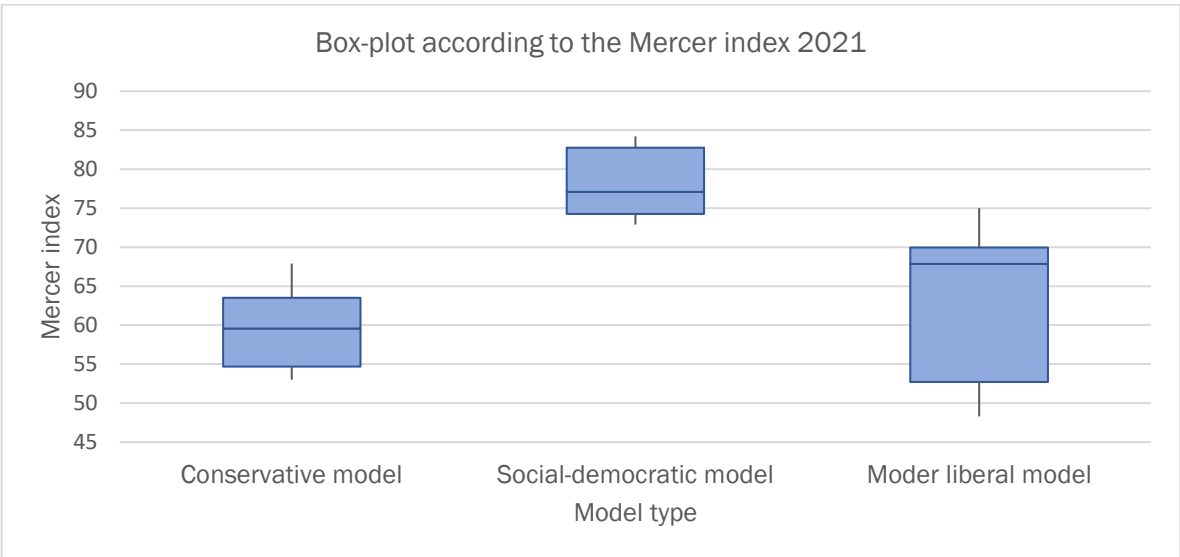
**Graph 1.** Comparison of models using API 2021



Source: Author’s own work

The analysis described above was also performed for the Mercer index, where the Tukey test showed significant differences between pairs of models: conservative and social democratic; social democratic and modern liberal. The difference between the remaining pair (conservative model and modern liberal model) is not statistically significant at the 0.05 level. The graphical comparison of the above pension models shows that in all pairs the social democratic model appears to be better performing. This is the same as with the API index.

**Graph 2.** Comparison of models using the Mercer 2021



Source: Author’s own work

## 3.2 Factors affecting the API and the Mercer index

### Correlation analysis

The factors influencing the evolution of the API and the Mercer index in the year 2018 and 2021 were examined using the Pearson correlation coefficient. A total of 37 factors were studied by correlation analysis. The following were found to be statistically significant at the 0.05 level.

**Table 3.** Correlation coefficients of factors with the API and the Mercer index

| Factor                                          | API   |       | Mercer |       |
|-------------------------------------------------|-------|-------|--------|-------|
|                                                 | 2018  | 2021  | 2018   | 2021  |
| 7 Income of older people aged over 75           | 0.47  | 0.41  | -0.38  | -0.30 |
| 10 Income source of older people, work          | 0.06  | 0.16  | -0.61  | -0.65 |
| 11 Current retirement ages ... at age 22, men   | -0.32 | -0.30 | 0.30   | 0.55  |
| 12 Current retirement ages ... at age 22, women | -0.41 | -0.41 | 0.45   | 0.55  |
| 13 Future retirement ages ... at age 22, men    | -0.44 | -0.31 | 0.50   | 0.46  |
| 14 Future retirement ages ... at age 22, women  | -0.50 | -0.40 | 0.49   | 0.46  |
| 15 Employment rate of older workers, 55-59      | -0.45 | -0.45 | 0.57   | 0.57  |
| 16 Employment rate of older workers, 60-64      | -0.48 | -0.48 | 0.41   | 0.41  |
| 19 Public debt (%)                              | 0.32  | 0.34  | -0.38  | -0.50 |
| 32 Net pension replacement rate, mandatory ...  | -0.40 | 0.18  | 0.24   | 0.16  |
| 33 GDP per capita                               | -0.46 | -0.46 | 0.55   | 0.55  |
| 36 Employment rate                              | -0.48 | -0.43 | 0.61   | 0.65  |

Source: Author's own work

The table above shows that the current retirement age, together with the employment rate of the older population (55-59 years) and GDP per capita significantly affects the evolution of the Mercer index. With an increase in these values (higher employment rate of the elderly and higher retirement age) the Mercer index increases, this means higher performance and sustainability of the pension model. Furthermore, the Mercer index is strongly influenced by employment growth and different sources of income of the elderly. In comparison with the Mercer index, the API index is almost unaffected by factor 10 (Income source of older people). The influence of the other factors mentioned above on the API is very similar to that on the Mercer index.

### General Linear Model

The general linear model adds interdependencies between factors that cannot be revealed using correlation coefficients. These coefficients show only the dependence of individual factors on the variables of interest (API and Mercer indices).

A total of 4 models were created: API 2018, API 2021, Mercer 2018 and Mercer 2021. For each model different factors were selected following the procedure described in the methodology.

### API 2018

For the API index model with data from the year 2018, statistical significance of the following factors at the 0.05 significance level was found: GDP per capita ( $p=0.013<0.05$ ), fertility rate ( $p=0.045<0.05$ ) and income of elderly people aged 65+ ( $p=0.017<0.05$ ).

The model with interactions of statistically significant factors with the type of pension model did not show that these factors had different effects on the API in different pension models ( $p$ -values of the interactions were higher than the chosen significance level of 0.05). This implies that the above-mentioned

factors have an impact on the evolution of the API index, but there was no evidence of a different effect of these factors on the API index in different pension models. The factors have the same effect on the API index in any country and type of pension model (conservative, modern liberal, social democratic, post-communist).

## **API 2021**

In 2021, the effect of only two factors was proved: GDP per capita ( $p=0.010<0.05$ ) and expected years of retirement for women ( $p=0.011<0.05$ ). Two other factors were at least close to statistical significance at the 0.05 level and were statistically significant at the 0.1 significance level, namely fertility rate ( $p=0.079$ ) and income of the elderly ( $p=0.055$ ). Testing the model with interactions gave similar results as with API 2018.

## **Mercer 2018**

The Mercer index scores are affected by the factors: current retirement age ( $p=0.048<0.05$ ) and employment income of elderly people ( $p=0.041<0.05$ ). According to the model with interactions of statistically significant factors with the type of pension model, it was not proved that these factors would affect Mercer 2018 to different degrees in different pension models ( $p$ -values of the interactions were higher than the chosen significance level of 0.05).

## **Mercer 2021**

According to the results of the general linear model for the dependence of Mercer 2021 on the selected factors, the following factors were found to be statistically significant at the 0.05 significance level: fertility rate ( $p=0.013<0.05$ ). Another factor was at least close to statistical significance at the 0.05 significance level and was statistically significant at the 0.1 significance level: employment rate ( $p=0.052$ ). According to the model with the interactions of the selected factors with the type of pension model, it was not found that these factors would affect Mercer 2021 to different degrees in different pension models ( $p$ -values of the interactions were higher than the chosen significance level of 0.05).

Due to the lack of input data, countries in the post-communist model were omitted from the Mercer 2018 and Mercer 2021 models.

## **DISCUSSION AND CONCLUSION**

According to experts and the results of the analysis, there is no global and universal solution that could help create a stable pension system. On the contrary, these are partial steps that help the stability of the pension system in the face of demographic aging. Also, the indices used take into account more areas when assessing pension systems.

At the beginning of the millennium, reforms of pension models were brought about mostly in post-communist countries, mainly due to cracks in pension models incompatible with the development of market economies. However, it became clear later that similar reforms would have to be adopted by western countries. Therefore, an analysis comparing pension systems in different parts of the world was carried out in order to obtain the widest possible range of results from the adjustments and the reforms of pension systems already implemented.

The analysis of variance showed that the performance of different pension models (conservative, social-democratic, modern liberal and post-communist) depends on different factors. However, we cannot claim that the factors in question affect significantly only some of the pension models. The pension indices analysed (API and Mercer) cover different areas of pension systems and are therefore influenced by different factors. For example, the API pension index is more sensitive to the evolution of the employment rate of the population aged 60 to 64 and also the income of seniors over 75. On the other hand, the Mercer index is more sensitive to a larger number of factors that affect the performance of pension models. These

include, for example, the income of people over 75, the trend in future retirement age for men, the level of public debt and the general unemployment rate.

The results of the statistical analysis showed that of the models compared the best performing appears to be the social-democratic model. This model is used e.g., in Iceland, the Netherlands, Norway, Sweden, Finland, Israel and Denmark. The representatives of this model score the highest on the indices and represent one of the most sustainable pension systems in the world. For this reason, a lot of recommendations, which are used as inspiration for the Czech government, are already enshrined in the legislation of the countries with this model. A great advantage of these pension systems is predominantly the low level of income poverty in old age (the Netherlands 3.1%; Denmark 3%; Norway 4.3%; whereas the Czech Republic 10.4%). The stability of the whole system is also maintained by different sources of income of the elderly population and by not relying on the state pension (in the Netherlands, private labour income accounts for about 39% of the total income and thus has the highest ratio among OECD countries). Another positive factor affecting the pension system is part-time employment (the Netherlands = 36.9%, Norway = 19.9%, Denmark = 18.6%, whereas the Czech Republic = 4.9%).

The advantage of the above countries is the division of the first pension pillar into a solidarity part, which is the same for all citizens, and a merit (percentage) part which is based on the contributions to the pension system during working life. What has also become effective is the division of the solidarity part of the pension into a minimum and a variable part where the variable part itself depends on the length of time of contributions payment to the pension scheme.

The statistical analysis shows the factors that are crucial for the successful pension reform. A key element in the setting up of a sustainable pension system is the indexation (valorisation) of pensions, which should take into account the development of GDP and nominal wages not only the growth rate of minimum wages. However, this element is not taken into account in the pension system of the Czech Republic and so we can currently see the impact of a sub-optimal indexation formula that does not take into account the development of GDP and thus goes against the sustainability of the pension system.

Other key factors include: current retirement age; future retirement age (the retirement age of today's 22-year-olds) and employment rate.

As suggested above, it is important to set a retirement age that should respect life expectancy. This can help to make the pension system more financially sustainable and to stabilise the ratio of working life to life in retirement.

The experience of other countries shows that it is not possible to carry out a pension reform without changes in the tax system. From the point of view of experts, it is advisable to redirect taxation from labour to consumption, property and environmental taxes, together with the introduction of progressive elements of taxation and equal taxation for employees and self-employed persons. The main problem is low minimal levies on the self-employed and also their low assessment bases for social insurance contributions, which creates inequality in pension contributions.

The suboptimal setting of revenues into the pension system leads to a negative impact on public debt, which has a significant effect on the performance of pensions systems, as shown by the statistical analysis. What is positive is the shift of some responsibility onto citizens themselves, as in their future pensions, a key role will be played by various employer-supported employee schemes. These can help to offset the replacement ratio of net wages during working life and thus significantly reduce the poverty rate in old age. Equally important is the linking of private and public pension systems and the streamlining of the third pension pillar. Some inspiration can be found in pension systems (e.g., Sweden, Norway ...) combining a PAYG system and a funded system.

All of the above recommendations can be a good basis for changes to the Czech pension system, which are inevitable given the current state of public finances. They will need to be discussed by all political parties, because without a general consensus the pension reform cannot live longer than one term, as shown by experience from the years 2013-2016.

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