ISSN 2392-1641
e-ISSN 2450-0097

Economics and Business Review

Volume 10 (2) 2024

CONTENTS

Poznań University of Economics and Business Press

Paper based publication

https://doi.org/10.18559/ebr.2024.2

ISSN 2392-1641
e-ISSN 2450-0097

POZNAŃ UNIVERSITY OF ECONOMICS AND BUSINESS PRESS
ul. Powstańców Wielkopolskich 16, 61-895 Poznań, Poland
phone +48 61 854 31 54, +48 61 854 31 55
https://wydawnictwo.ue.poznan.pl, e-mail: wydawnictwo@ue.poznan.pl
postal address: al. Niepodległości 10, 61-875 Poznań, Poland

Printed and bound in Poland by:
Poznań University of Economics and Business Print Shop

Circulation: 80 copies

sciendo

sciendo Economics and Business Review https://www.ebr.edu.pl Vol. 10 (2), 2024: 60–91 https://doi.org/10.18559/ebr.2024.2.1140

Taxation of public pensions in European Union countries

Maciej Cieślukowski[1]

Abstract

The aging of society is one of the most important trends shaping the social, economic and political life of the 21st century. However, with the increasing number of people of retirement age, the problem of ensuring adequate conditions for a longer life arises. The state influences these conditions through the pension security system, including taxation of pensions. The paper attempts to answer the question whether taxation of remunerations and public pension benefits may have a significant impact on making decisions about choosing a country of work in the common market. For this purpose, Member States have been ranked in terms of two dimensions—the conditions of taxation of wages and the conditions of taxation of retirement benefits. The countries were classified using a multi-criteria comparative analysis and the agglomeration method. The study shows that taxing salaries and pension benefits is of marginal importance from the point of view of an employee's decision-making. The main factors are the average expenditure on net salaries and the average expenditure on net pension benefits.

Keywords

- public pensions
- taxes
- social security contributions
- EU countries
- labour costs

JEL codes: H2, H55, J26, J32

Article received 16 January 2024, accepted 10 May 2024.

Suggested citation: Cieślukowski, M. (2024). Taxation of public pensions in European Union countries. *Economics and Business Review*, *10*(2), 60–91. https://doi.org/10.18559/ebr.2024.2.1140

[1] Department of Public Finance, Poznań University of Economics and Business, al. Niepodległości 10, Poznań, Poland, Maciej.cieslukowski@ue.poznan.pl, https://orcid.org/0000-0001-6058-0113.

Introduction

The aging of society is one of the most important trends shaping the social, economic and political life of the 21st century. Causes include the decreasing birth rate, on the one hand, and technological progress in medicine and the healthier and more aware lifestyle among retired people on the other. However, with the increasing number of people of retirement age, the problem of ensuring adequate conditions for a longer life arises. In 2020, in EU countries, a total of 19.2% of the population over 60 years of age was at risk of poverty and social exclusion (Eurostat). However, the variation in this indicator across individual countries is enormous: in Luxembourg it was 8.3%, while in Bulgaria it was 43.5%.

The state can influence these conditions through the pension security system, including taxation of pensions. This issue is a subject of interest in the literature. The taxation of public and private pensions is examined in terms of factors such as its fiscal and redistributive effects, and its impact on the capital market and economic growth. The taxation of occupational pensions is also of interest to the European Commission in the context of the functioning of the common European market.

People of working age can choose any country in the common European market to improve their living conditions both at working age and after retirement. The paper attempts to answer the question whether taxation of remunerations and public pension benefits may have a significant impact on making such decisions. In this way, people of retirement age could reduce the potential negative effects of poverty. To the author's knowledge, such a topic has not been the subject of particular research interest so far.[2]

For this purpose, Member States have been classified in terms of two dimensions—the conditions of taxation of wages and the conditions of taxation of retirement benefits. The empirical data are of a macroeconomic nature. EU countries were ranked using multidimensional comparative analysis (MCA). In order to analyse the ranking results obtained, cluster analysis was used using the agglomeration algorithm and the Euclidean distance measure. Calculations were performed using Multivariate Statistics from the Statistica 13 package. As a result of applying the agglomeration method in the first dimension of the analysis (conditions of taxation of wages), six clusters of Member States were obtained, while in the second dimension of the analysis (conditions of taxation of pension benefits), two clusters were obtained.

[2] The impact that taxing pensions has on mobility is relatively minor and is not particularly evident in the literature. However, a related issue focusing on ongoing or planned or even expected pension reforms (caused by fiscal difficulties) is an issue analysed in the literature.

The paper is organised as follows: Section 1 provides a review of the relevant academic literature, Sections 2 and 3 provide information on the structure and taxation principles of public pensions in EU countries. Section 4 presents the demographic structures in EU countries. Section 5 presents the research methods and sources of data. The last section presents empirical findings. The paper ends with conclusions.

1. Literature review

Research on the taxation of pensions is generally conducted in terms of the taxation of private pensions (individual and occupational) and the taxation of public pensions, both from a theoretical and empirical perspective. Research on the taxation of private pensions is older and much more extensive, and is conducted in terms of the optimal taxation of capital income at the saving stage (payment of contributions), investment operations (pension funds), and payment of retirement benefits (Cremer & Pestieau, 2016). In this regard, it is possible to apply six basic taxation models: *EEE*, *EET*, *ETT*, *TTT*, *TTE*, *TEE*, where E denotes exempt and T denotes taxed. OECD reports (OECD, 2011, 2023) show that the *EET* system is in force in most European Union and OECD countries. Research generally emphasizes the advantage of the *EET* system over the competing *TEE* system in the context of the impact on savings, development of the capital market and improvement of corporate governance, the impact on economic growth and better risk-sharing between generations and between retirees and the state. Very good reviews of the literature and research achievements in this field are provided, e.g., by Cremer and Pestieau (2016) and Armstrong et al. (2015). Moreover, the *EET* system is also preferred by the European Commission in the context of the functioning of the common market and counteracting pension tax avoidance (European Commission, 2001). An overview of the effects of taxation of occupational pensions in the common market is provided by Patterson (2002) and Kluzek (2022), among other authors.

Ferrarini and Nelson (2003) point out that research on the taxation of social benefits is relatively new and dates back only to the early 1970s. Taxation of public pensions is considered at the stage of professional work and the stage of payment of pension benefits. Here we can consider four basic tax models: *EE*, *ET*, *TT* and *TE*. Initially, research was conducted separately on these two aspects (Cremer & Pestieau, 2016). In a new approach to research in this area, authors combine the design of the optimal pension level with taxation in a single model (Cremer et al., 2008; Diamond, 2009). The authors empha-

sise that in order to function over the participants' lifetimes (tens of years), the pension system must be in balance, that is, the demand for pension rights (the sum of contributions paid) and their supply (the sum of pension benefits received) must be equal. Therefore, the amount of pensions and the contribution rate are closely related and cannot be shaped freely.

Theoretical research shows that imbalances may result from situations when people of retirement age extend their working life but additional years of work do not increase their pension, or when working people take early retirement. Then the level of pensions should be adjusted through appropriate taxation. Lozachmeur (2006) and Cremer et al. (2008) indicate that taxation of income during work should be higher than the taxation of retirement benefits.

The redistributive and fiscal effects of taxes on pensions are also a relatively new subject of research. Ferrarini and Nelson (2003) point out that the redistributive effects of social benefits should be examined after they are taxed. Ignoring income taxes may lead to an overestimation of the positive impact of benefits on reducing income inequality and may lead to incorrect conclusions regarding the importance of various tax instruments in the redistribution of income.

Keenay and Whitehouse (2003) conducted a comparative analysis of average and marginal pension tax rates in 15 OECD countries in relation to the applicable working age. Their study shows that in all countries people of retirement age experience a much lower tax burden than people of working age. Similar conclusions also result from regular OECD studies (OECD, 2021, 2023).

Verbist (2007) examines the impact of taxation on pensions and unemployment benefits on redistributive effects in 15 EU countries using EUROMOD. The author finds significant differences in taxation, but points out that in all countries taxation of pensions is lower than taxation of income from work, and pensions after taxation have greater purchasing power than before taxation. Additionally, research shows that in most countries, taxation of pensions is more progressive than taxation of income from work, which translates into the considerable importance of the tax system in reducing income inequality among older people.

The use of various types of preferences in the taxation of pension contributions and benefits may lead to the creation of income savings that affect redistributive effects. In the literature on the subject, such savings are called tax expenditures (Swift, 2006). Barrios et al. (2020) estimate the fiscal and redistributive effects of tax expenditures in EU countries, across both private and public pensions, using the EUROMOD model. In particular, the authors compare the current pension taxation systems with the *ET* model system. All derogations are treated as tax expenditures. Research shows that these deviations are significant and progressive.

Jun et al. (2023) show that OECD countries, by trying to improve the redistributive effects of public pensions, introduce elements of private security into the system. As a result, tax expenditure for private pensions is increasing.

Another detailed analysis of fiscal and redistributive effects and the impact on poverty using the EUROMOD model is made by Ivaškaitė-Tamošiūnė and Thiemann (2021). The authors examine the indicated effects for 27 EU countries in scenarios of transition from the current taxation systems (*EE*, *ET*, *TE*, *TT*) to the *EE* and *TT* systems.

Genser and Holtzmann (2021) consider the effects of taxation on foreign public and private pensions in the context of the applicable rules in double taxation agreements signed by Germany. The taxation of cross-border pensions is assessed as very complex, unfair and inconsistent with the international mobility of citizens. The authors propose a new instrument in bilateral tax treaties named 'pretaxation of pensions' as a suitable economic concept for global pension taxation.

2. Pension systems in EU countries

Pension systems in today's developed countries serve three main goals: 1) helping individuals redistribute resources from work in old age, 2) protecting people emerging poverty in old age, 3) providing insurance and reducing disparities in monthly old-age income, regardless of longevity (Shi & Kolk, 2022). In traditional typologies of pension systems in OECD countries, systems are referred to as "Bismarck" are oriented towards income replacement (meeting the first and third goals), while "Beveridge" systems focus on protecting against poverty (second goal) with less emphasis on linking pensions to previous earnings (Ebbinghaus, 2021). These goals are achieved through the mechanism of transferring funds from higher income earners to lower earners as an integral part of mandatory government welfare systems.

In 2020, obligatory pension security systems in EU countries were a combination of two tiers (pillars) (Table 1). The first pillar is basic pension security. Pensions are awarded on the basis of the principle of residence (provisioning technique) or on the basis of contributions paid (insurance technique) but are not linked to earnings. In the first case, the pension is granted to residents of a given country and usually reflects basic living costs (basic pension). Another solution may be so-called targeted pensions that depend on additional residence criteria, e.g., the amount of assets owned. Then, less wealthy people receive higher pensions. The contributory system includes basic and minimum pensions. The former usually depend on the contributions paid and the

Table 1. Obligatory pension systems in EU countries in 2020

Country	First tier				Second tier	
	residence-based		contribution-based			
	basic	tar-geted	basic	mini-mum	public	private
Austria				X	DB	
Belgium				X	DB	
Bulgaria				X	DB	
Romania				X	DB	
Czech Republic			X	X	DB	
Denmark	X	X			FDC	FDC
Cyprus				X	DB	
Estonia			X		DB*/Points	FDC*
Malta				X	DB	
Finland		X			DB	
France				X	DB + Points	
Germany					Points	
Greece	X				DB + NDC	
Hungary				X	DB	
Ireland			X			
Italy					DB*+NDC	
Latvia				X	DB*/NDC + FDC	
Lithuania			X		Points	
Luxembourg			X	X	DB	
Netherlands	X					FDC
Poland				X	FDC	
Portugal				X	DB	
Slovakia				X	Points	
Slovenia				X	DB	
Spain				X	DB	
Sweden		X			NDC + FDC	FDC

* Changes applicable to people who retired in 2020.

Source: based on (Euromod, 2011–2022; OECD, 2021, 2023).

contribution period. The state may also provide, upon the meeting of certain contribution conditions, a minimum amount of pension benefit.

The second pillar is based solely on a contribution system closely related to earnings. There are three detailed pension calculation schemes: defined benefit (DB), points-based, and defined contribution (DC). The DB scheme is an expression of the pay-as-you-go principle, so pensions are calculated based on the contribution period, income earned and contributions applicable at a given time. The points system means that employees earn pension points based on their earnings. After retirement, the amount of the benefit is the product of the sum and the value of pension points.

Defined Contribution (DC) systems are based on individual pension accounts and can take two forms: Financial Defined Contribution (FDC) or Notional Defined Contribution (NDC). In FDC, contributions are transferred to an individual pension account and then invested in accordance with the adopted regulations. The accumulation of contributions and investment earnings is usually converted into a monthly pension at the time of retirement. The second type (NDC) consists of programs with individual accounts in which contributions are capitalized and for which a hypothetical rate of return is applied. In consequence, the accounts exist only in the books of the managing authority. At retirement, the accumulated nominal capital is converted into a monthly pension using a formula based on life expectancy or mortality rates.

Denmark, the Netherlands and Sweden also have mandatory private insurance pillars. They are an important complement to pension systems based mainly on a provisioning scheme. Such an additional program was also introduced in Estonia in 2020. In Ireland, there exists only the first pillar of pension security.

It should be emphasised that pension systems across EU countries also differ in terms of such factors as the principles and amounts of payment of pension contributions, indexation of pensions, sources of financing and payment of pensions, and retirement age. Some countries also have different pension systems for public and private sector employees (Euromod, 2011–2022; OECD, 2021, 2023).

For example, in Denmark and Malta, pension funds are not separated as subsectors of public finances. Contributions apply in Malta, but they go into the state budget. By contrast, in Denmark, public pensions are generally financed by taxes, and in the case of local civil servants, pensions are also paid from local budgets. In the last few decades, many countries also shifted their public pension systems towards private ones (Manor & Ratajczak, 2020).

3. Principles of taxation of public pensions in EU countries

Public pensions may be taxed at two stages of life: when working and receiving remuneration, and after retirement, i.e. when receiving a pension benefit. Taxation of a pension during the working period is considered in the context of the occurrence and tax treatment of compulsory pension insurance contributions. If it is possible to deduct all contributions from income tax (the tax base), pensions are exempt from taxation (*E* – exempt), otherwise they are fully taxed (*T* – taxed). Countries may also apply partial deductions for contributions (*t* – taxed partially). Pension contributions may be levied to varying degrees on both employees and employers. In turn, the pension benefit is one of the sources of income, and as such it may be subject to income tax (*T*), it may be subject to taxation on preferential terms (*t*), or it may be completely exempt from tax (*E*).[3]

Pension taxation systems in EU countries are diverse, and it is difficult to provide clear reasons for their construction. Taking into account the fiscal burden imposed on the employee and the pension benefit, six models of taxation of public pensions can be distinguished (Table 2).

Table 2. Classification of EU countries in terms of the model of taxation of public pensions in 2019–2022

Model	Country
EE	Bulgaria, Slovakia
ET	Croatia, Cyprus, Denmark, Estonia, Greece, Malta, Poland
Et	Austria, Belgium, Finland, Latvia, Portugal, Romania, Slovenia, Spain, Sweden, Italy
TE	Lithuania, Hungary
Tt	Czech Republic
tt	France, Germany, Ireland, Luxembourg, Netherlands

Source: based on (Euromod, 2011–2022; European Commission, n.d.; Ivaškaitė-Tamošiūnė & Thiemann 2021, pp. 10–11).

Table 2 shows that in most countries, public pensions are exempt from taxation at least at one stage of life. The most popular among EU countries is the *Et* model. In this model, an employed person has the option of fully deducting pension insurance contributions from the income tax base, and the pen-

[3] In theory, taxation of pension liabilities during the working period is also possible in systems in which the liabilities are expressed in money terms (in practice not applied).

sion benefit is taxed on preferential terms. As a rule, pensioners are granted various tax reliefs depending on the amount of their pension and their family status. In turn, the friendliest tax regulations are found in Bulgaria and Slovakia. In these countries, the entire pension insurance contribution can be deducted from the tax base, and the pension benefit is completely tax-free.

The tax burden of the pension is also influenced by the division of the pension contribution between the employee and the employer. In this respect, six models can be distinguished in EU countries (Table 3).

Table 3. Classification of EU countries in terms of the division of mandatory pension insurance contributions between the employee (*Ee*) and the employer (*Er*) in 2019–2022

Model	Country
Ee = Er	Cyprus, Germany, Luxembourg, Malta, Poland
Ee < Er	Austria, Belgium, Bulgaria, Czech Republic, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Slovakia, Spain
Ee > Er	Slovenia
Ee	Croatia, Lithuania, Netherlands, Romania
Er	Estonia, Sweden
No contributions	Denmark

Source: based on (Euromod, 2019–2022; Ivaškaitė-Tamošiūnė & Thiemann 2021, pp. 10–11).

In most EU countries, the employer pays the higher pension contribution. Particularly important differences in this respect are found in Italy, the Czech Republic, France, and Spain, among other countries. Only in Slovenia does the employee pay the greater part of the pension contribution. In four countries, only employees pay the contribution, but in Lithuania and Romania such rules have only been in force for a few years. Until the end of 2019 and 2018, respectively, the majority of the pension contribution was paid by employers. In Estonia and Sweden, pension contributions are paid exclusively by the employer, while in Denmark public pensions are financed by taxes.

In the context of the further analysis, it is significant that in Ireland and Malta compulsory social security contributions are of a general nature and also cover, in addition to pension insurance, other types of insurance (e.g., health, unemployment).

4. Demographic structure of EU countries

Pension systems, including the conditions for taxation of pension benefits, depend largely on the demographic structure of the population. Between 2010 and 2020, there was an average increase in the median age in EU countries from 40.1 to 42.7 years. This means that the EU population is aging. The median age has increased in all EU countries, except Sweden, where the rate decreased slightly from 40.7 to 40.5 years (Figure 1). The highest average median age in the study period was recorded in Germany (45.5), Italy (45.2) and Portugal (43.5), and the lowest in Ireland (36.1), Cyprus (36.8) and Slovakia (39.0).

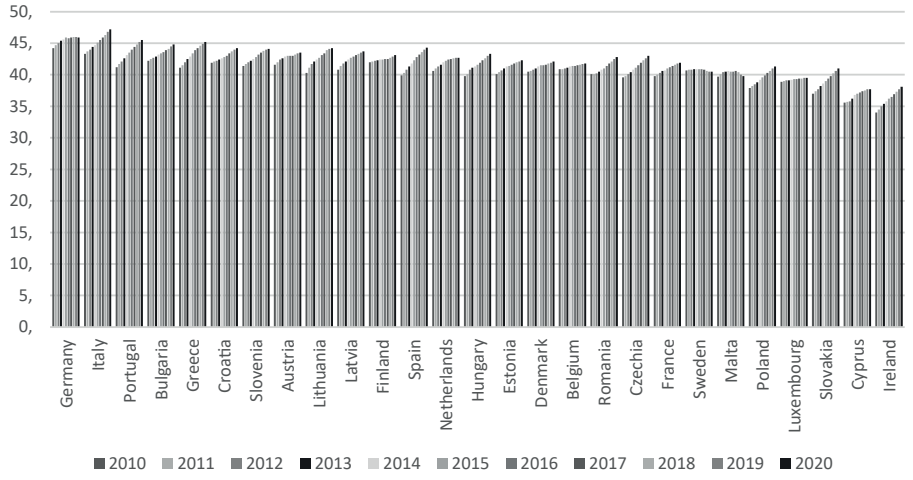

Figure 1. Median age in EU countries in 2010–2020

Source: based on Eurostat data.

As a result of aging population, the number of people of retirement age and the elderly dependency ratio are increasing. In the years 2010–2020, the total number of retirees in EU countries increased from 82.3 to almost 91.7 million people. The highest increase in the number of retirees was recorded in Luxembourg (58.8%), Ireland (45.0%) and Slovakia (44.3%). In turn, in five countries the number of retirees decreased. The largest decline was recorded in Greece (7.4%), Latvia (6.0%) and Estonia (3.2%). The number of retirees across EU countries varies greatly (Figure 2). Over 65.7% of the total number of retirees live in Germany, France, Italy, Poland and Spain.

In the years 2010–2020, the elderly dependency ratio for EU countries increased from 26.3 to 32.0%. This means that for every person aged 65 or over, the number of working age people decreased. In 2010, it was less than

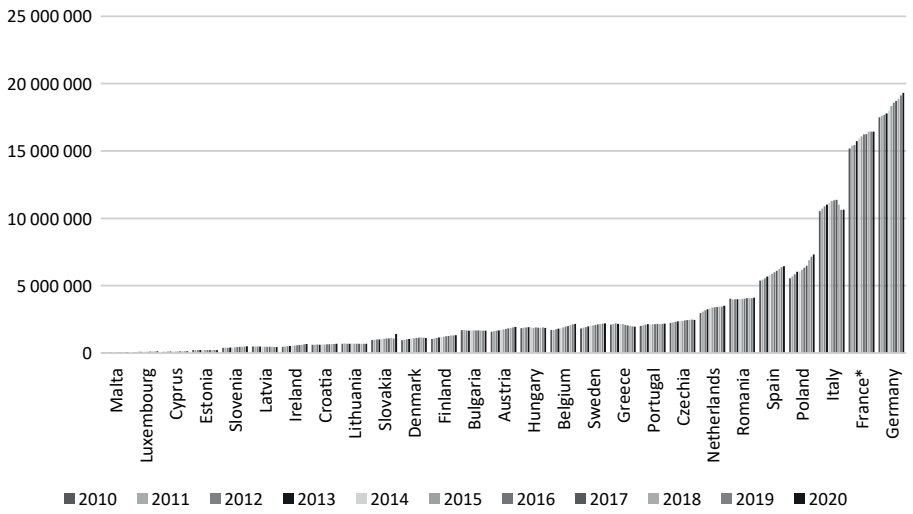

Figure 2. Number of pensioners in EU countries in 2010–2020

* No data for 2019 and 2020. Data from 2018 were used for the analysis.

Source: based on Eurostat data.

4 people, and at the end of 2020, just over 3 people. The lowest average old age dependency ratio was recorded in Ireland (19.5%), Slovakia (20.2%) and Luxembourg (20.5%), and the highest in Italy (33.7%), Germany (32.1%) and Greece (32.1%). As a result of population aging, the number of people of retirement age and the elderly dependency ratio are decreasing.

The increasing old-age dependency ratio means that fewer people work to pay one pension benefit. As a result, pension systems become financially inefficient without additional state support or changes to the system. One of the most popular reforms concerns the increase in the retirement age to order to reduce pension expenses.

In most countries, the retirement age for men and women is equal. Higher ages for men apply in Austria, Bulgaria, Croatia, Hungary, Lithuania, Poland and Romania. The Netherlands and Greece have the highest retirement age, at 66.3 and 67 years. The lowest age for men is 62 and applies in Italy, Luxembourg and Slovenia. In turn, the lowest age for women is 60 and applies in Austria and Poland. The average retirement age across the EU in the year in question is 64.3 years for men and 63.5 years for women. Between 2018 and 2022, the retirement age was slightly increased in France, Latvia, Lithuania, Malta, the Netherlands, Portugal, Slovenia and Slovakia. In 2020, the retirement age for men and women was equalized in Slovenia and Italy, with the latter country significantly lowering it from 67 and 66.3 to 62 years. It should also be emphasised that since 2023, most countries have significantly increased the retirement age, even to 67 years (Bulgaria, Denmark, Greece,

Italy). Only in France was the age lowered to 62.3 years. In Austria, the retirement age for women will gradually rise to that of men (i.e. 65) between 2024 and 2033 (Fratica-Dragomir, 2023).

5. Methods and materials

The classification of Member States was carried out in terms of two dimensions, i.e. divided into the conditions of taxation of remuneration for work and the conditions of taxation of pension benefits.

The conditions of taxation of remuneration from work were described using four macroeconomic variables (X_1–X_4), while the conditions for the taxation of pension benefits were described using 11 macroeconomic variables (X_5–X_{15}):

X_1 – Average annual expenditure on gross wages per person (EUR) – average data 2010–2020,
X_2 – Average expenditure on net wages per person (EUR) – average data 2010–2020,
X_3 – Implicit Tax Rate (*PIT+SSC* employee) (%) – data 2020,
X_4 – Implicit Tax Rate (*SCC* employer) (%) – data 2020,
X_5 – Average annual gross pension expenditure per person (EUR) – average data 2010–2020,
X_6 – Average annual net pension expenditure per person (EUR) – average data 2010–2020,
X_7 – Pension Effective Tax Rate (*PETR*, %) – $((X_1–X_2)/X_1)$,
X_8 – Average annual net pension expenditure per person (*PPS*) – average data 2010–2020,
X_9 – Gross Pension Replacement Rate (*GPRR*, %) – data 2022,
X_{10} – Net Pension Replacement Rate (*NPRR*, %) – data 2022,
X_{11} – Gross Pension Wealth (*GPW* men, %) – data 2022,
X_{12} – Net Pension Wealth (*NPW* men, %) – data 2022,
X_{13} – Gross Pension Wealth Pension (*GPW* women, %) – data 2022,
X_{14} – Net Pension Wealth (*NPW* women, %) – data 2022,
X_{15} – Relationship between the amount of an employee's fiscal payments and average annual gross pension expenditure per person (EUR) $((X_1–X_2)/X_5)$.

Variables X_3, X_7 *and* X_{15} are destimulants, while the remaining variables are stimulants. Some variables require additional explanation. To assess the fiscal burden of a pension at the stage of professional work, the *ITR* (*Implicit Tax Rate*) indicator was selected, covering total labour costs, i.e. both total mandatory social security contributions and personal income tax (*PIT*) paid by the employee. An objective comparison of the actual tax burden of pen-

sions at the stage of work in EU countries, resulting solely from the payment of mandatory pension contributions, is difficult. This is due to different rules on contribution to pension systems. Firstly, in several countries (Denmark, Finland, Greece, the Netherlands and Sweden), residence-based pensions constitute an important part of the system. In Denmark, pension contributions are marginal and pensions are financed mainly by taxes. Therefore, the argument that in Denmark the tax burden of a working pension is the lowest due to the lack of compulsory pension contributions would be incorrect, since the income tax on wages is one of the highest in the world. Secondly, in some countries a general social security contribution is levied without a detailed separation of the pension contribution (Ireland, Malta). As a result, the tax costs of pensions at the stage of work are considered in the article through the prism of the total fiscal burden of work. This approach is also supported by the fact that the pension contribution is one of the obligatory elements of the social security contribution system and the employee cannot choose the type of contribution payment.

The *ITR* indicator, (*PIT + SSCe + SSCr + Tr*)*/*(*We + Tr*), is the quotient of the sum of taxes and social security contributions paid by employees (*PIT, SSCe*) and employers (*Tr, SSCr*) imposed on remuneration and the sum of remuneration paid (*We*) and taxes (e.g., payroll tax) paid by employers on wages (*Tr*). This indicator is a macroeconomic approach to the tax costs of labour in the economy, showing the average tax burden of labour for all employees (European Commission, 2022, p. 42). In the analysis, this indicator was divided into the *ITR* corresponding to the employee's burden (variable X_3) and the *ITR* corresponding to the employer's burden (variable X_4). For the employee, the situation is more favorable the lower the X_3 variable and the higher the X_4 variable.

PETR shows the average tax burden imposed on pension expenditure and is calculated using the formula *PETR = GPE–NPE/GPE*. This indicator is the ratio of the difference between gross pension expenditure (*GPE*) and net pension expenditure (*NPE*) to gross pension expenditure (*GPE*).

The *GPRR* (*Gross Pension Replacement Rate*) and *NPRR* (*Net Pension Replacement Rate*) indicators show what part of the average gross and net remuneration obtained over the entire working period will constitute the gross and net pension, respectively. However, these indicators do not provide a comprehensive measure of cumulative pension payments, i.e. taking into account life expectancy, normal retirement age and indexation of pension benefits. Such measures are the *Gross Pension Wealth* (*GPW*) and *NPW* (*Net Pension Wealth*) indicators, which indicate what part of the average gross and net earnings will constitute the accumulated pension flows. These indicators are presented separately for women and men.

The last indicator (variable X_{15}) is the share of the current average amount of taxes and contributions paid by the employee on remuneration (*PIT + SSCe*) in relation to the average expenditure on pensions per person (*PE*). This indica-

tor shows the degree to which current pension expenditure is covered by the employee's mandatory labour costs. The situation is more favorable for the employee when the value of this indicator is lower. This means that the labour costs the employee must incur are lower than the amount of the benefit paid.

Diagnostic variables derived from or were developed on the basis of the following databases and studies:

- Eurostat and Euromod, country reports (variables X_1, X_2, X_5, X_6, X_7, X_8, X_{15}),
- OECD, 2023 (variables X_9–X_{14}),
- European Commission Data (n.d.) (variables X_3, X_4).

All variables are presented in Appendix A1.

Within two dimensions of the analysis, countries were ranked using multidimensional comparative analysis (MCA). The zero unitarization method was used in the MCA analysis as one of the best methods for this type of application.

Multidimensional comparative analysis is often used to classify EU countries in terms of selected variables. For example, Jankowiak (2021) compared the health care systems of EU countries using the so-called synthetic indicator. Vambol et al. (2023) used a multi-criteria analysis of municipal solid waste management in Poland compared to other EU countries. Iwacewicz-Orłowska and Sokołowska (2018) prepared a ranking of EU countries in terms of the value of environmental governance indicators in selected years.

In order to express the ranking results obtained, it was decided to additionally group the Member States from the point of view of the similarity of the variables studied. For this purpose, cluster analysis was ultimately employed, using the agglomeration algorithm and the Euclidean distance measure. The results of this type of grouping are hierarchical trees. Calculations were performed using Multivariate Statistics of the Statistica 13 package. As a result of applying the agglomeration method in the first dimension of the analysis (conditions of taxation of wages), 6 clusters of Member States were obtained, while in the second dimension of the analysis (conditions of taxation of pension benefits), 2 clusters were obtained.

An alternative cluster search algorithm was V-fold cross-validation of variables. The use of this method consisted in repeating the procedure of drawing a sample for analysis three times from the data and building a model based on it. Initial cluster centers were determined by maximizing Euclidean cluster distances. After finding the optimal number of clusters, the *k*-means clustering algorithm was used. The calculations were performed using the Data Mining module of the Statistica 13 package. Ultimately, two clusters were obtained in both dimensions of the analysis (conditions of taxation of wages and conditions of taxation of pension benefits).

The clusters in the second dimension of the analysis turned out to be identical when using two alternative clustering algorithms (agglomeration and

cross-evaluation). The paper presents detailed results of the agglomeration method, due to the fact that it resulted in more clusters in the first dimension of the analysis.

6. Results of the analysis

6.1. Wages and the fiscal burden of work

The average expenditure on gross wages per employee in the EU countries (EU-27) in 2010–2020 increased from €24,800 to €32,300. The largest increases in spending were recorded in Lithuania (133.6%), Romania (108.6%) and Bulgaria (103.6%). In Greece and Cyprus, expenditure decreased by 24.7% and 3.0%, respectively, while in Italy the increase in expenditure was only 1.7%. A particularly significant decline in spending in Greece occurred in 2013 and was a negative effect of the 2008 financial crisis (Leventi & Picos, 2019).

However, the spread of expenditure in the period being examined was very large (Figure 3). The highest figure (Luxembourg) was more than eight times higher than the lowest (Bulgaria). The classification of countries in terms of wages measured in *PPS* per person is not significantly different from the classification of countries in terms of wages measured in euro. Only the spread of salaries decreases significantly. The highest *PPS*-based figure (Luxembourg) was 3.5 times higher than the lowest (Bulgaria).

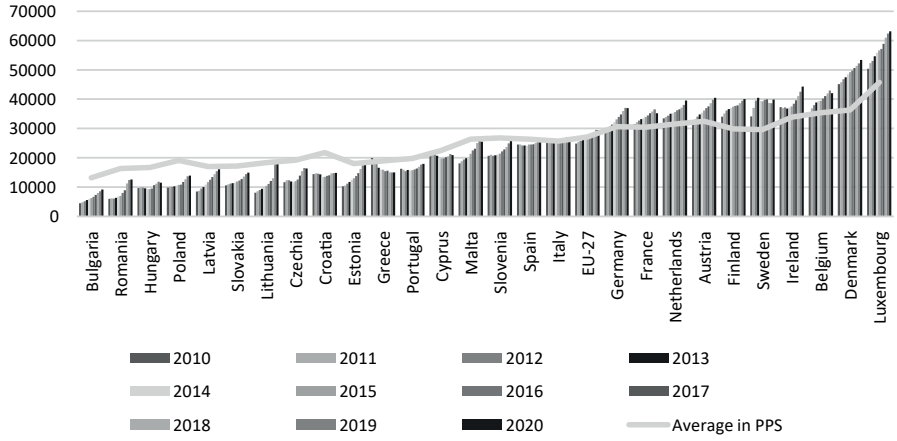

Figure 3. Average gross remuneration per person (euro and *PPS*) in EU countries in 2010–2020

Source: based on Eurostat data.

Between 2009 and 2020, the average *ITR* for the 27 EU countries increased from 36.8% to 37.8%. A significant increase in the indicator was recorded in the years 2010–2013 (by 1.4 percentage points on average) and was due to countries' reactions to the negative fiscal effects of the 2008 financial crisis (Leventi & Picos, 2019), among other factors. In subsequent years, *ITR* was very stable, and there were no significant changes in the burden in the first year of the pandemic.

ITR across EU member states varies both in terms of total weight and its structure (Figure 4). For example, in 2020, the lowest load of 23.5% was recorded in Malta, while the highest (44.1%) was recorded in Italy. On average, the largest part of *ITR* was contributions and taxes paid by employers (almost 40.2% of the total burden), followed by *PIT* (almost 34.2%), and the smallest part was contributions paid by employees (less than 25.7%).

In terms of the division of labour costs between employer and employee, the former incurs the highest costs in Italy, France and the Czech Republic, and the lowest in Lithuania, Denmark and Romania. In turn, employees in the latter three countries incur the highest labour costs, while they incur the lowest in Estonia, Cyprus and Bulgaria.

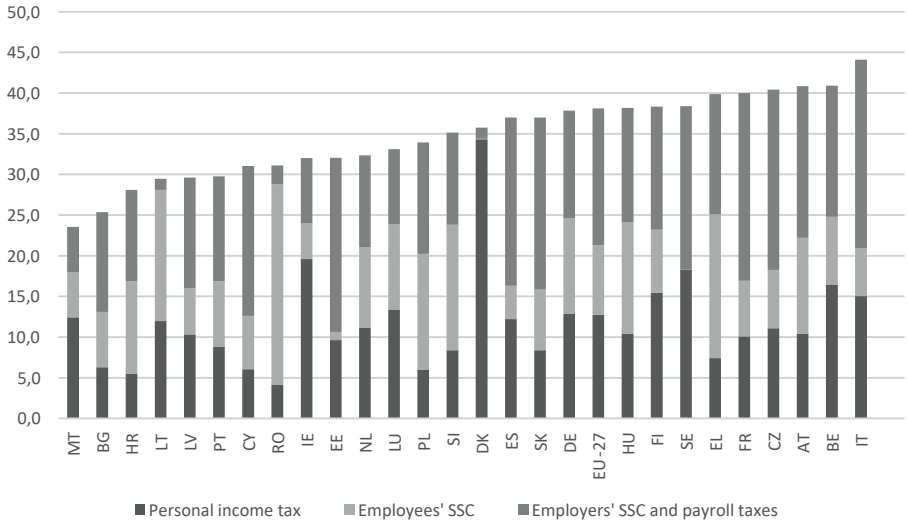

Figure 4. *ITR* on labour in EU member states in 2020

Source: based on (European Commission Data, n.d.).

The average expenditure on net wages per person resulted from the development of gross expenditure and *ITR*, which in many countries were affected by the financial crisis of 2008. In the years 2010–2020, the average expenditure on net wages per person in the EU increased from €19,800 to €23,700. The

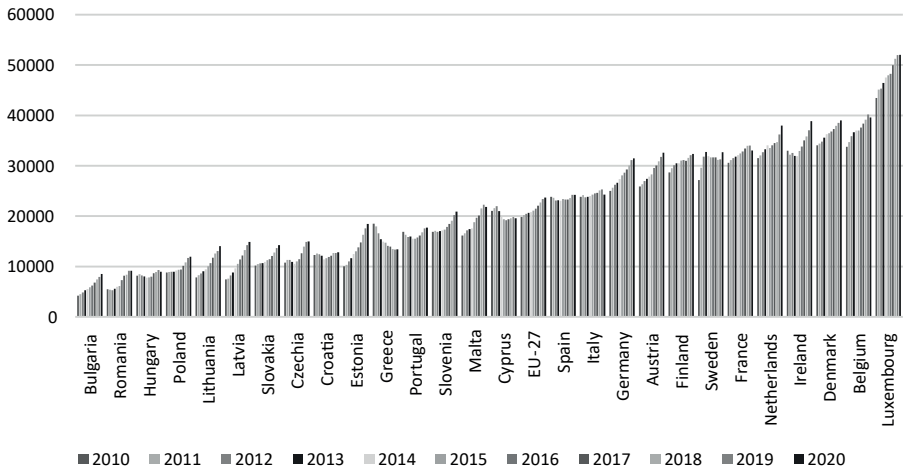

Figure 5. Average spending on net wages per employee in EU countries in 2010–2020 (euro)

Source: based on Eurostat data.

highest increases in expenditure were recorded in Bulgaria (100.8%), Latvia (99.8%) and Estonia (83.3%). A decline in salary expenditure was recorded in Greece (27.5%) and Cyprus (7.0%), while a minimal increase in expenditure was recorded in Italy (1.9%) and Spain (1.6%).

The expenditure discussed varied across EU member states (Figure 5). The lowest spending was recorded in Bulgaria, Romania and Hungary, and the highest in Luxembourg, Belgium and Denmark.

6.2. Pension expenditure and taxation of pension benefits

The average spending on pensions in the EU per person increased from €10,600 to €13,300 in the years analysed. The amount of this expenditure varies greatly across EU member states (Figure 9). In the Western EU countries and in Scandinavia, the expenditure is much higher than in the countries of Central and Eastern Europe. The highest spending was recorded in Luxembourg, Denmark and Ireland, and the lowest in Bulgaria, Romania and Lithuania. The average pension expenditure in Luxembourg was more than 14 times higher than in Bulgaria.

The classification of countries is broadly similar in terms of spending per purchasing power (*PPS*), with spending gaps across countries narrowing significantly (Figure 6). Expenditure in *PPS* turned out to be higher than expenditure in euro in the countries of Central and Eastern Europe and in Portugal,

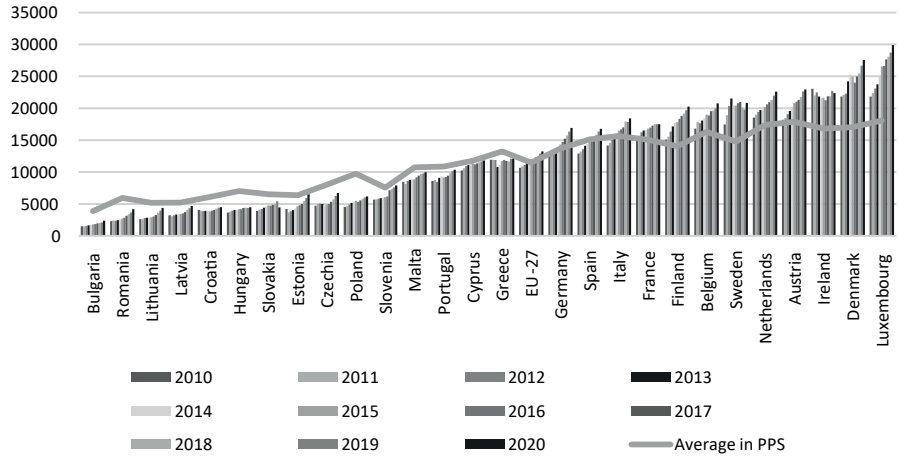

Figure 6. Classification of EU countries in terms of average gross expenditure on pensions per person in 2010–2020 (euro and *PPS*)

Source: based on Eurostat data.

Greece, Cyprus and Malta, while in the remaining countries the reverse was the case. As a result, the spending ratio between Luxembourg and Bulgaria decreased to four.

The average *PETR* in EU countries (EU-27) increased from 14.0% to 15.4% in the period under study. The largest increase in the indicator was recorded in Portugal, Cyprus, Greece and Ireland, but it occurred mainly in the years 2013–2018 and was mainly the result of the PIT reform resulting from the 2008 financial crisis. In turn, the largest decline in *PETR* was recorded in Belgium, Sweden, Poland and Malta.

PETR was very diverse across individual countries (Figure 7). A significantly lower *PETR* was recorded in the countries of Central and Eastern Europe than in Western Europe and Scandinavia. In Bulgaria, the Czech Republic, Lithuania and Slovakia, as well as in Hungary from 2014, pensions were exempt from taxation and contributions. However, the highest *PETR* was recorded in the Netherlands, Denmark and Italy.

The average net expenditure on pensions per person in the EU countries (EU-27) increased from €9,300 to €11,400 in the period in question. The largest increases in spending were recorded in Romania (81.0%), Lithuania (66.8%) and Bulgaria (60.5%). In Greece and Ireland, spending fell by 3.9% and 9.1%, respectively. Cyprus saw an 8.1% increase in spending. Expenditure varied across countries. Much higher expenditure was incurred by the countries of Western Europe and Scandinavia, mainly Luxembourg, Ireland and Denmark, and the lowest by the countries of Central and Eastern Europe, including Bulgaria, Romania and Lithuania (Figure 8). The purchasing power of the expenditure

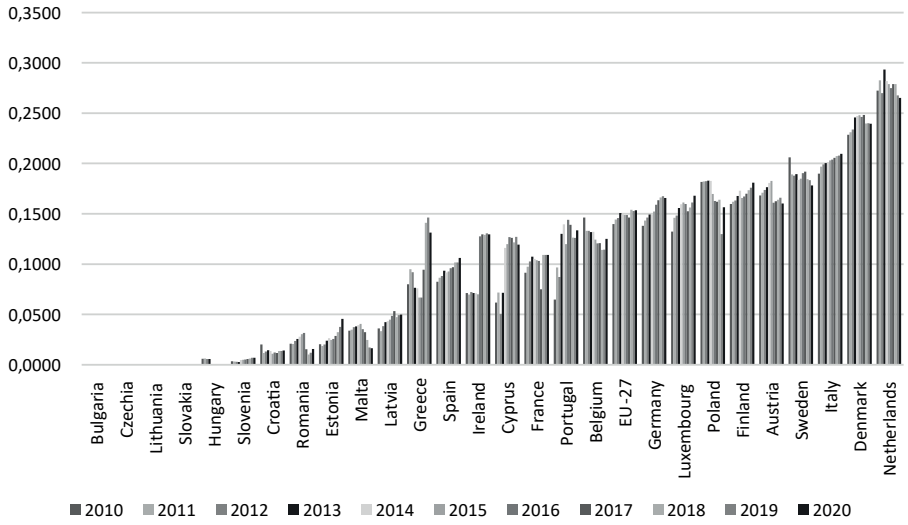

Figure 7. *PETR* in EU countries in the years 2010–2020

Source: based on Eurostat data.

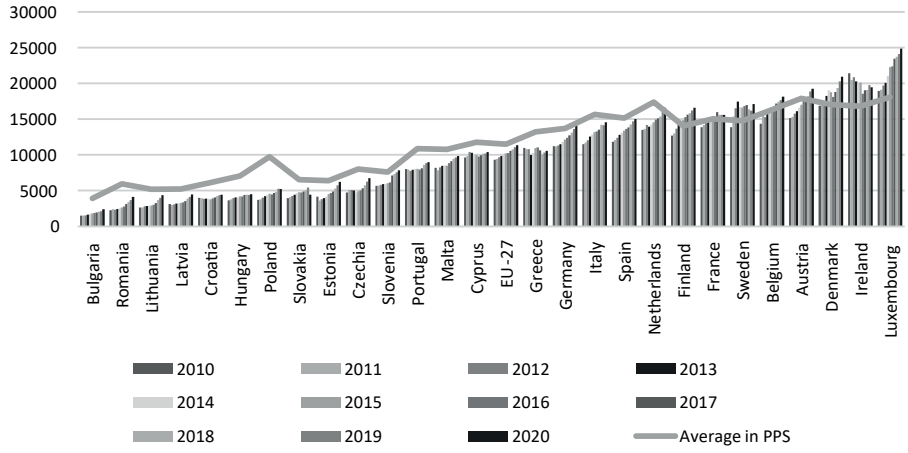

Figure 8. Average net spending on pensions per person in EU countries in 2010–2020 (euro and *PPS*)

Source: based on Eurostat data.

in question was also much higher in Western and Scandinavian countries, but in the countries of Central and Eastern Europe, expenditure expressed in *PPS* was clearly higher than expenditure expressed in euro.

6.3. Replacement rates

The average replacement rate in gross terms (*GPRR*) (before taxes and contributions for salaries and pensions) in the EU in 2022 was 54.9% (Figure 9). However, the spread of values of the indicator between countries is very large. The lowest rates were recorded in Lithuania (18.2%), Ireland (26.2%) and Estonia (28.1%), and the highest in Greece (80.8%), Spain (80.4%) and Italy (76.1%).

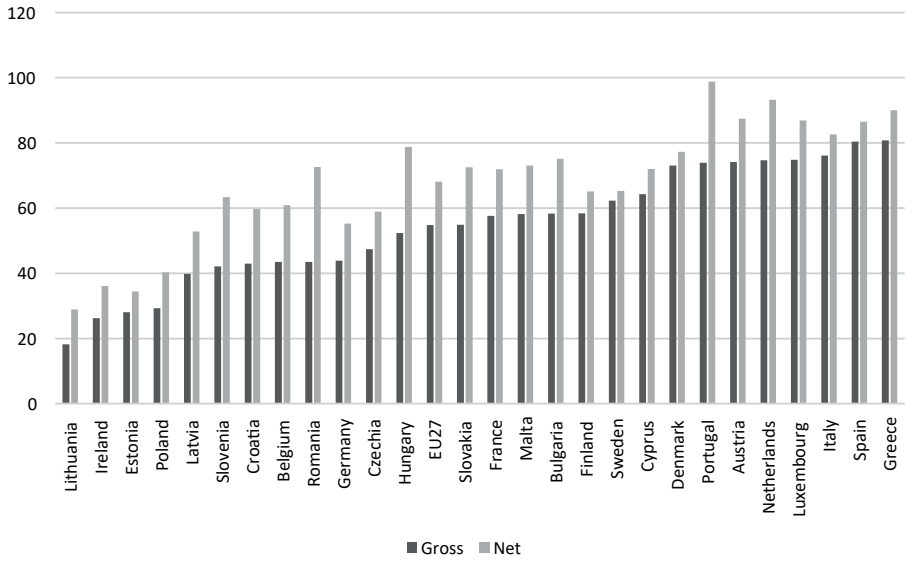

Figure 9. Gross pension replacement rate (*GPRR*) and net pension replacement rate (*NPRR*) in UE countries in 2022

Source: based on (OECD, 2023).

NPRR (after taxes and contributions on wages and pensions) is higher than the gross rate in all EU countries. The average replacement rate for the entire EU increases to 68.1%, while the spread of the rate between member states decreases (Figure 14). The lowest rate was again recorded in Lithuania (28.9%), but it was only three times lower than the highest rate, which was recorded in Portugal (98.8%).

Figure 10 shows the classification of EU countries in 2022 in terms of gross wealth pension (*GPW*) and net wealth pension (*NPW*) for men. The Figure shows that, in general, in most Western EU countries and the Mediterranean countries, the *GPW* is clearly higher than in most Central and Eastern European countries. However, after tax, the situation changes in many countries. Such countries as Romania, Hungary, Slovenia and Bulgaria significantly improve

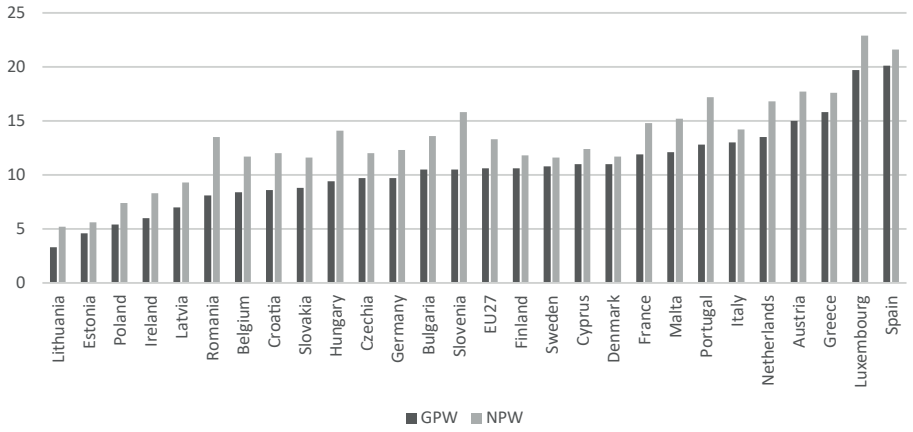

Figure 10. Classification of EU countries in 2022 according to the *GPW* and *NPW* indicators for men

Source: based on (OECD, 2023).

their positions, while Finland, Sweden, Cyprus, Denmark and Italy fall in the classification. In the case of women, the results of the analysis across countries are very similar, but the average *GPW* and *NPW* indicators for the entire EU are higher than the indicators for men. This is mainly due to the longer life expectancy of women (OECD, 2023).

6.4. Results of multidimensional comparative analysis

Table 4 presents classifications of countries in terms of two dimensions: the conditions for taxation of remuneration (Rank 1) and the conditions for taxation of retirement benefits (Rank 2). Mean is averaged data after unitarization of individual variables.

Table 4 generally shows that better remuneration taxation conditions exist in Western European countries than in Central and Eastern European countries. This is mainly due to much higher expenditure on gross and net salaries in the former compared to the latter (Figures 2 and 6). In this case, the total tax burden imposed on remuneration is less important, because the taxation rules vary greatly across individual countries (Figure 4). The highest *ITR* is recorded by Denmark, Romania and Lithuania, and the lowest by Cyprus, Bulgaria and Slovakia.

The taxation conditions for pension benefits are also generally better in Western European countries than in Central and Eastern European countries, despite the fact that in the former the tax rate on pension benefits (*PETR*) is

Table 4. Ranking of EU countries in terms of conditions of taxation of remuneration (Rank 1) and public pension (Rank 2)

Country	RANK 1: MEAN	RANK 2: MEAN	RANK 1: SCORE	RANK 2: SCORE
Belgium	0.702941	0.532712	1	13
Luxembourg	0.698623	0.880144	2	1
Austria	0.676405	0.761461	3	3
Sweden	0.634892	0.550966	4	11
Spain	0.608214	0.839146	5	2
France	0.601081	0.597740	6	9
Cyprus	0.574375	0.548604	7	12
Italy	0.566580	0.632108	8	7
Finland	0.560158	0.528033	9	14
Denmark	0.534153	0.616946	10	8
Ireland	0.521643	0.448817	11	17
Germany	0.497056	0.458843	12	16
Estonia	0.481840	0.217795	13	26
Slovakia	0.472773	0.429921	14	19
Malta	0.450844	0.585385	15	10
Czechia	0.448581	0.419530	16	20
Greece	0.426956	0.716641	17	4
Portugal	0.426905	0.636640	18	6
Netherlands	0.426299	0.678776	19	5
Croatia	0.417008	0.385998	20	22
Slovenia	0.401654	0.445860	21	18
Hungary	0.347027	0.466463	22	15
Poland	0.335962	0.233709	23	25
Bulgaria	0.300068	0.412303	24	21
Latvia	0.260655	0.245448	25	24
Lithuania	0.179612	0.124439	26	27
Romania	0.125827	0.368056	27	23

Source: own analysis.

much higher than in the latter (Figure 7). In particular, this is due to significantly higher gross and net pension expenditure per person in Western countries than in Central and Eastern European countries (Figure 6 and 8). Most of the former also recorded a higher rate of replacing wages with pensions.

6.5. Agglomeration analysis

The ranking results were analysed using the agglomeration method. The following results were obtained: 6 groups (6 clusters) regarding the conditions of taxation of wages (Figure 11 and Table 5) and 2 groups (2 clusters) in the field of taxation of pension benefits (Figure 12 and Table 6).

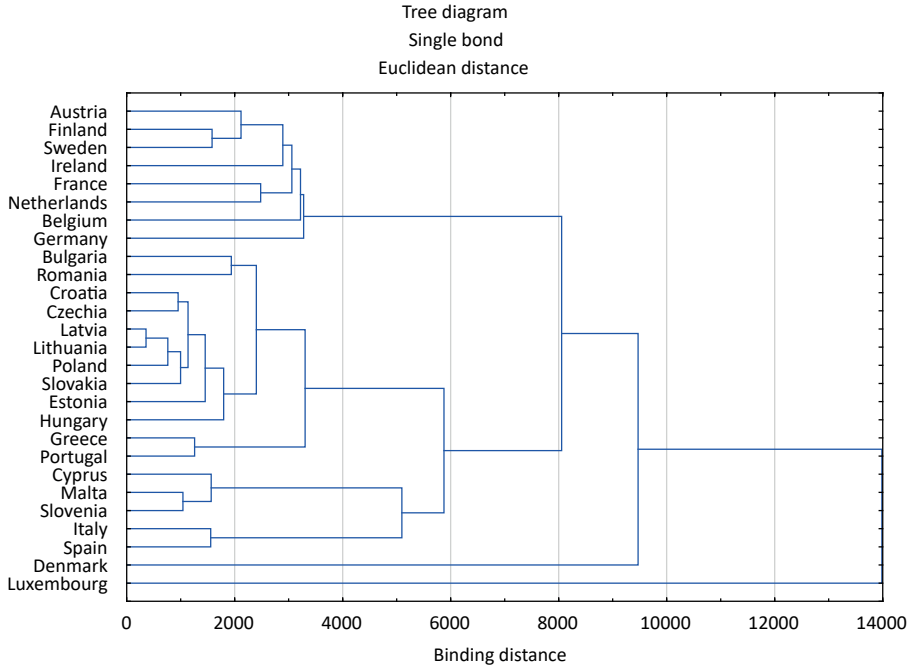

Figure 11. Grouping of EU countries using the agglomeration method in terms of taxation of salary expenses

Source: own calculations.

Taking into account the conditions for taxation of salary expenses, Denmark and Luxembourg constitute separate clusters. These countries clearly differ from other countries with higher average gross and net expenditure on wages. Moreover, these countries recorded a relatively low fiscal burden imposed

Table 5. Grouping of EU Member States using the agglomeration method in terms of remuneration taxation conditions

Country	Cluster	X_1	X_2	X_3	X_4
Denmark	1	49109.31	36463.67	20.90576	1.360517
Luxembourg	2	56857.55	48104.46	24.07332	9.219679
Italy	3	26020.30	24337.21	23.8007	23.18912
Spain	3	24695.24	23519.59	16.01317	20.66356
Cyprus	4	20816.43	20213.56	13.08473	18.41868
Malta	4	21816.73	19009.72	10.64343	5.576068
Slovenia	4	22283.86	18078.63	21.28347	11.34707
Austria	5	36316.25	28879.57	15.83743	18.62296
Belgium	5	39670.99	37244.51	16.91304	16.12316
Finland	5	37280.16	30765.73	24.59416	15.12468
France	5	34022.14	32447.03	28.78754	23.09641
Germany	5	33126.34	28128.63	25.08654	13.24185
Ireland	5	38980.48	34099.53	23.21672	8.022056
Netherlands	5	35920.94	34045.06	34.38331	11.32244
Sweden	5	38798.25	31212.8	23.88081	20.10379
Bulgaria	6	6589.063	6113.04	17.76654	12.27906
Croatia	6	14310.31	12253.07	12.62212	11.21446
Czechia	6	13362.05	12156.47	21.02964	22.16659
Estonia	6	13620.68	13587.65	17.97300	21.40355
Greece	6	16544.75	15127.29	18.24333	14.78820
Hungary	6	10241.25	8398.241	18.29423	14.09105
Latvia	6	11949.45	10752.89	28.10606	13.60554
Lithuania	6	11702.55	10493.57	22.21888	1.355045
Poland	6	11318.82	9835.81	20.23988	13.69864
Portugal	6	16370.14	16373.07	16.84640	12.92705
Romania	6	8354.274	6913.999	24.77601	2.325089
Slovakia	6	12333.32	11673.72	16.88872	21.16879

Source: own calculations.

on the employer for maintaining workplaces. Denmark constitutes a separate cluster, which is due to its characteristic pension system.

The third cluster consists of Italy and Spain. These countries seem very similar to each other, particularly in terms of the amount of expenditure on wages and the fiscal burden imposed on the employer.

The fourth cluster consists of Cyprus, Malta and Slovenia. These countries are characterised by lower expenditure on wages than the previous countries, but these expenditures are very similar. However, visible differences occur in the taxation of remuneration imposed on the employee and the employer.

The fifth cluster consists of the remaining Western European countries, except Greece and Portugal. These are countries with a similar level of socio-economic development and are characterized by much higher expenditure on wages than the countries in clusters 3 and 4. Taxation of wages, as in the case of the previous clusters, is quite diverse, although the tax burden imposed on the employee is, with the exception of Austria, higher than the burden imposed on the employer.

The last cluster consists of the countries of Central and Eastern Europe, together with Greece and Portugal. These countries are characterised by much lower expenditure on salaries than previous countries. Taxation of wages is

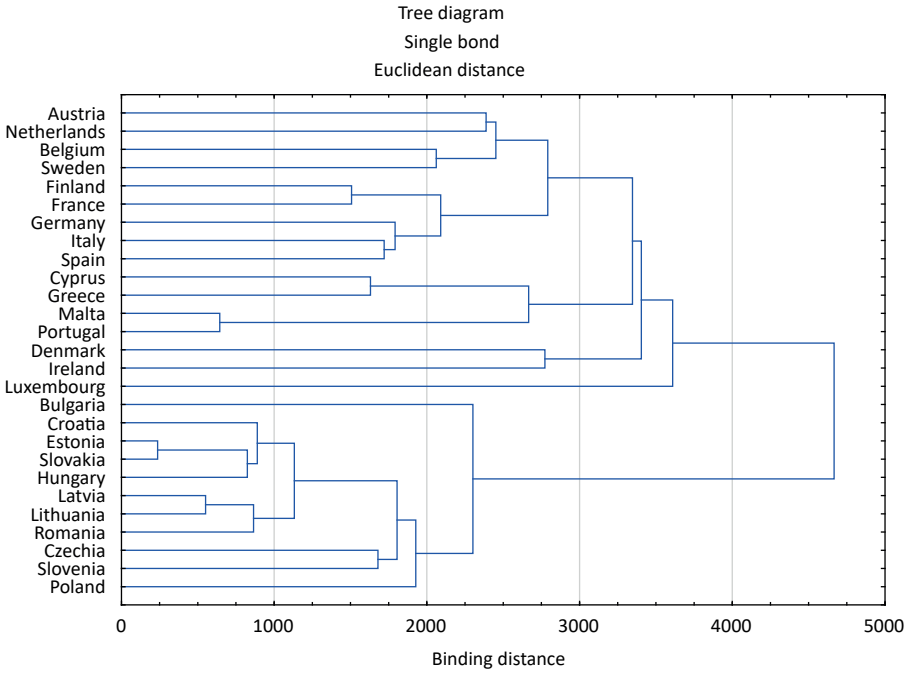

Figure 12. Grouping of EU countries using the agglomeration method in terms of pension taxation conditions

Source: own calculations.

Table 6. Grouping of EU Member States using the agglomeration method in terms of pension taxation conditions

Country	Cluster	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
Austria	1	20538.43	17059.1	0.169667	17880.41	74.1	87.4	15	17.7	16.6	19.5	0.280039
Belgium	1	18779.70	16405.78	0.126849	16302.01	43.5	60.9	8.4	11.7	9.1	12.8	0.357278
Cyprus	1	11185.93	10045.08	0.101089	11778.73	64.3	72	11	12.4	12	13.4	0.243500
Denmark	1	24480.02	18580.76	0.240714	17037.69	73.1	77.3	11	11.7	12.2	12.9	0.419390
Finland	1	17807.46	14789.33	0.168985	14048.06	58.4	65.1	10.6	11.8	12	13.3	0.514882
France	1	16706.92	15014.04	0.101213	15053.12	57.6	71.9	11.9	14.8	13.5	16.8	0.586232
Germany	1	14548.97	12288.38	0.154552	13704.54	43.9	55.3	9.7	12.3	10.8	13.6	0.571192
Greece	1	11716.19	10572.41	0.097217	13227.49	80.8	90	15.8	17.6	17.5	19.5	0.257619
Ireland	1	22057.55	19908.81	0.097451	16804.3	26.2	36.1	6	8.3	6.5	9.0	0.410290
Italy	1	16361.73	13045.38	0.202265	15665.66	76.1	82.6	13	14.2	14.8	16.0	0.378506
Luxembourg	1	25785.1	21780.18	0.154576	18081.42	74.8	86.9	19.7	22.9	21.8	25.3	0.530830
Malta	1	9066.93	8782.091	0.031826	10765.63	58.2	73.1	12.1	15.2	13.4	16.9	0.256101
Netherlands	1	20362.51	14730.12	0.27681	17381.99	74.7	93.2	13.5	16.8	14.5	18.1	0.370455
Portugal	1	9310.171	8194.577	0.118833	10864.33	73.9	98.8	12.8	17.2	14.4	19.3	0.296211
Spain	1	14758.20	13358.7	0.094283	15125.75	80.4	86.5	20.1	21.6	22.7	24.4	0.267952
Sweden	1	20147.73	16361.44	0.188151	14760.26	62.3	65.3	10.8	11.6	11.7	12.6	0.459870
Bulgaria	2	1825.067	1825.067	0	3897.101	58.3	75.1	10.5	13.6	11.9	15.3	0.641427
Croatia	2	4074.885	4019.549	0.013555	6117.869	43	59.7	8.6	12	9.6	13.3	0.443267
Czechia	2	5323.974	5323.974	0	8020.164	47.4	58.9	9.7	12	10.8	13.4	0.527800
Estonia	2	4777.291	4638.945	0.027608	6378.965	28.1	34.4	4.6	5.6	5.3	6.5	0.512434
Hungary	2	4150.538	4142.293	0.002129	7040.048	52.4	78.8	9.4	14.1	10.6	16.0	0.451401
Latvia	2	3637.928	3475.098	0.044165	5226.269	39.8	52.8	7	9.3	8	10.6	0.923196
Lithuania	2	3177.975	3177.975	0	5174.781	18.2	28.9	3.3	5.2	3.7	5.9	0.818186
Poland	2	5372.307	4471.863	0.168781	9748.034	29.3	40.3	5.4	7.4	5.4	7.4	0.426430
Romania	2	2931.378	2871.651	0.021265	5943.734	43.5	72.6	8.1	13.5	9.2	15.4	0.706103
Slovakia	2	4604.712	4603.598	0.000242	6529.703	54.9	72.5	8.8	11.6	9.9	13.1	0.452350
Slovenia	2	6486.458	6454.409	0.004777	7581.584	42.1	63.4	10.5	15.8	11.9	17.9	0.731182

Source: own calculations.

quite different between the employee and the employer, but in average categories the former is higher than the latter. At the same time, in most of the countries surveyed, the tax burden imposed on the employee is lower than the tax burden imposed in the countries belonging to cluster 5. In the countries surveyed, the tax burden between the employee and the employer is higher than the tax burden imposed in the countries belonging to cluster 4.

The agglomeration analysis in terms of taxation of pension expenditure divided the EU countries into two clusters. The first are the countries of Western Europe, and the second are the countries of Central and Eastern Europe (Table 6). This division shows that in Western countries the conditions for taxation of pension benefits are not as diverse as in the case of taxation of wages.

In general, Western EU countries offer much better conditions for the taxation of public pensions than the countries of Central and Eastern Europe. This first group of countries is characterized by significantly higher expenditure on pension benefits in gross, net and purchasing power terms, even though the effective tax burden imposed on pensions is clearly higher. Most Western countries also record higher replacement rates and retirement wealth indicators for both women and men. In Western countries, the relationship between the amount of an employee's fiscal payments and average annual gross pension expenditure per person is also clearly lower than in the countries of Central and Eastern Europe.

Conclusions

This paper has attempted to present and assess the conditions of taxation of public pensions in EU member states at the stage of work and at the stage of payment of pension benefits. Taxation systems were assessed separately for two life stages, using separate diagnostic variables. For this purpose, the multi-criteria comparative analysis method and the agglomeration analysis method were used.

The selection of variables and research methods resulted primarily from the approach to the analysis, namely, from the employee's point of view and the usefulness of the results achieved in making decisions about the choice of country of work and country of retirement.

The results of both the multi-criteria comparative analysis and the agglomeration analysis are very convergent. The analysis shows that the fundamental differences in the conditions of taxation of wages and pension benefits in EU countries should be divided into Western European countries and Central and Eastern European countries. In the former countries, there was a significantly higher tax burden imposed on the employee on the remuneration re-

Appendix A1. Diagnostic variables

Country	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
Austria	36 316.25	28 879.57	15.84	18.62	20 538.43	17 059.10	0.17	17880.41	74.10	87.40	15	17.7	16.6	19.5	0.28
Belgium	39 670.99	37 244.51	16.91	16.12	18 779.70	16 405.78	0.13	16302.01	43.50	60.90	8.4	11.7	9.1	12.8	0.36
Bulgaria	6 589.06	6 113.04	17.77	12.28	1 825.07	1 825.07	0.00	3897.101	58.30	75.10	10.5	13.6	11.9	15.3	0.64
Croatia	14 310.31	12 253.07	12.62	11.21	4 074.88	4 019.55	0.01	6117.869	43.00	59.70	8.6	12	9.6	13.3	0.44
Cyprus	20 816.43	20 213.56	13.08	18.42	11 185.93	10 045.08	0.10	11778.73	64.30	72.00	11	12.4	12	13.4	0.24
Czechia	13 362.05	12 156.47	21.03	22.17	5 323.97	5 323.97	0.00	8020.164	47.40	58.90	9.7	12	10.8	13.4	0.53
Denmark	49 109.31	36 463.67	20.91	1.36	24 480.02	18 580.76	0.24	17037.69	73.10	77.30	11	11.7	12.2	12.9	0.42
Estonia	13 620.68	13 587.65	17.97	21.40	4 777.29	4 638.94	0.03	6378.965	28.10	34.40	4.6	5.6	5.3	6.5	0.51
Finland	37 280.16	30 765.73	24.59	15.12	17 807.46	14 789.33	0.17	14048.06	58.40	65.10	10.6	11.8	12	13.3	0.51
France	34 022.14	32 447.03	28.79	23.10	16 706.92	15 014.04	0.10	15053.12	57.60	71.90	11.9	14.8	13.5	16.8	0.59
Germany	33 126.34	28 128.63	25.09	13.24	14 548.97	12 288.38	0.15	13704.54	43.90	55.30	9.7	12.3	10.8	13.6	0.57
Greece	16 544.75	15 127.29	18.24	14.79	11 716.19	10 572.41	0.10	13227.49	80.80	90.00	15.8	17.6	17.5	19.5	0.26
Hungary	10 241.25	8 398.24	18.29	14.09	4 150.54	4 142.29	0.00	7040.048	52.40	78.80	9.4	14.1	10.6	16	0.45
Ireland	38 980.48	34 099.53	23.22	8.02	22 057.55	19 908.81	0.10	16804.3	26.20	36.10	6	8.3	6.5	9	0.41
Italy	26 020.30	24 337.21	23.80	23.19	16 361.73	13 045.38	0.20	15665.66	76.10	82.60	13	14.2	14.8	16	0.38
Latvia	11 949.45	10 752.89	28.11	13.61	3 637.93	3 475.10	0.04	5226.269	39.80	52.80	7	9.3	8	10.6	0.92
Lithuania	11 702.55	10 493.57	22.22	1.36	3 177.97	3 177.97	0.00	5174.781	18.20	28.90	3.3	5.2	3.7	5.9	0.82
Luxembourg	56 857.55	48 104.46	24.07	9.22	25 785.10	21 780.18	0.15	18081.42	74.80	86.90	19.7	22.9	21.8	25.3	0.53
Malta	21 816.73	19 009.72	10.64	5.58	9 066.93	8 782.09	0.03	10765.63	58.20	73.10	12.1	15.2	13.4	16.9	0.26
Netherlands	35 920.94	34 045.06	34.38	11.32	20 362.51	14 730.12	0.28	17381.99	74.70	93.20	13.5	16.8	14.5	18.1	0.37
Poland	11 318.82	9 835.81	20.24	13.70	5 372.31	4 471.86	0.17	9748.034	29.30	40.30	5.4	7.4	5.4	7.4	0.43
Portugal	16 370.14	16 373.07	16.85	12.93	9 310.17	8 194.58	0.12	10864.33	73.90	98.80	12.8	17.2	14.4	19.3	0.30
Romania	8 354.27	6 914.00	24.78	2.33	2 931.38	2 871.65	0.02	5943.734	43.50	72.60	8.1	13.5	9.2	15.4	0.71
Slovakia	12 333.32	11 673.72	16.89	21.17	4 604.71	4 603.60	0.00	6529.703	54.90	72.50	8.8	11.6	9.9	13.1	0.45
Slovenia	22 283.86	18 078.63	21.28	11.35	6 486.46	6 454.41	0.00	7581.584	42.10	63.40	10.5	15.8	11.9	17.9	0.73
Spain	24 695.24	23 519.59	16.01	20.66	14 758.20	13 358.70	0.09	15125.75	80.40	86.50	20.1	21.6	22.7	24.4	0.27
Sweden	38 798.25	31 212.80	23.88	20.10	20 147.73	16 361.44	0.19	14760.26	62.30	65.30	10.8	11.6	11.7	12.6	0.46

Appendix A2. Unitarization

Country	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
Austria	0.5913682	0.5421711	0.781212	0.79087	0.781024	0.763415	0.387061	0.985829	0.892971	0.83691	0.696429	0.706215	0.678947	0.701031	0.946242
Belgium	0.6581046	0.7413769	0.735904	0.676379	0.7076212	0.7306756	0.541745	0.874551	0.404153	0.457797	0.303571	0.367232	0.284211	0.35567	0.832605
Bulgaria	0	0	0.699952	0.50032	0	0	1	0	0.640575	0.660944	0.428571	0.474576	0.431579	0.484536	0.41455
Croatia	0.1536001	0.1462212	0.916651	0.451561	0.0938988	0.1099709	0.951033	0.156565	0.396166	0.440629	0.315476	0.384181	0.310526	0.381443	0.706093
Cyprus	0.2830275	0.3357954	0.897165	0.781514	0.3906865	0.411925	0.634806	0.555658	0.736422	0.616595	0.458333	0.40678	0.436842	0.386598	1
Czechia	0.1347363	0.1439206	0.562499	0.953168	0.1460309	0.1753388	1	0.290677	0.466454	0.429185	0.380952	0.384181	0.373684	0.386598	0.581725
Denmark	0.845863	0.7227819	0.567718	0.000251	0.9455311	0.839669	0.1304	0.926416	0.876997	0.692418	0.458333	0.367232	0.447368	0.360825	0.741222
Estonia	0.1398813	0.1780032	0.691255	0.918221	0.1232145	0.1410103	0.900262	0.174972	0.158147	0.078684	0.077381	0.022599	0.084211	0.030928	0.604332
Finland	0.6105435	0.5870889	0.41235	0.630649	0.6670439	0.649671	0.389525	0.715646	0.642173	0.517883	0.434524	0.372881	0.436842	0.381443	0.60073
France	0.545731	0.6271278	0.235712	0.995754	0.6211116	0.660932	0.634358	0.786503	0.629393	0.615165	0.511905	0.542373	0.515789	0.561856	0.495756
Germany	0.5279108	0.524288	0.39161	0.544416	0.5310471	0.5243422	0.441667	0.691428	0.410543	0.377682	0.380952	0.40113	0.373684	0.396907	0.517885
Greece	0.1980504	0.2146688	0.679868	0.615238	0.4128175	0.4383511	0.648796	0.657796	1	0.874106	0.744048	0.700565	0.726316	0.701031	0.979227
Hungary	0.0726536	0.0544207	0.677724	0.583308	0.0970562	0.1161219	0.992308	0.221579	0.546326	0.713877	0.363095	0.502825	0.363158	0.520619	0.694126
Ireland	0.6443682	0.6664811	0.470373	0.305349	0.8444263	0.906221	0.647951	0.909962	0.127796	0.103004	0.160714	0.175141	0.147368	0.159794	0.754611
Italy	0.3865492	0.4339976	0.445773	1	0.6067044	0.5622776	0.269301	0.829688	0.92492	0.76824	0.577381	0.508475	0.584211	0.520619	0.801373
Latvia	0.1066351	0.1104953	0.264418	0.561072	0.0756618	0.0826871	0.840449	0.093707	0.345048	0.341917	0.220238	0.231638	0.226316	0.242268	0
Lithuania	0.1017236	0.1043197	0.512405	0	0.0564652	0.0677975	1	0.090077	0	0	0	0	0	0	0.154494
Luxembourg	1	1	0.43429	0.3602	1	1	0.441579	1	0.904153	0.829757	0.97619	1	0.952632	1	0.577267
Malta	0.3029268	0.3071265	1	0.193323	0.3022476	0.3486336	0.885026	0.484234	0.638978	0.632332	0.52381	0.564972	0.510526	0.56701	0.981461
Netherlands	0.5835042	0.665184	0	0.456506	0.7736819	0.6467042	0	0.95069	0.902556	0.919886	0.607143	0.655367	0.568421	0.628866	0.813218
Poland	0.0940899	0.0886555	0.595767	0.565336	0.1480482	0.1326374	0.390263	0.412493	0.177316	0.16309	0.125	0.124294	0.089474	0.07732	0.730864
Portugal	0.1945767	0.2443363	0.738711	0.529998	0.3123996	0.3191918	0.570707	0.491192	0.889776	1	0.565476	0.677966	0.563158	0.690722	0.922448
Romania	0.0351157	0.0190744	0.40469	0.044428	0.0461732	0.0524469	0.923177	0.144288	0.404153	0.625179	0.285714	0.468927	0.289474	0.489691	0.319396
Slovakia	0.1142716	0.1324242	0.736928	0.907469	0.1160117	0.139239	0.999127	0.185599	0.586262	0.623748	0.327381	0.361582	0.326316	0.371134	0.692731
Slovenia	0.3122194	0.2849532	0.551807	0.457635	0.1945486	0.2319878	0.982741	0.259757	0.381789	0.493562	0.428571	0.59887	0.431579	0.618557	0.2825
Spain	0.3601894	0.4145264	0.773809	0.884329	0.5397793	0.577979	0.659395	0.791624	0.99361	0.824034	1	0.926554	1	0.953608	0.964025
Sweden	0.6407431	0.5977354	0.442399	0.858692	0.7647179	0.7284536	0.320287	0.765857	0.704473	0.520744	0.446429	0.361582	0.421053	0.345361	0.681667

ceived and higher taxation of pension benefits. However, the predominance of these burdens does not translate into a deterioration of the overall conditions for taxation of salaries and pension benefits. In Western countries, the amount of expenditure on net wages and the amount of expenditure on net pension benefits is much higher than in the countries of Central and Eastern Europe, which also translates into better results in terms of other variables and, therefore, into an overall better assessment of the conditions for the taxation of pension benefits.

In the group of Western countries, the exceptions are Greece and Portugal, which recorded relatively low expenditure on salaries at the level of Central and Eastern European countries. It can be assumed that this was mainly a consequence of the financial crisis of 2008.

As a result, it can be concluded that in such conditions, effective rates of taxation of wages and pension benefits are not important factors in deciding on the choice of the country of work or the country of retirement. After retirement, choosing a country of residence other than for work is less important from a fiscal point of view, because the pension will be paid by the country of work, and double taxation agreements between EU Member States show that such pensions are exempt from income tax on the basis of reciprocity.

In the context of the analysis results, an employee in the common market should be guided mainly by the amount of net salary expenses or the amount of net pension benefits, which determine the remaining variables to the greatest extent. Then the best conditions for taxation of wages are offered by countries such as Belgium, Luxembourg and Austria, and the best conditions for taxation of pension benefits are offered by countries such as Luxembourg, Spain and Austria.

References

Armstrong, A., Davis, P., & Ebell, M. (2015). An economic analysis of pension tax proposals. *National Institute of Economic and Social Research*. https://eprints.lse.ac.uk/86276/1/CFMDP2015-33-Paper.pdf

Barrios, S., Mascarola, C., Figari, F., & Luca F. G. (2020). Size and distributional pattern of pension-related tax expenditures in European countries. *International Tax and Public Finance*, *27*, 1287–1320.

Cremer, H., & Pestieau, P. (2016). *Taxing pensions*. CESifo Working Paper Series, 5930. https://doi.org/10.2139/ssrn.2799616

Cremer, H., Lozachmeur, J. M., & Pestieau, P. (2008). Social security and retirement decision: A positive and normative approach. *Journal of Economic Surveys*, *22*, 213–233.

Diamond, P. (2009). Taxes and pensions. *Southern Economic Journal*, *76*, 2–15.

Ebbinghaus, B. (2021). Inequalities and poverty risks in old age across Europe: The double-edged income effect of pension systems. *Social Policy & Administration*, *55*, 440–455.

Euromod. (2011–2022). *Euromod country reports, models 2011–2022. Tax-benefit microsimulation model for the European Union*. https://euromod-web.jrc.ec.europa.eu/resources/country-reports

European Commission. (2001). The elimination of tax obstacles to the cross-border provision of occupational pensions, COM (2001) 214 final.

European Commission. (2022). *Taxation trends in the European Union, Taxation and Customs Union*. Luxembourg: Publications Office of the European Union.

European Commission. (n.d.). Taxes in Europe Database v4. https://ec.europa.eu/taxation_customs/tedb/#/home

European Commission Data. (n.d.). Data on Taxation Trends. https://taxation-customs.ec.europa.eu/taxation/economic-analysis-taxation/data-taxation-trends_en

Ferrarini, T., & Nelson, K. (2003). Taxation of social insurance and redistribution: A comparative analysis of ten welfare states. *Journal of European Social Policy*, *13*(1), 21–33.

Fratica-Dragomir A. M. (2023). The public pension system in Austria, Lichtenstein, Germany. *Univers Strategic—Revistă de Studii Strategice Interdisciplinare și de Securitate*, *4*(56), 77–99.

Genser, B., & Holtzmann, R. (2021). Frontloaded income taxation of old-age pensions: For efficiency and fairness in a world of international labor mobility. *CESifo Economic Studies*, *67*(1), 61–77.

Ivaškaitė-Tamošiūnė, V., & Thiemann, A. (2021). *The budgetary and redistributive impact of pension taxation in the EU: A microsimulation analysis*. European Commission, JRC Working Papers on Taxation and Structural Reforms, 08/2021. https://joint-research-centre.ec.europa.eu/document/download/1be7f6da-86e2-4994-a237-24fa7bbe14fe_en

Iwacewicz-Orłowska, A., & Sokołowska, D. (2018). Ranking of EU countries in terms of the value of environmental governance indicators in 2010 and 2015, using the Hellwig method. *Ekonomia i Środowisko, 23*(3), 50–62.

Jankowiak, M. (2021). The EU Member States' national healthcare systems compared using the single synthetic index. *Economics and Business Review*, *7*(2), 37–49.

Jun, B. W., Park, S. J., & Yoon, S. M. (2023). Effects of socio-economic factors on governmental tax expenditures for private pensions in selected OECD countries. *The Singapore Economic Review*, *68*(5), 1599–1611.

Keenay, G., & Whitehouse, E. (2003). The role of the personal tax system in old-age support: A survey of 15 countries. *Fiscal Studies*, *24*(1), 1–21.

Kluzek, M. (2022). Opodatkowanie emerytur w Polsce na tle rozwiązań w państwach Unii Europejskiej. *Studia BAS*, *4*(72), 53–71.

Leventi, C., & Picos, F. (2019). *The tax structure of an economy in crisis: Greece 2009–2017*. European Commission, JRC Working Papers on Taxation and Structural Reforms, 03/2019. https://joint-research-centre.ec.europa.eu/system/files/2020-01/jrc119508.pdf

Lozachmeur, J. M. (2006). Optimal age-specific income taxation, *Journal of Public Economic Theory*, *8*, 697–711.

Manor, M., & Ratajczak, J. (2020). Shift to private pension system: The case of Poland and Israel. *Economics and Business Review*, *6*(1), 82–102.

OECD. (2011). *Pensions at a glance 2011*. https://doi.org/10.1787/pension_glance-2011-en

OECD. (2021). *Pensions at a glance 2021*. https://doi.org/10.1787/ca401ebd-en

OECD. (2023). *Pensions at a glance 2023*. https://doi.org/10.1787/678055dd-en

Patterson, B. (2002). *Tax coordination in the EU: The latest position*. European Parliament Working Paper, Economic Affairs, 128. https://www.europarl.europa.eu/RegData/etudes/etudes/join/2002/312788/DG-4-ECON_ET(2002)312788_EN.pdf

Shi, J., & Kolk, M. (2022). How does mortality contribute to lifetime pension inequality? Evidence from five decades of Swedish taxation data. *Demography*, *59*(5), 1843–1871.

Swift, Z. L. (2006). *Managing the effects of tax expenditures on national budgets*. World Bank Policy Research Papers, WPS3927. https://documents.worldbank.org/curated/en/602361468341100836/Managing-the-effects-of-tax-expenditures-on-national-budgets

Vambol, V., Kowalczyk-Juśko, A., Vambol, S., Khan, N. A., Mazur, M., Goroneskul, M., & Kruzhilko, O. (2023). Multi criteria analysis of municipal solid waste management and resource recovery in Poland compared to other EU countries. *Scientific Reports*, *13*, *22053.*

Verbist, G. (2007). The distribution effects of taxes on pensions and unemployment benefits in the EU-15. micro-simulation in action: Policy analysis in Europe using EUROMOD. *Research in Labour Economics*, *25*, 73–99.

Aims and Scope

The **Economics and Business Review** is a quarterly journal focusing on theoretical, empirical and applied research in the fields of Economics and Corporate and Public Finance. The Journal welcomes the submission of high quality articles dealing with micro, mezzo and macro issues well founded in modern theories and relevant to an international audience. The EBR's goal is to provide a platform for academicians all over the world to share, discuss and integrate state-of-the-art Economics and Finance thinking with special focus on new market economies.

The manuscript

1. Articles submitted for publication in the **Economics and Business Review** should contain original, unpublished work not submitted for publication elsewhere.
2. Manuscripts intended for publication should be written in English, edited in Word in accordance with the **APA editorial** guidelines and sent to: secretary@ebr.edu.pl**.** Authors should upload two versions of their manuscript. One should be a complete text, while in the second all document information identifying the author(s) should be removed from papers to allow them to be sent to anonymous referees.
3. Manuscripts are to be typewritten in **12' font in A4 paper** format, one and half spaced and be aligned. Pages should be numbered. Maximum size of the paper should be up to 20 pages.
4. Papers should have an abstract of about 100-150 words, keywords and the Journal of Economic Literature classification code (**JEL Codes**).
5. Authors should clearly declare the aim(s) of the paper. Papers should be divided into numbered (in Arabic numerals) sections.
6. **Acknowledgements** and references to grants, affiliations, postal and e-mail addresses, etc. should appear as a separate footnote to the author's name a, b, etc and should not be included in the main list of footnotes.
7. **Footnotes** should be listed consecutively throughout the text in Arabic numerals. Cross-references should refer to particular section numbers: e.g.: See Section 1.4.
8. **Quoted texts** of more than 40 words should be separated from the main body by a four-spaced indentation of the margin as a block.
9. **References** The EBR 2022 editorial style is based on the **7th editio**n of the Publication Manual of the American Psychological Association (**APA**). For more information see APA Style used in EBR guidelines.
10. **Copyrights** will be established in the name of the **EBR publisher**, namely the Poznań University of Economics and Business Press.

More information and advice on the suitability and formats of manuscripts can be obtained from:

Economics and Business Review
al. Niepodległości 10
61-875 Poznań
Poland
e-mail: secretary@ebr.edu.pl
www.ebr.edu.pl

Subscription

Economics and Business Review (EBR) is published quarterly and is the successor to the Poznań University of Economics Review. The EBR is published by the Poznań University of Economics and Business Press.

Economics and Business Review is indexed and distributed in Scopus, Claritave Analytics, DOAJ, ERIH plus, ProQuest, EBSCO, CEJSH, BazEcon, Index Copernicus and De Gruyter Open (Sciendo).

Subscription rates for the print version of the EBR: institutions: 1 year – €50.00; individuals: 1 year – €25.00. Single copies: institutions – €15.00; individuals – €10.00. The EBR on-line edition is free of charge.