Social Indicators Research (2024) 174:905–931
https://doi.org/10.1007/s11205-024-03417-5

ORIGINAL RESEARCH

An Evaluation of the Impact of the Pension System on Income Inequality: USA, UK, Netherlands, Italy and Türkiye

Can Verberi[1] · **Muhittin Kaplan**[2]

Accepted: 12 August 2024 / Published online: 4 September 2024

Abstract
This study examines empirically the impact of various characteristics of pension systems, in particular their quality and integrity, on income inequality, utilizing micro-level data from the United States, United Kingdom, Netherlands, Türkiye and Italy. To this end, the income inequality model, which includes public pension (or public/private pension mix), age, education, gender, marital status and employment as independent variables, has been estimated using quantile regression. The results provide a number of valuable information on the impact of the pension system on income inequality: (i) Public pension income significantly reduces overall income inequality across almost all inequality groups in all countries, except for the UK and the Netherlands; (ii) Different types of pension systems vary significantly in their redistributive effects on income; (iii) The empirical results also show that the effect of different pension systems on inequality changes by inequality groups significantly.

Keywords Personal income inequality · Pension system types · Public/private pension mix · Quantile regression

JEL Classification D31 · D63 · E25 · G23 · H55

This article is partly based on the PhD thesis prepared at Istanbul University by Can Verberi.

✉ Can Verberi
canverberi@sirnak.edu.tr

Muhittin Kaplan
muhittin.kaplan@ihu.edu.tr

[1] Department of Economics, Sirnak University, 73100 Sirnak, Turkey

[2] Department of Economics, Ibn Haldun Universtiy, 34480 Istanbul, Turkey

1 Introduction

As well known, pension systems, established to ensure income security for the elderly, significantly impact income redistribution. However, the effects on income distribution can be positive or negative, depending on the specific pension system design. Pension systems can be categorized by their two main pillars: the public pension pillar, administered by the state, and the private pension pillar, typically managed by corporations. This study aims to examine how pension systems in the USA, UK, Netherlands, Türkiye, and Italy affect overall income inequality across different inequality groups in these countries. Additionally, it compares the outcomes of the pension system types, public pension, and public/private pension mix on income distribution, deliberating on the three primary linkages through which the pension systems impact overall income inequality in these countries.

Formal pension systems are a relatively recent development in economic history. Among two distinct type of pension systems, public pension systems, with a considerably longer history compared to private ones. The establishment of the public pension system, being one of the applications of the Welfare State regime in the post-World War II era, was intended to preserve the income level of the elderly population (Zhu & Walker, 2018). This system comprises two fundamental types, namely, the Beveridge and Bismarckian types. The Bismarckian pension system, which is implemented in continental Europe, Southern Europe, the USA, Türkiye, Sweden, Finland and Norway in the establishment process, focuses on employed individuals who aspire to maintain their income status during their retirement period (Babat et al., 2020; Schludi, 2005; Wang & Timonen, 2021). On the other hand, the Beveridge pension system aims to provide minimum pension benefits through lower contributions in contrast to the Bismarckian pension system (Conde-Ruiz et al., 2016). It is employed in establishment process by Anglo-Saxon countries, namely, the United Kingdom, Canada, New Zealand, Australia, and Ireland, except the USA, but also Netherlands as a basic pension system (Hinrichs, & Lynch, 2010; Ebbinghaus, 2021).

In later years, many countries have applied the elements of Bismarckian and Beveridge pension system types in a mixed manner. Thus, the current institutional structure of the public pension system has become complex. This complex structure can be envisaged as a combination of basic, targeted, and minimum contributory pension plans (OECD, 2023). In this sense, the differences in public pension systems across countries are nothing more than various combinations of pension plans/pension plan mixed. Basic plans come in two different forms, namely residence-based benefits, and contribution-based benefits. These plans are pension plans in which the level of the benefit may vary depending on the number of years of residence or contribution but remains unaffected by the earnings levels throughout one's career (Barr & Diamond, 2009). On the other hand, in targeted pension plans, the value of the benefit is dependent on income from other sources and, in some cases, assets as well. Consequently, pensioners with lower income receive higher benefits compared to retirees who are better off (Holzmann & Hinz, 2005). The minimum contributory pension plan is a different category of retirement plan. These plans establish a minimum lifetime entitlement that can be achieved in two ways: either by gradually increasing the level of entitlement once the length of the contribution period surpasses specific thresholds, or by calculating year-by-year entitlements for low earners based on a higher earnings level through minimum pension credits (Orenstein, 2008; Whitehouse, 2007).

The establishment of the private pension system (PPS) in Chile in 1981 could be attributed to the neo-liberal economic policy argument t at emerged as a solution to the encountered issues with public pension systems. These issues, such as an increase in the elderly population,

disruptions in macroeconomic indicators, and escalating costs, posed a significant threat to the sustainability of the pension system (Franco & Morcaldo, 1990). Consequently, the government viewed PPS as a viable alternative to transfer the burden of the public pension system to the private sector, primarily due to its earning-related structure. As a result, the government aimed to curtail public spending and transitioned from a public pension system to a public/private pension mix through the implementation of PPS.

The literature pertaining to theory is inconclusive regarding the connection between pension systems and income inequality. In this regard, three primary linkages can be discerned in the literature. Firstly, the pension system has the potential to diminish overall income inequality by supplying additional income to the elderly to sustain their previous income level. This can be explained through the following means. The elderly are in a disadvantageous position in the income distribution due to their diminished work capacity (Friedman, 1957; Modigliani, 1966; Rowntree, 1901; von Weizsäcker, 1988), decreased income resources as they no longer possess capital or labor income, and skill biases (Katz & Murphy, 1991; Levy & Murnane, 1992; Mincer, 1974; O'Connor, 1973). Consequently, the pension system serves to advance income equality by providing supplementary income to the elderly.

The second linkage through which pension systems affects income inequality is related to differences in income redistribution effects of various pension (plan) types. Pension plan types exhibit distinct impacts on income inequalities arising from intergenerational and intragenerational inequalities. Intergenerational inequality denotes the economic, social, or other status differences between different generations within a society (Wildman et al., 2022), leading to income inequality through the disparities in opportunities, wealth, and living standards between older and younger generations. Conversely, intragenerational inequality addresses disparities within the same generation (Peugny, Van de Velde, & Hamilton, 2013), causing income inequality among individuals of similar ages but different socioeconomic backgrounds, including variations in income, education, and career advancement opportunities within a cohort. Basic pension plans, which comprise a minimum/flat rate pension plan, engender a vertical distribution of income among the elderly and facilitate the provision of minimum income protection for the elderly at risk (Neugschwender, 2015). Consequently, such systems reduce poverty among the elderly and income inequality stemming from intergenerational and intragenerational inequalities. Targeted pension plan has the potential to mitigate old-age poverty as it offers more substantial benefits to low-income elderly individuals who lack or possess meager insurance-based pensions (Byun, 2022). Conversely, earnings-related pension plans involve horizontal redistribution, as they intend to maintain the status post-retirement (Conde-Ruiz & González, 2016; Palme, 2006), thereby exacerbating income inequality caused by intergenerational and intragenerational inequalities among the elderly. The minimum contributory pension plan is also called as minimum pensions within earnings-related plans (Whitehouse, 2007). Thus, it mitigates income inequality caused by intergenerational and intragenerational inequalities and reduces poverty if the minimum pension is increased.

The third consideration is the influence of the public/private mix[1] in the pension system on income inequality, which varies depending on the institutional framework of the public pension system within a given country. The first approach to the third consideration argues that the inclusion of earning-related funding and a flat-rate benefit in the public pension system results in a reduction of income inequality through PPS (Been et al., 2017). Nevertheless, Korpi and Palme (1998) contend that a strong earnings-relatedness

[1] Public/private pension mix type can be defined as the pension system in where both public and private pensions systems operate simultaneously in a country.

in public pension system mitigates income inequality more as the second approach to the third consideration.

Over a prolonged period, a substantial body of empirical literature has accumulated to assess the theoretical linkages between pension systems and income inequality. Within this empirical literature, many studies have investigated these linkages by utilizing decomposition methodologies (Benedict & Shaw, 1995; Hwang, 2016; Myles, 2000). Additionally, various other studies have employed regression methodology to scrutinize the correlation between the pension system and income distribution (Been et al., 2017; Ebbinghaus, 2021; van Vliet et al., 2012). However, the outcomes of the empirical literature exhibit a mixed result concerning the effect of pension systems on income inequality.

This research is expected to make a significant contribution to the existing literature in several ways. Firstly, it seeks to conduct an empirical examination of how pension system types affect income inequality in five countries with varying pension system characteristics, particularly focusing on pension plan design, quality and integrity, and development levels. The countries of interest are the USA, UK, Netherlands, Türkiye, and Italy. Secondly, while previous studies on the subject have not employed personal inequality measurements, this research employs the Gini Admissible Personal Inequality Indexes (GAPII) as an overarching measure of inequality in the empirical analysis. Thirdly, this study also contributes to the literature by analyzing the effect of the pension system on overall income distribution by considering pension plan, the quality and integrity types separately for public pension and public/private pension mix. Additionally, this study examines the redistributive function of the pension system, considering the three redistributive channels of the pension system. Finally, this study also employs a micro-level dataset to analyze the redistribution effect of pension system by inequality groups, using quantile regression methodology.

This study is organized as follows. Section 2 discusses the properties of pension systems in Türkiye, USA, Italy, UK and Netherlands. A literature review is given in Sect. 3. Section 4 presents the model, data, and methodology. Finally, Sect. 5 provides the empirical results, and the conclusions and implications are presented in Sect. 6.

2 The UK, USA, Turkish, Italian, Netherlands Pension Systems

The public pension systems in countries have been established as two fundamental types, namely, the Beveridge and Bismarckian types. The origins of the UK pension system can be traced back to the eighteenth century, when both public and private sector pension schemes were established. The Customs and Excise Departments was the site of the first public scheme, founded in this era (Walker & Foster, 2006), while the first private pension scheme emerged in the early eighteenth century (Blake, 2003). In 1908, the Old Age Pensions Act led to the creation of the first public pension system in the modern sense, which included non-contributory benefits (Bozio, Crawford, & Tetlow, 2010). The first contributory benefits plan was developed in 1925 by means of the Widows, Orphans, and Old Age Contributory Pensions Act, although it was not universally applicable. The transition to universal coverage became possible after the presentation of the Beveridge Report in 1942, which called for a flat-rate income for the elderly that exceeded the poverty measure (Hagemann & Scherger, 2016). The UK pension system, modeled on the Beveridge plan, consists of three pillars. The first is a public pension that takes the form of a flat-rate pension, known as the basic state pension (BSP). The second pillar is an earning-related state pension, which

Table 1 Institutional structures of pension systems in Netherlands, Italy, Türkiye, the USA and the UK. *Source:* Aben (2011), Elveren (2008), Fabián et al. (2018), Hagemann and Scherger (2016). ✓ Indicates the existing tier/pension system type

Countries	State pillar		Corporate pillar	
	Tier 1	Tier 2	Tier 1	Tier 2
Italy	✓	✓	✓	
Türkiye	✓		✓	
United States	✓		✓	✓
United Kingdom	✓	✓	✓	
Netherlands	✓		✓	✓

encompasses the State Earnings-Related Pension Scheme (SERPS) and occupational pensions. The third pillar encompasses private pension plans (Table 1).

The inception of the USA pension system can be traced back to the establishment of the army pension plan in 1799. In the nineteenth century, the naval pension plan was introduced as a pension scheme, which solely covered disabled men. Currently, various pension policies are proposed based on military pension plans (Clark et al., 2003). Following the war, retirement plans provided broader coverage for state and local employees. Subsequently, after World War I, all public employees were offered pension plans. The American Express Corporation founded the first employer-sponsored pension plan in 1875, which marked the advent of the first private pension plan (Clark et al., 2003; Seburn, 1991). The USA pension system is composed of three pillars. The first pillar, referred to as Old Age, Survivors, and Disability Insurance (OASDI), is the public pension system, which its purpose is to safeguard the income level of retirees (Van Dalen et al., 2010). OASDI is financed through a pay-as-you-go benefit program (Schmult, 2012). The second pillar is an employer-sponsored pension plan, which operates as a defined contribution (DC) plan (Fabián et al., 2018). This pension plan differs from the Italian second pillar, as it is a private pension plan. The third pillar comprises voluntary saving arguments, which are defined benefit (DB) plans, such as life annuities. The Italian pension system, on the other hand, dates back to 1898 and underwent an evolution similar to other continental European countries. The system covered both public and private employees and was fully funded (Canziani, & Demekas, 1995). The Italian pension system was established based on the Bismarckian pension type (Schludi, 2005). However, following the fiscal burden the country faced, Italy shifted from a fully funded system to a pay-as-you-go system in 1952 in the post-World War period. Currently, the Italian pension system comprises three pillars, with the first pillar providing public pension benefits while the second and third pillars constitute voluntary and privately funded systems (Aben, 2011). It is important to note that the second and third pillars differ in that the former is managed by the government, while the latter is overseen by financial institutions.

The establishment of the Turkish pension system can be traced back to the post-World War II era. Notably, the European welfare state regime played a pivotal role in shaping the Turkish pension system, as German academics fleeing from Nazi Germany had a significant influence on its development (Elveren, 2008). The Turkish pension system, which comprises two pillars, features a public pension system as the first of these pillars. While the Turkish public pension system can be classified as a Beveridge type for health services, it adopts a Bismarckian type in terms of pension income transfer (Aysan, 2013; Babat et al., 2020). The second pillar comprises the private pension system, which encompasses Voluntary Private Pension Plans as well as the Automatic Enrollment System (AES). The foundations of the Dutch pension system are intricately tied to the socio-economic development

level of country. Originating in the post-World War II era, the General Old-Age Pensions Act (AOW) was established in 1957, marking the inception of the first pillar of the Dutch pension system. This legislation ensured that all residents would receive a basic state pension upon reaching retirement age, representing a significant milestone in the evolution of the Netherlands' pension framework (van Hekken et al., 2022). The second pillar of the Dutch pension system revolves around private employee pensions, which accumulate during an individual's working life. These occupational pensions are typically funded through contributions from both employees and employers, based on collective employment agreements. The capital amassed in these pension funds is strategically invested to provide a substantial retirement income that complements the AOW (Westerhout, Ponds, & Zwaneveld, 2021). Lastly, the third pillar encompasses individual private pensions (Knoef et al., 2016). This pillar offers individuals the opportunity to further fortify their financial stability during retirement.

Tables 2 and 3 confirm that Türkiye, Italy, the UK, the USA, and the Netherlands have different types of pension plans, and their pension systems vary in terms of quality and integrity. Table 2 illustrates the current pension plan types in the first tier of the public pension systems in Türkiye, Italy, the UK, USA and Netherlands, along with the ratio of their benefits to the Average Wage (AW). It highlights the variations in pension designs among these countries, reflecting differences in benefit values and the implemented pension plans. Moreover, it is evident that Türkiye and Italy have implemented identical pension plans. However, the UK distinguishes itself by adopting a contribution-based basic pension plan instead of the minimum contributory pension plan used by the other countries. The USA differentiates itself in pension design by exclusively implementing only a targeted pension plan, setting it apart from Türkiye, Italy, and the UK. Among these countries, the Netherlands is the only country that implements a residence-based basic pension plan. Analyzing the ratio of benefit values to AW, all countries except Türkiye exhibit pension plans with similar values over the years. In Türkiye, the minimum contributory pension plan has consistently provided approximately 3-times or 4-times higher benefits compared to the targeted pension plan over time. In Italy, the ratios of the minimum contributory and targeted pension plans to AW are very close. Similarly, in the UK, they are close, but the contribution-based basic plan has seen a reduction in its ratio over the years. In the US, the targeted pension plans have maintained a consistent ratio to AW. Similarly, in the Netherlands, the residence-based basic pension plan has exhibited nearly the same ratio to AW over the years.

In Table 3, Mercer CFA institute global pension index in 2023 categorizes different countries based on the quality (adequacy and sustainability) and integrity of their retirement income systems. It shows that Netherlands, UK, US, Italy, Türkiye have different the quality and integrity of their pension systems, except for grade E. Therefore, we prefer to include analysis these countries.[2] Netherlands has an A grade and an index value over 80 and it boasts a top-tier pension system. It's characterized by its robustness, sustainability, and integrity, ensuring that it delivers first-class benefits to retirees. The UK's pension system is rated B–B^+. It has a sound structure with many commendable features, but there are areas that need improvement to elevate it to an A-grade system. United States and Italy are in the C–C^+ category. Their pension systems have good features but also face significant risks and shortcomings. Addressing these issues is crucial for the efficacy and sustainability of their pension systems. Türkiye's pension system falls under grade D. While it

[2] In the analysis, the Netherlands is represented by grade A, the UK by grade B–B+, United States and Italy by grade C–C+, and Türkiye by grade D. We are grateful to the blind referees for raising this point.

Table 2 The benefit value of pension plans in first tier in public pension system in Türkiye, Italy, UK, Netherlands and USA

	Benefit value in 2022 (% of AW* earnings)				Benefit value in 2020 (% of AW earnings)				Benefit value in 2018 (% of AW earnings)			
	Residence-based basic	Targeted	Contribution-based basic	Minimum contributory	Residence-based basic	Targeted	Contribution-based basic	Minimum contributory	Residence-based basic	Targeted	Contribution-based basic	Minimum contributory
Türkiye	–	11.5	–	33.5	–	11.1	–	33.5	–	10.3	–	40.4
Italy	–	18.0	–	20.2	–	19.8	–	22.7	–	18.8	–	21.1
United Kingdom	–	21.4	21.7	–	–	21.6	16.7	–	–	21.6	16.7	–
United States	–	15.6	–	–	–	15.6	–	–	–	16.4	–	–
Netherlands	29.1	–	–	–	29.2	–	–	–	29.0	–	–	–

Source: OECD (2019), OECD (2021), OECD (2023)

*AW is defined as average wage

Table 3 Mercer CFA institute global pension index in 2023

Grade	Index value	Countries	Description
A	> 80	Netherlands, Iceland, Denmark and Israel	A first-class and robust retirement income system that delivers good benefits, is sustainable and has a high level of integrity
B–B^{+}	65–80	Australia, Finland Singapore, Norway Sweden, UK, Switzerland, Canada, Ireland, Chile, Uruguay, Belgium, New Zealand, Portugal and Germany	A system that has a sound structure, with many good features but has some areas for improvement that differentiate it from an A-grade system
C–C^{+}	50–65	Kazakhstan, Hong Kong, SAR, US, UAE, Croatia, France, Colombia, Spain, Saudi Arabia, Poland, Japan, Italy, Malaysia, Brazil, Peru, China (Mainland), Mexico, Botswana, South Africa, Taiwan, Austria, Indonesia and Korea (South)	A system that has some good features but also has major risks and/or shortcomings that should be addressed; without these improvements, its efficacy and/or long-term sustainability can be questioned
D	35–50	Thailand, Türkiye, India, Philippines and Argentina	A system that has some desirable features but also has major weaknesses and/or omissions that need to be addressed; without these improvements, its efficacy and sustainability are in doubt
E	< 35	Nil	A poor system that may be in the early stages of development or nonexistent

Source: Mercer (2023)

has some positive aspects, there are major weaknesses that need to be addressed. Without improvements, the efficacy and sustainability of the system remain uncertain.

3 Literature Review

Numerous investigations scrutinize the impact of the pension system on the distribution of income. These studies propose that the institutional framework of the public pension system plays a pivotal role in ascertaining this association. Certain studies concentrate on the correlation between public and private pension mix and income distribution. Nevertheless, there is no unanimity regarding the causation between the public/private pension mix benefits and income inequality. Our categorization of the preceding inquiries was carried out employing distinct methodologies.

Various prior investigations delve into the correlation between public/private pension mix and income distribution, often employing decomposition methodologies in their analyses. Most of these studies arrive at the conclusion that there exists a positive causal link between public/private pension mix and income inequality. Hwang (2016) scrutinizes the impact of both public and private pension schemes on income inequality within the elderly population of South Korea using decomposition methodology, based on 1998 and 2010 data. The results manifest that private pension contributions exacerbate income inequality in the elderly population. Additionally, public pensions unexpectedly distort income equality. Similarly, Benedict and Shaw (1995) probe the association between pension benefits and income inequality in the United States utilizing the 1983 Survey of Consumer Finances (SCF) dataset and decomposition methodology. The analysis highlights that both private and public pensions contribute to the escalation of income inequality.

Pryor's (2007) investigation aims to delve into the relationship between pre-tax income components of U.S. families. In order to accomplish this, he employs the Panel Study on Income Dynamics (PSID) dataset from the year 1975 to 2000 and conducts a coefficient of variation analysis. The results of the analysis indicate a positive association between retirement and social transfer incomes and income inequality, which is consistent with the findings of Hwang (2016) and Benedict and Shaw (1995). Başlevent (2014), on the other hand, examines the relationship between social transfers and income distribution within Türkiye using the Survey of Income and Living Conditions (SILC) household dataset and Shorrock decomposition methodology. His investigation reveals that pension payments are a contributing factor to income inequality in the year 2013. Similarly, Selim, Günçavdı, and Bayar (2014) study individual income inequality by considering functional income resources and regional imbalances. They employ the Shorrock decomposition methodology and the TURKSTAT dataset from the years 2002–2011. According to their findings, pension and transfer incomes have an increasingly detrimental effect on income distribution over the years. Furthermore, Bayar and Günçavdı (2021) investigate the linkage between income sources and income distribution during the reform period from 2002 to 2007. They utilize the TURKSTAT Household Budget Surveys and Shorrock and Jenkins decomposition methodologies to analyze the period from 2002 to 2013. Their results show that retirement earnings contribute to income inequality, which is consistent with the findings of Başlevent (2014) and Selim, Günçavdı, and Bayar (2014).

However, there are a number of studies that confirm the negative relationship between the public/private pension mix and income inequality undertaken by using decomposition

methodology. Wroński (2021) conducts an analysis on the relationship between the public pension system and wealth inequality, utilizing the Coefficient of Variation (CV), Theil, and MLD decomposition methods. He uses the dataset Eurosystem Household Finance and Consumption Survey (HFCS) conducted in 2016 in Poland. The results demonstrate that both public and private pension wealth have a reducing effect on overall wealth inequality. Conversely, other studies, unlike Wroński (2021), find that the public/private pension mix may lead to less income equality than the public pension system, as determined using decomposition methods. Myles (2000) investigates the Canadian Pension System's impact on income inequality among the elderly, using the Survey of Consumer Finances dataset from 1988 to 1996 and the Gini decomposition method. The findings reveal that the pension system helps to decrease income inequality among elderly households. Furthermore, private pensions may increase income inequality while public pensions may decrease income inequality among the elderly.

Several investigations conduct to examine the relationship between the public pension system and income distribution, with a focus on decomposition methodologies. These studies tend to emphasize the positive redistributive impact of the public pension system. For instance, Kaneko (2001) conducts Income Redistribution Surveys in 1981 and 1993 to examine the linkage between the social security system and income inequality in Japan. The Gini decomposition analysis reveals that pension benefits play a crucial role in promoting income equality. Similarly, Oshio and Urakawa (2007) seek to elucidate the linkage between the social security system and income inequality among elderly individuals in Japan. They utilize the SIRs household dataset from 1992 and 2001 and employ the MLD decomposition method. Analysis results indicate that social security promotes income equality among the elderly. In contrast to these findings, Lustig and Wang (2020) examine the impact of taxes and transfers on income inequality in China. Using data from the China Family Panel Studies (CFPS) survey in 2014, they conduct an analysis employing the Gini decomposition methodology. The results show that public pension benefits contribute to an increase in income inequality.

Numerous studies explore the link between public/private pension mix and income inequality using regression methodologies. These studies show that the relationship between the two can be either positive or negative, with some indicating that the public/private pension mix reduces income inequality. For instance, Van Vliet et al. (2012) conduct a study on the impact of the shift from public pension systems to PPS on the income distribution of older individuals in 15 European countries. Their research employs pooled time-series cross-section regression and dataset from 1995 to 2007. They find no empirical evidence to suggest that the shift from public pension systems to PPS increases income inequality among older people. In fact, they discover that public and private pension spending, as well as their sum, reduces income inequality among older people. Similarly, Jang (2019) analyzes the interaction between private pensions, institutional design of the public pension system, and income inequality among older individuals in 19 developed OECD countries. Fixed effect and random effect models are utilized with dataset from 1980 to 2011. The study findings indicate that private pension reduces income inequality among older people when there is a high coverage rate in the public pension system. However, many studies conclude that the public/private pension mix decreases income inequality less than the public pension system. In contrast to Van Vliet et al.'s analysis, Been et al. (2017) extend the analysis to 17 European countries from 1995 to 2011. The results show that private pension spending increases income inequality among the elderly, while public pension spending decreases it. Ebbinghaus (2021) also tests the effects of the pension system on poverty in older people in 30 European countries, employing regression analysis through

EU-SILC data from 2017/18. He uses a micro dataset to obtain macro measurements and concludes that the public pension system decreases poverty, while private pensions may create social inequality among older people. Furthermore, Caminada and Goudswaard (2005) test the redistribution effect of public and private pensions on 16 wealthy countries using microdata and regression analysis in 1997. They also obtain macro measurements through a micro dataset and find that private pension plans increase income inequality like Been et al. (2017) and Ebbinghaus (2021) and that public social spendings reduce income inequality.

To sum up, previous studies utilizing decomposition and regression methodologies don't reach a consensus regarding the linkage between the pension system and overall income inequality. In this study, we aim to address the gaps in existing literature highlighted in the introduction section by examining the impact of pension systems with different characteristics such as pension plans, the quality and integrity, and development levels, on income inequality in the USA, UK, Netherlands, Türkiye, and Italy. Additionally, we utilize the Gini Admissible Personal Inequality Indexes (GAPII) as an overall inequality measurement and quantile regression in a household dataset to compare inequality groups. Furthermore, we test the three redistributive channels of the pension system to fill other gaps in the literature.

4 Data, Model and Methodology

4.1 Sources and Descriptive Statistics of the Data

This study makes use of cross-sectional data obtained from the UK, USA, Italy, Netherlands and Türkiye. Data availability and comparability were key factors in selecting datasets. Therefore, the study employed the most recent household data from each sample country, ensuring the closest possible years across all datasets.[3] The datasets involve: Household Budget Survey in 2019 (from Turkish Statistical Institute (TURKSTAT, 2019)) (covering 2019), Survey of Income and Program Participation in 2021 (from the U.S. Census Bureau, 2021) (covering 2020), Living Costs and Food Survey in 2021 (from UK Data Service, 2022) (covering from April 2020 to March 2021), DNB Household Survey in 2021 (from DHS Data Repository, 2021) (covering 2021) and Survey on Household Income and Wealth (SHIW) in 2020 (from Bank of Italy, 2020) (covering 2020) household datasets in the analyses (See Tables 4 and 5 for details).

Table 4 presents descriptive statistics of the data subject to empirical analysis by countries. Household per capita datasets are utilized in the empirical analysis, including all age groups. The dataset subject to empirical analysis has adjustments in many ways. Firstly, household per head data is generated using the "OECD-modified" equivalence scale method and included in the analysis. This method is developed by Hagenaars et al. (1994). According to this method, household income or expenditure can be modified based on specific coefficients. For example, the coefficient of a household having one adult is 1, if two adults it's 1.5, and if two adults and one child, it's 1.8. Applying this method, the yearly

[3] Due to the unavailability of household datasets as panel data for closely consecutive years for all countries, it was not possible to employ panel data analysis in cross-country comparisons.

Table 4 Descriptive statistics of household datasets

	GAPII	PPEN	PMIX	AGE	EDUC	EMPLOY-MENT	GENDER	MAR-RIAGE
Italy (N = 6211)								
Mean	0.674851	28.8451	28.72553	61.97843	4.6474	0.889068	0.641282	0.859443
Median	0.143253	0	0	62	5	1	1	1
Maximum	100	100	100	98	8	1	1	1
Minimum	0	0	0	17	1	0	0	0
Std. Dev	2.632655	32.63851	32.58563	14.27358	1.865864	0.314073	0.479663	0.347592
Türkiye (N = 11,515)								
Mean	1.377326	20.82815	20.88051	51.72731	2.997308	0.600347	0.76726	0.953105
Median	0.455126	0	0	51	2	1	1	1
Maximum	100	100	100	98	7	1	1	1
Minimum	0	0	0	18	1	0	0	0
Std. Dev	3.483418	33.41226	33.4456	15.12517	1.596443	0.489848	0.422596	0.211424
United Kingdom (N = 5390)								
Mean	8.229343	14.65336	29.86493	54.75547	3.327829	0.616698	0.592022	0.841744
Median	3.859161	0	0	56	4	1	1	1
Maximum	100	99.89263	100	80	5	1	1	1
Minimum	0	0	0	19	1	0	0	0
Std. Dev	12.29824	24.90072	40.41445	16.00272	1.429855	0.486236	0.491505	0.365015
United States (N = 6028)								
Mean	0.993527	3.364362	5.120394	54.12177	10.97014	0.558062	0.471632	0.775879
Median	0.289277	0	0	56	11	1	0	1
Maximum	100	100	100	87	16	1	1	1
Minimum	0	0	0	15	1	0	0	0
Std. Dev	2.898575	12.89852	15.61994	17.64444	2.652942	0.496659	0.499236	0.417037
Netherlands (N = 1137)								
Mean	3.704732	17.037	36.02165	57.81706	3.17854	0.555849	0.709763	0.7854
Median	1.49039	0	0	60	3	1	1	1
Maximum	100	100	100	96	5	1	1	1
Minimum	0	0	0	21	2	0	0	0
Std. Dev	6.686732	27.06564	45.31134	17.04509	1.18186	0.49709	0.454072	0.410725

Source: Authors' own calculations

total income, public pension, and private pension income data have been redistributed and included in the analysis. Quantile methodology is employed for empirical analyses.

4.2 The Empirical Model and the Definition of Variables

In light of the theoretical and empirical literature discussed above, this study develops two different empirical models to examine the impact of pension system on income inequality. These models are represented in Eq. (1) and Eq. (2) as follows:

$$GAPII_i = \alpha_0 + \alpha_1 PPEN_i + \alpha_2 AGE_i + \alpha_3 EDUC_i + \alpha_4 EMPLOYMENT_i + \alpha_5 GENDER_i + \alpha_6 MARRIAGE_i \quad (1)$$

Table 5 Data sources and variable definitions

Variables	Measurement	Data sources
GAPII	Gini-admissible personal inequality index (multiplied by 100)	Own calculation (from household surveys)
PPEN	Yearly public pension income (% of yearly income)	Own calculation (from household surveys)
PMIX	Yearly sum of public and private pension income (% of yearly income)	Own calculation (from household surveys)
AGE	Individual's age	Household surveys
EDUC	Education level* (1 = no education level, 2 = primary school, 3 = secondary school, 4 = high school, 5 = vocational school of higher education, 6 = university, 7 = postgraduate)	Household surveys
EMPLOYMENT	Employment status (0 = not working, 1 = working)	Household surveys
GENDER	Gender (1 = male, 0 = female)	Household surveys
MARRIAGE	marital status (0 = unmarried, 1 = married)	Household surveys

Note: *Categories in EDUC dummy is the same as the education levels used in each country's survey statistics

$$GAPII_i = \beta_0 + \beta_1 PMIX_i + \beta_2 AGE_i + \beta_3 EDUC_i + \beta_4 EMPLOYMENT_i + \beta_5 GENDER_i + \beta_6 MARRIAGE_i \quad (2)$$

where GAPII is the dependent variable and measured as the Gini Admissible Personal Inequality Indexes; PPEN and PMIX represent the ratio of public pension and the sum of public and private pension income to total income, respectively; AGE, EDUC, EMPLOYMENT, GENDER and MARRIAGE are individual's age, education level, employment status, gender and marital status respectively; and εi represents error terms. Model 1 employs PPEN variable as an explanatory variable while Model 2 includes PMIX variable as an explanatory variable. In these models, AGE, EDUC, EMPLOYMENT, GENDER and MARRIAGE variables represents demographic and socio-economic status of households, and they are employed as control variables. Choosing control variables is a crucial stage in empirical analysis. We employ the five control variables related to income inequality. In Eqs. (1) and (2), AGE is the first control variable of income inequality. It is expected that an increase in individuals' age causes a decrease in their productivity and, therefore, negatively affects income distribution (Modigliani, 1966; Rowntree, 1901). However, Becker (1964) argues that investments in human capital can help to reduce income inequality by increasing earnings potential over time. The employment status is the second determinant of income distribution. According to Walrasian theory, involuntary unemployment leads to disequilibrium in income distribution (Hahn, 1987). The difference in education level increases the income gap (Mincer, 1974). Thus, an increase in education level is negatively related to income inequality. Moreover, Knight and Sabot (1983) argue that unequal education distribution increases income inequality and that an increase in average education level reduces income inequality. Marital status correlates with socio-economic stability, with unmarried individuals often facing greater vulnerability and income distribution disadvantages (Lurie & Stier, 2022). However, if people increasingly marry others with similar education levels, it can lead to a concentration of wealth and exacerbate income inequality (Nie et al., 2019). Lastly, gender plays a substantial role in income inequality, with gender-based differences influencing wage rates and labor supply (Fritzell, 1999).

4.3 Inequality and Measurement

Evaluating income inequality is a crucial step in formulating effective economic policies. A wide range of indices have been employed in the literature as an inequality measurement. However, the studies frequently use the Gini coefficient, the share of income ratio of percentiles, Theil and Atkinson indices, the Palma ratio and the coefficient of variation as inequality indicators (Nga Ndjobo et al., 2023; Rani, & Furrer, 2016). In the literature, many studies analyze income inequality through different measurement techniques. Many studies prove that Gini coefficient is the most commonly used index (Klasen 1997; Zagorski et al., 2014; Rözer et al., 2013; Tesch-Römer et al., 2008; Shahbaz et al., 2015; Gupta et al., 2002). The main advantage of the Gini coefficient is to reflect full income inequality (Sanso-Navarro et al., 2020). Thus, it could measure bias from a perfectly equal distribution. Furthermore, it is efficient for wealth distribution in all populations (Kulp et al., 2023).

While the Gini coefficient is a widely used measure of income inequality, it has limitations. One limitation is that it can be less sensitive to changes in income at the very top and bottom of the income distribution compared to the middle (Tan et al., 2021). This means

that the Gini coefficient might be more responsive to changes in inequality among middle-income groups (Wei et al., 2016). The other limitation is that the Gini coefficient's focus on a single value overlooks the heterogeneity among individuals' experience within different income groups (Davies, 2016). It treats all individuals equally, neglecting the differential impact of inequality on various population segments.

Davies (2016) developed a new income inequality index called Gini Admissible Personal Inequality Indexes (GAPII). The GAPII provides a more disaggregated perspective, by assigning a score to each individual based on their relative advantage or disadvantage compared to others in the income distribution. This approach offers valuable insights into how inequality manifests for different income groups and how potential policy interventions might affect them. It is important to note, however, that GAPII do not directly measure absolute income levels; rather, it captures an individual's relative advantage or disadvantage compared to others. Consequently, individuals with identical relative positions within the income distribution will receive the same GAPII score. This underscores the need for cautious interpretation of GAPII coefficients. Notably, the quantiles employed in GAPII do not represent income groups but rather serve as a means to categorize individuals based on their relative income inequality positions.

The choice between the Gini coefficient and GAPII hinges on the specific research question at hand. If a general overview of income inequality is required for initial analysis or cross-country comparisons, the Gini coefficient remains a valuable tool due to its simplicity and established usage (Davies, 2016). However, for a more nuanced understanding of how inequality impacts various population segments and how policy changes might affect them, GAPII provide a more insightful and informative approach. Moreover, this method provides important advantages in solving the data insufficiency problem in regression analysis and personal interpretation of income inequality.

The GAPII personal equality index can be written as follows (Davies, 2016):

$$G_i = \frac{1}{2n\bar{y}}\left[n_i^l\left(y_i - \bar{y}_i^l\right) + n_i^h\left(\bar{y}_i^h - y_i\right)\right] \tag{3}$$

where n_i^l represents the number of individuals having income less than or equal to y_i, not including individual i; n_i^h is the number of individuals' income being strictly bigger than y_i to $n_i^l + n_i^h = n - 1.\bar{y}_i^l \text{and} \bar{y}_i^h$ are mean income of individuals having less than or equal, excluding i, and mean income of individuals income with strictly greater than y_i respectively. The GAPII may exceed one if the upper-income groups hold a significant portion of total income. Therefore, the GAPII is normalized employing the following min–max normalization formula:

$$G_i^l = \frac{G_i - \min(G_i)}{\max\left(G_i\right) - \min(G_i)}$$

Thus, personal inequality index is distributed between 0 and 1, just like the Gini coefficient.

4.4 Methodology

A review of the empirical literature on the subject shows that varied empirical methods used in income inequality-pension system analysis. These methods include regression,

decomposition and cointegration methods. Regression analysis is mostly chosen method in the empirical literature on the subject. It has different properties from decomposition methodologies. Regression methods allow testing significance level of variables, show explanatory power of the models and finally, regression analysis is more efficient than non-regression-based decomposition for controlling endogeneity (Manna, & Regoli, 2012).

However, this study employs quantile regression methodology in estimation of the empirical models given in Eq. (1) and Eq. (2) because Quantile regression has many advantages for performing empirical analysis over regression method. It is entirely a robust, flexible, and easily interpretable method (Koenker, & Bassett, 1978). Robustness enables us to resist outliers due to the non-normality assumption for error distribution. Flexibility allows an estimation of coefficients for each quantile. Easiness of interpretations provides all perspective for dependent variables since Quantile regression have a multiple-level estimation function other than the mean parameter. It can be shown as follows:

$$Q_\tau\left(Y_i|x_i\right) = \beta_0 + \beta_1 X_i + \varepsilon_i, \tag{4}$$

where $0 < \tau < 1$ refers to the quantile level; Y_i represents the dependent variable, X_i is a vector of independent variables; β_0 and β_1 are the estimated coefficients; and ε_i is called the error term. The Quantile regression aims at estimating the conditional quantile function $Q_\tau(Y_i|x_i)$ using a given value of τ, rather than traditional regression analysis employing the mean.

5 Empirical Results

This section presents the results derived from the estimating Eqs. (1) and (2) utilizing data from Türkiye, Italy, UK, USA and Netherlands. The utilization of quantile regression coefficients enables the assessment of how retirement income and pension income influence income inequality across different levels of inequality. Additionally, the countries are ranked based on their coefficients at each quantile, facilitating a comparison between them. The quantile regression results derived from estimating Eq. (1) and (2) are provided in Tables 6, 7, 8 and 9 below (See more details in Appendix). The findings of this study can be succinctly summarized as follows.

First, the results in Table 6 show that public pension income has a significant and negative impact on overall income inequality across almost all inequality groups for all countries except UK and Netherlands. PPEN vary significantly from the OLS estimates across many quantiles for each country. In USA, PPEN has a negative and increasing effect on reducing income inequality at 10% and 1% significance levels as deviations from mean income increases from q10 to q80, implying that retirement income is more beneficial for higher inequality groups than lower inequality groups in terms of reducing inequality. In UK, PPEN has a positive, increasing and statistically significant effect on income inequality as we move from q10 to q60, meaning that retirement income is more harmful for higher inequality groups than lower inequality groups in terms of increasing inequality. In Türkiye and Italy, PPEN has a negative and increasing effect on reducing income inequality at 1% significance level as deviations from mean income increases from q10 to q90 (for Türkiye) from q20 to q90 (for Italy), meaning that retirement income is more beneficial for higher inequality groups than lower inequality groups in terms of reducing inequality.

Considering the impact of PMIX on income inequality, Tables 7, 8 and 9 show that in Türkiye, PMIX has a negative and increasing effect on reducing income inequality at 1%

Table 6 Quantile regression estimation results in all countries for Model 1

Variables	(1) OLS	(2) q10	(3) q20	(4) q30	(5) q40	(6) q50	(7) q60	(8) q70	(9) q80	(10) q90
PPEN (Türkiye)	−0.0126***	−0.0002***	−0.0006***	−0.0015***	−0.0028***	−0.0044***	−0.0063***	−0.0088***	−0.0107***	−0.0135***
PPEN (Italy)	−0.1757***	−0.0002	−0.0025***	−0.0054***	−0.0116***	−0.0184***	−0.0250***	−0.0317***	−0.0501***	−0.0996***
PPEN (United Kingdom)	−0.0333***	0.0040***	0.0139***	0.0233***	0.0260***	0.0344***	0.0286***	0.0180	−0.0135	−0.0265
PPEN (United States)	−0.0118***	−0.0002**	−0.0006***	−0.0011***	−0.0016***	−0.0021***	−0.0031***	−0.0038***	−0.0054*	−0.0111
PPEN (Netherlands)	−0.0194**	0.0006	0.0021	0.0019	0.0018	0.0043	0.0064	0.0016	−0.0125	−0.0232

Standard errors in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

Table 7 Quantile regression estimation results in Türkiye for Model 2

Türkiye (N = 11,515)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	OLS	q10	q20	q30	q40	q50	q60	q70	q80	q90
PMIX	−0.0127***	−0.0002***	−0.0006***	−0.0015***	−0.0028***	−0.0044***	−0.0063***	−0.0088***	−0.0108***	−0.0136***
AGE	0.0416***	0.0004***	0.0011***	0.0024***	0.0057***	0.0092***	0.0137***	0.0185***	0.0211***	0.0287***
EDUC	0.7567***	0.0049***	0.0218***	0.0527***	0.1105***	0.1867***	0.3102***	0.4886***	0.7359***	1.1834***
EMPLOYMENT	0.2507***	−0.0019	−0.0003	−0.0188	−0.0378	−0.0382	−0.0481	−0.0737	−0.0709	0.0138
MARRIAGE	−0.7683***	−0.0152**	−0.0515***	−0.0782***	−0.2075***	−0.4003***	−0.4838***	−0.6278***	−0.8065***	−0.6399*
GENDER	−0.0947	−0.0018	−0.0036	0.0043	0.0065	−0.0120	−0.0482	−0.1209**	−0.1914**	−0.3622*
Constant	−2.1228***	0.0082	0.0259	0.0132	−0.0019	0.0456	−0.0947	−0.1706	−0.1388	−0.7012
R-squared	0.112									
Pseudo R2		0.000636	0.00296	0.00674	0.0138	0.0265	0.0454	0.0734	0.120	0.186

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.16$

Table 8 Quantile regression estimation results in Italy and USA for Model 2

Italy (N = 6233)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	OLS	q10	q20	q30	q40	q50	q60	q70	q80	q90
PMIX	−0.1761***	−0.0002	−0.0024***	−0.0053***	−0.0113***	−0.0183***	−0.0244***	−0.0312***	−0.0491***	−0.0992***
AGE	0.0336***	0.0001	0.0006***	0.0011***	0.0020***	0.0035***	0.0049***	0.0069***	0.0120***	0.0243***
EDUC	0.2706***	0.0012***	0.0052***	0.0103***	0.0185***	0.0372***	0.0622***	0.1045***	0.1984***	0.4307***
EMPLOYMENT	−0.0534	−0.0246***	−0.0634***	−0.1225***	−0.1722***	−0.1939***	−0.2128***	−0.2234***	−0.2317***	−0.2252
MARRIAGE	0.0867**	0.0011*	0.0022	0.0058*	0.0096*	0.0144**	0.0231**	0.0383**	0.0480	0.0648
GENDER	0.2549***	0.0025**	0.0062**	0.0176***	0.0340***	0.0544***	0.0812***	0.1031***	0.1453***	0.1930
Constant	−2.5480***	0.0164***	0.0205**	0.0416**	0.0333	−0.0582*	−0.1708***	−0.3692***	−0.8162***	−1.8202***
R-squared	0.061									
Pseudo R^2		0.00153	0.00455	0.00783	0.0126	0.0195	0.0282	0.0420	0.0710	0.139
United States (N = 6028)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	OLS	q10	q20	q30	q40	q50	q60	q70	q80	q90
PMIX	−0.0031	−0.0001	−0.0005***	−0.0009***	−0.0011**	−0.0014***	−0.0014*	−0.0017	−0.0004	−0.0027
AGE	0.0112***	−0.0000	−0.0000	−0.0005*	−0.0009**	−0.0011**	−0.0011	−0.0009	−0.0000	0.0094
EDUC	0.1678***	−0.0003	0.0017*	0.0051***	0.0100***	0.0172***	0.0303***	0.0502***	0.0859***	0.1655***
EMPLOYMENT	0.6231***	−0.0043*	−0.0162***	−0.0465***	−0.0577***	−0.0575***	−0.0038	0.0943**	0.3496***	1.4491***
MARRIAGE	0.1247	−0.0008	−0.0037	−0.0015	−0.0036	−0.0001	0.0088	0.0445	0.0427	0.0961
GENDER	0.1673**	0.0026	0.0085*	0.0122	0.0032	0.0058	0.0278	0.0825**	0.0701	0.0617
Constant	−1.9633***	0.0182***	0.0426***	0.1057***	0.1640***	0.2051***	0.1697**	0.0736	−0.1215	−0.9420
R-squared	0.040									
Pseudo R^2		0.000175	0.000693	0.00129	0.00161	0.00259	0.00490	0.0118	0.0304	0.0779

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 9 Quantile regression estimation results in Netherlands for Model 2

Netherlands (N = 1137)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	OLS	q10	q20	q30	q40	q50	q60	q70	q80	q90
PMIX	−0.0294***	−0.0021***	−0.0028**	−0.0053**	−0.0129***	−0.0172***	−0.0300***	−0.0349***	−0.0342**	−0.0340
AGE	0.0235	0.0007	−0.0012	−0.0010	0.0006	−0.0013	−0.0053	−0.0004	−0.0071	0.0369
EDUC	0.9870***	0.0178	0.0489*	0.0832**	0.1074	0.2024**	0.2943**	0.6264***	0.7244***	2.1917***
EMPLOYMENT	−0.5081	−0.1852***	−0.2047*	−0.3750**	−0.8958***	−1.0427**	−2.0680***	−1.9334**	−0.8076	1.1292
MARRIAGE	0.3018	−0.0856***	−0.0657	−0.0897	−0.2099	−0.2502	−0.2178	−0.2535	0.1728	0.7984
GENDER	0.8970**	−0.0283	−0.0970	−0.1666	−0.1265	−0.0302	0.1654	0.7524	1.4600**	1.2097
Constant	−0.3233	0.2512***	0.5354***	0.9344***	1.8144***	2.5042***	4.2129***	3.8213***	4.3704**	−0.7294
R-squared	0.049									
Pseudo R^2		0.00262	0.00490	0.00595	0.00927	0.0142	0.0229	0.0347	0.0417	0.0606

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 10 Country ranking by redistributive effects of public pension income

Quantile	Public pension income Rank	Public/private pension mix income Rank
q10	TUR > USA > UK	UK > NLD > TUR
q20	ITL > TUR = USA > UK	UK > NLD > USA > TUR > ITL
q30	ITL > TUR > USA > UK	UK > NLD = USA > TUR > ITL
q40	ITL > TUR > USA > UK	UK > NLD > USA > TUR > ITL
q50	ITL > TUR > USA > UK	UK > USA > NLD > TUR > ITL
q60	ITL > TUR > USA	UK > NLD > USA > TUR > ITL
q70	ITL > TUR > USA	UK > NLD > USA > TUR
q80	ITL > TUR > USA	UK > USA > NLD > TUR
q90	ITL > TUR	UK > USA > NLD > TUR

significance level as deviations from mean income increases from q10 to q90, meaning that pension income is more beneficial for higher inequality groups than lower inequality groups in terms of reducing inequality. The findings are the same for Italy, the UK and Netherlands. Specifically, this condition is observed from q20 to q90 for Italy and from q10 to q80 for Netherlands. In USA, the similar condition holds for quantiles from q20 to q60 but increasing redistributive effects disappear with q70 and next quantiles.

Second, the findings also support the hypothesis that different pension system types differ significantly in terms of their redistributive effects on income. The results in Table 10 indicate that redistributive effects of PPEN and PMIX across countries differ significantly. In the UK and Netherlands, the redistributive effects of PMIX are stronger than PPEN. In contrast to UK, PPEN is more efficient than PMIX for reducing income inequality in all quantiles in Italy. In Türkiye, PPEN has an equal coefficient with PMIX in other quantiles excluding q80 and q90. However, PMIX redistributes income more efficiently than PPEN in q80 and q90. Moreover, Table 10 summarizes estimation results on redistributive effects of public pension income. Italy has the highest rank in terms of reducing income inequality with PPEN at all quantiles excluding q10 and comparing the impact of pension income on inequality. This implies that the Italian pension system is the most effective country in mitigating income inequality, except for the lowest quantile (q10). Türkiye has the second highest rank in terms of reducing income inequality with PPEN in all quantiles excluding q10. USA has the third highest rank in terms of reducing income inequality with PPEN in all quantiles excluding q10. UK has the lowest rank in terms of reducing income inequality with positive PPEN coefficients at all quantiles, except for q70, q80 and q90. This implies that the UK pension system is the least effective in providing income equality, except at the higher quantiles (q70, q80, and q90). Finally, Table 10 shows country ranking by redistributive effects of public/private pension mix income (PMIX). The magnitude of the coefficients varies across countries, with UK having the largest coefficients. UK has the highest rank in terms of reducing income inequality with PMIX at all quantiles. Netherlands has the second highest rank excluding q50, q80 and q90 in terms of reducing income inequality with PMIX. Italy has the lowest rank in terms of reducing income inequality with PMIX at all quantiles excluding q10, q70 and q90.

Third, the findings of the study (Tables 7, 8 and 9) also provide valuable insights on the importance of control variable of the model, namely, education, age and employment status, in determining overall income inequality. In Türkiye, while the AGE and EDUC variables have

positive and statistically significant effects on income inequality, the coefficients of MARRIAGE and GENDER are negative in many quantiles. In other countries, AGE and EDUC demonstrate analogous impacts on income inequality. However, MARRIAGE (for UK and Italy) and GENDER (excluding Netherlands) have positive effects on income inequality. Moreover, AGE has a negative effect on income inequality in UK and USA at different quantiles. In Italy, USA, UK and Netherlands, the coefficient of EMPLOYMENT is negative and statistically significant, reflecting that employed individuals have more income inequality than non-employed ones.

In all countries, the positive coefficient for EDUC validates the argument put forth by Knight and Sabot in 1983 that inequality in educational level exacerbates income inequality. The negative coefficient for EMPLOYMENT suggests that being employed is linked to a reduction in income inequality. This finding supports the notion by Walrasian Theory that access to employment opportunities can enhance income stability and contribute to a more equitable income distribution. The positive coefficient for AGE confirms the assertions made by Modigliani (1966) and Rowntree (1901) that an escalation in an individual's age contributes to income inequality by inducing a decline in their productivity. The positive coefficient for MARRIAGE indicates that marriage is associated with higher income levels and potentially less income inequality within the household in Italy and UK. The negative coefficient for MARRIAGE verifies unmarried individuals may face financial strain in Türkiye due to a lack of partner income. Finally, the positive and negative coefficients for GENDER display gender-based disparity in wage rates and labor supply.

Fourth, taken together, the empirical findings of this study also shed a light on three theoretical channels through which pension income affects income inequality level. The results display that while in the UK, specifically the public pension, generally exacerbates income inequality, the USA, Italy, and Türkiye, tend to reduce income inequality within their state pillars. Furthermore, the public/private pension mix demonstrates effectiveness in reducing income inequality across all pension systems. In particular, the public/private pension mix in the UK, which country implements targeted and basic pension plans in the first tier of public pension system, and Netherlands, which implements residence based basic plan in the public pension system, presents a more discernable redistributive effect in comparison to the USA, Italy, and Türkiye. This confirms the first approach regarding the correlation between the public/private pension mix and income inequality. In countries where basic pension plan isn't implemented, the first primary linkage related to the redistributive effects of the pension system is valid in both the state pillar and the corporate pillar. However, in the UK where the basic and targeted pension plans are employed, none of the three redistributive channels related to the redistributive effects of the pension system approve the public pension, while the corporate pillar approves the first and third channels. We assess that this result in terms of the state pillar is due to the income-inequality-distorting structure of the State Earnings-Related Pension Scheme (SERPS) and occupational pensions' earning-related structures. Thus, we can conclude that the basic and targeted pension plans implemented in the UK do not sufficiently negatively affect intergenerational and intragenerational inequality due to SERPS and occupational plans. By analyzing the redistributive function of the pension system, both the public pension and public/private pension mix systems play a predominant role in providing additional income for the elderly. Finally, the redistributive effect of pension system types by inequality groups is examined. In the public pension system, Italy demonstrates a greater redistributive effect, while the UK contributes to increasing income inequality among higher-inequality groups.

6 Conclusions and Policy Implications

This study examined the relationship between the pension system and overall income inequality in the USA, UK, Netherlands, Türkiye, and Italy, considering different characteristics of pension systems, in particular pension plan, the quality and integrity and the public/private pension mix. The empirical results shed light on the redistributive effects of pension systems in these countries and provide insights into the role of retirement income and pension income in reducing income inequality. The findings reveal that the pension system and its types have varying effects on income inequality across the examined countries. The state pillar (public pension) tends to exacerbate income inequality in the UK. In contrast, countries not implementing basic pension plan, such as the USA, Italy, and Türkiye, generally contribute to reducing income inequality within their state pillars. The public/private pension mix demonstrates effectiveness in reducing income inequality across all pension systems, with the basic/targeted pension plan mix within the public/private pension mix exhibiting a more pronounced redistributive effect compared to other pension plans and their mix.

The analysis of the redistributive function of the pension system highlights the significant role played by both the public pension and public/private pension mix systems in providing additional income for the elderly population. Moreover, examination of the redistribution effect of pension system types by inequality groups reveals that Italy exhibits a greater redistributive effect within the public pension system, while the United Kingdom contributes more to increasing income inequality among higher-inequality groups. In addition to the specific findings related to pension systems, several socioeconomic factors are found to influence income inequality. Higher levels of education (EDUC) are found to contribute to income inequality among higher-inequality groups, supporting the notion that increase in education level causes income inequality by unequal education distribution. Furthermore, being employed (EMPLOYMENT) is associated with lower income inequality, emphasizing the importance of employment opportunities in enhancing income stability and distribution. The positive coefficient for age (AGE) verifies that increase in individuals' age can contribute to income inequality by decreasing in their productivity over time. Finally, the coefficients for (GENDER) and (MARRIAGE) confirm that the disparities of marital status and gender are crucial determinants of income inequality.

These findings have important implications for policymakers. The study suggests that policymakers should consider the design and structure of pension systems, particularly the inclusion of a public/private pension mix, to effectively address income inequality. Additionally, policies that promote access to education and employment opportunities can play a crucial role in reducing income inequality. Overall, this research contributes to the existing literature by providing insights into the relationship between the pension system, pension system types, and overall income distribution, and it offers recommendations for better economic outcomes.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11205-024-03417-5.

Declarations

Conflict of interest None.

References

Aben, M. (2011). Overview of the Italian pension system. http://eprints.biblio.unitn.it/2077/1/Aben_%282011%29__Overview_of_the_Italian_pension_system.pdf

Aysan, M. F. (2013). Reforms and challenges: The Turkish pension regime revisited. *Emerging Markets Finance and Trade, 49*(sup5), 148–162. https://doi.org/10.2753/ree1540-496x4905s509

Babat, S., Gultekin-Karakas, D., & Hisarciklilar, M. (2020). An appraisal of Türkiye's voluntary individual pension system from a perspective of pension equality. *Social Policy & Administration, 55*(5), 784–801. https://doi.org/10.1111/spol.12659

Bank of Italy (2020). Survey on Household Income and Wealth micro dataset, 2020. [Data file]. https://www.bancaditalia.it/statistiche/tematiche/indagini-famiglie-imprese/bilanci-famiglie/distribuzione-microdati/documenti/ind20_stata.zip?language_id=1

Barr, N., & Diamond, P. (2009). Reforming pensions: Principles, analytical errors and policy directions. *International Social Security Review, 62*(2), 5–29. https://doi.org/10.1111/j.1468-246X.2009.01327.x

Başlevent, C. (2014). Social transfers and income inequality in Türkiye: How informative is the survey of income and living conditions?. Ekonomi-tek, 3(3), 23–42. https://dergipark.org.tr/en/download/article-file/1730548

Bayar, A. A., & Günçavdı, N. (2021). Economic reforms and income distribution in Türkiye. *Economic Systems, 45*(1), 100778. https://doi.org/10.1016/j.ecosys.2020.100778

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.

Been, J., Caminada, K., Goudswaard, K., & van Vliet, O. (2017). Public/private pension mix, income inequality and poverty among the elderly in Europe: An empirical analysis using new and revised OECD data. *Social Policy & Administration, 51*(7), 1079–1100. https://doi.org/10.1111/spol.12282

Benedict, M. E., & Shaw, K. (1995). The impact of pension benefits on the distribution of earned income. *ILR Review, 48*(4), 740–757. https://doi.org/10.1177/001979399504800409

Blake, D. (2003). The UK pension system: Key issues. *Pensions: An International Journal, 8*(4), 330–375. https://doi.org/10.1057/palgrave.pm.5940242

Bozio, A., Crawford, R., & Tetlow. (2010). The history of state pensions in the UK: 1948 to 2010 (IFS Briefing Note No. BN105). https://www.bl.uk/britishlibrary/~/media/bl/global/social-welfare/pdfs/non-secure/h/i/s/history-of-state-pensions-in-the-uk-19482010.pdf

Byun, Y. (2022). Welfare expansion without inequality reduction: Institutional explanation of old-age poverty in Korea. *Journal of Social Policy, 53*, 491–511. https://doi.org/10.1017/S0047279422000460

Caminada, K., & Goudswaard, K. (2005). Are public and private social expenditures complementary? *International Advances in Economic Research, 11*(2), 175–189. https://doi.org/10.1007/s11294-005-3014-9

Canziani, P., & Demekas, D. G. (1995). The Italian public pension system: current prospects and reform options. *IMF Working Papers*, 95(33), 1. https://doi.org/10.5089/9781451845150.001

Census Bureau. (2021). Survey of Income and Program Participation (SIPP) micro dataset, 2021. [Data file]. https://www2.census.gov/programs-surveys/sipp/data/datasets/2021/pu2021_dta.zip

Clark, R. L., Craig, L. A., & Wilson, J. W. (2003). *A history of public sector pensions in the United States*. University of Pennsylvania Press.

Conde-Ruiz, J. I., & González, C. I. (2016). From bismarck to beveridge: The other pension reform in Spain. *Series, 7*(4), 461–490. https://doi.org/10.1007/s13209-016-0148-3

Davies. (2016). The gini coefficient and personal inequality measurement (Western University Research Report No. 2016–1). https://ir.lib.uwo.ca/cgi/viewcontent.cgi?article=1807&context=economicsresrpt

DHS Data Repository (2021). DNB Household Survey 2021.

Ebbinghaus, B. (2021). Inequalities and poverty risks in old age across Europe: The double-edged income effect of pension systems. *Social Policy & Administration, 55*(3), 440–455. https://doi.org/10.1111/spol.12683

Elveren, A. Y. (2008). Assessing gender inequality in the Turkish pension system. *International Social Security Review, 61*(2), 39–58. https://doi.org/10.1111/j.1468-246X.2008.00309.x

Fabián, I. D., Devolder, P., del Olmo García, F., & Herce, J. A. (2018). A two-step mixed pension system: How to reinvent social security with the help of notional accounts and term annuities. *Retirement Management Journal*, 7(1), 31–40. https://adunti.net/wp-content/uploads/2022/05/rmj071-atwostepmixedpensionsystem.pdf

Franco, D., & Morcaldo, G. (1990). The Italian pension system: Development and effects on income distribution and poverty. *Labour, 4*(2), 105–128. https://doi.org/10.1111/j.1467-9914.1990.tb00235.x

Friedman, M. (1957). Theory of the consumption function. USA: Princeton University Press. http://www.jstor.org/stable/j.ctv39x7zh

Fritzell, J. (1999). Incorporating gender inequality into income distribution research. *International Journal of Social Welfare, 8*(1), 56–66. https://doi.org/10.1111/1468-2397.00062
Gupta, S., Davoodi, H., & Alonso-Terme, R. (2002). Does corruption affect income inequality and poverty? *Economics of Governance, 3*, 23–45. https://doi.org/10.1007/s101010100039
Hagemann, S., & Scherger, S. (2016). Increasing pension age—inevitable or unfeasible? Analysing the ideas underlying experts' arguments in the UK and Germany. *Journal of Aging Studies, 39*, 54–65. https://doi.org/10.1016/j.jaging.2016.09.004
Hagenaars, A. J. M., De Vos, K., & Zaidi, A. (1994). *Poverty statistics in the late 1980s: Research based on micro-data*. Office for official publications of the European Union.
Hahn, F. H. (1987). On involuntary unemployment. *The Economic Journal, 97*(Supplement), 1–16. https://doi.org/10.2307/3038226
Hinrichs, & Lynch. (2010). Old-age pensions. In The Oxford Handbook of the Welfare State. Oxford Academic. https://doi.org/10.1093/oxfordhb/9780199579396.003.0024
Holzmann, R., & Hinz, R. (2005). *Old age income support in the 21st century: An international perspective on pension systems and reform*. The World Bank.
Hwang, S. J. (2016). Public pensions as the great equalizer? Decomposition of old-age income inequality in South Korea, 1998–2010. *Journal of Aging & Social Policy, 28*(2), 81–97. https://doi.org/10.1080/08959420.2016.1145503
Jang, I. (2019). The distributive impact of private pensions in the context of the institutional designs of public pension systems across OECD countries. *International Journal of Social Welfare, 28*(2), 152–166. https://doi.org/10.1111/ijsw.12365
Kaneko, Y. (2001). The factors of income inequality and the coordination between income distribution policy and social security. *Review of Population and Social Policy*, 10, 55–80. https://www.ipss.go.jp/publication/e/R_S_P/No.10_P55.pdf
Klasen, S. (1997). Poverty, inequality and deprivation in South Africa: An analysis of the 1993 SALDRU survey. *Social Indicators Research*, *41*(1), 51–94. https://doi.org/10.1023/A:1006892216864
Knight, J. B., & Sabot, R. H. (1983). Educational expansion and the Kuznets effect. *The American Economic Review*, 73(5), 1132–1136. https://www.jstor.org/stable/pdf/1814679.pdf
Knoef, M., Been, J., Alessie, R., Caminada, K., Goudswaard, K., & Kalwij, A. (2016). Measuring retirement savings adequacy: Developing a multi-pillar approach in the Netherlands. *Journal of Pension Economics & Finance, 15*(1), 55–89. https://doi.org/10.1017/S1474747214000341
Koenker, R., & Bassett Jr, G. (1978). Regression quantiles. *Econometrica: journal of the Econometric Society*, 33–50. https://www.jstor.org/stable/pdf/1913643.pdf
Korpi, W., & Palme, J. (1998). The paradox of redistribution and strategies of equality: Welfare state institutions, inequality, and poverty in the Western countries. *American Sociological Review, 63*(5), 661–687. https://doi.org/10.2307/2657333
Kulp, C. W., Kurtz, M., Hunt, C., & Velardi, M. (2023). The distribution of wealth: An agent-based approach to examine the effect of estate taxation, skill inheritance, and the Carnegie Effect. *Journal of Economic Interaction and Coordination, 18*(2), 397–415. https://doi.org/10.1007/s11403-022-00372-7
Department for Environment, Food and Rural Affairs, Office for National Statistics. (2022). Living costs and food survey, 2020-2021. [data collection]. UK Data Service. SN: 9022, https://doi.org/10.5255/UKDA-SN-9022-1.
Lurie, L., & Stier, H. (2022). Marital status and gender inequality in household income among older adults in Israel: Changes over time. *Social Indicators Research, 159*(2), 801–820. https://doi.org/10.1007/s11205-021-02781-w
Lustig, N., & Wang, Y. (2020). The impact of taxes and transfers on income inequality, poverty, and the urban-rural and regional income gaps in China. (CGDEV Working Papers, No. 547). https://www.cgdev.org/sites/default/files/WP547-Lustig-Wang-Incidence-Analysis.pdf
Manna, R., & Regoli, A. (2012). Regression-based approaches for the decomposition of income inequality in Italy, 1998–2008. Rivista di statistica ufficiale, 14(1), 5–18. https://www.istat.it/it/files/2012/10/primocapitolo.pdf
Mercer. (2023). Mercer CFA Institute Global Pension Index 2023. https://rpc.cfainstitute.org/-/media/documents/article/industry-research/mercer-cfa-insitute-global-pension-index-2023.pdf
Mincer, Jacob. (1974). *Schooling experience and earnings*. National Bureau of Economic Research.
Modigliani, F. (1966). The life cycle hypothesis of saving, the demand for wealth and the supply of capital. *Social Research*, 160–217. https://www.jstor.org/stable/40969831
Myles, J. (2000). The maturation of Canada's retirement income system: Income levels, income inequality and low income among the elderly. (SSRN Working Papers, No. 147). https://doi.org/10.2139/ssrn.229486

Neugschwender, J. (2015). Pension institutions and income inequality across European societies: Denmark, Germany, Sweden, and the United Kingdom. (LIS Working Papers, No. 627). https://www.econstor.eu/bitstream/10419/119755/1/815786514.pdf

Nga Ndjobo, P. M., & Ngah Otabela, N. (2023). Can income inequality be affected by the interaction between ICTs and human capital?: The evidence from developing countries. *Journal of Quantitative Economics, 21*(1), 235–264. https://doi.org/10.1007/s40953-022-00336-5

Nie, H., & Xing, C. (2019). Education expansion, assortative marriage, and income inequality in China. *China Economic Review, 55*, 37–51. https://doi.org/10.1016/j.chieco.2019.03.007

OECD (2019), Pensions at a Glance 2019: OECD and G20 Indicators, OECD Publishing, Paris, https://doi.org/10.1787/b6d3dcfc-en.

OECD (2021). Pensions at a Glance 2021: OECD and G20 Indicators. OECD Publishing, Paris, https://doi.org/10.1787/ca401ebd-en.

OECD (2023). Pensions at a glance 2023: OECD and G20 indicators. OECD Publishing, Paris, https://doi.org/10.1787/678055dd-en.

Orenstein, M. A. (2008). *Privatizing pensions: The transnational campaign for social security reform*. Princeton University Press.

Oshio, T., & Urakawa, K. (2007). The impact of social security on intragenerational income distribution in Japan. https://www.rieb.kobe-u.ac.jp/coe/output/econ-pdf/0708.pdf

Palme, J. (2006). Welfare states and inequality: Institutional designs and distributive outcome. *Research in Social Stratification and Mobility, 24*(4), 387–403. https://doi.org/10.1016/j.rssm.2006.10.004

Peugny, C., Van de Velde, C., & Hamilton, P. (2013). Rethinking inter-generational inequality. *Revue Française De Sociologie, 54*(4), 641–662. https://doi.org/10.3917/rfs.544.0641

Pryor, F. L. (2007). The anatomy of increasing inequality of U.S. family incomes. *The Journal of Socio-Economics, 36*(4), 595–618. https://doi.org/10.1016/j.socec.2006.12.016

Rani, U. & Furrer, M. (2016). Decomposing income inequality into factor income components : evidence from selected G20 countries. (ILO Research Paper No. 15). https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms_499918.pdf

Rowntree, S. (1901). *Poverty: The study of town life*. Macmillan.

Rözer, J., & Kraaykamp, G. (2013). Income inequality and subjective well-being: A cross-national study on the conditional effects of individual and national characteristics. *Social Indicators Research, 113*, 1009–1023. https://doi.org/10.1007/s11205-012-0124-7

Sanso-Navarro, M., & Vera-Cabello, M. (2020). Income inequality and persistence changes. *Social Indicators Research, 152*(2), 495–511. https://doi.org/10.1007/s11205-020-02444-2

Schludi, M. (2005). The Reform of Bismarckian Pension Systems: A Comparison of Pension Politics in Austria, France, Germany, Italy and Sweden. Amsterdam University Press. https://library.oapen.org/bitstream/handle/20.500.12657/35137/340209.pdf?sequence=1

Schmult, B. (2012). Improving understanding of the social security OASDI trust fund. https://doi.org/10.2139/ssrn.2193603

Seburn, P. W. (1991). Evolution of employer-provided defined benefit pensions. *Monthly Labor Review*, 114(12), 16–23. https://www.jstor.org/stable/41843854

Selim, R., Guncavdi, O., & Bayar, A. A. (2014). Turkiye'de bireysel gelir dagilimi esitsizlikleri: Fonksiyonel gelir kaynaklari ve bolgesel esitsizlikler [Personal income inequalities in Türkiye: Funtional income resources and regional inequalities]. Istanbul: TUSIAD Yayin. https://tusiad.org/tr/yayinlar/raporlar/item/download/7151_094040dfc77f0f5cfc85e93440fa140f

Shahbaz, M., Loganathan, N., Tiwari, A. K., & Sherafatian-Jahromi, R. (2015). Financial development and income inequality: Is there any financial Kuznets curve in Iran? *Social Indicators Research, 124*, 357–382. https://doi.org/10.1007/s11205-014-0801-9

Tan, Y., & Uprasen, U. (2021). Carbon neutrality potential of the ASEAN-5 countries: Implications from asymmetric effects of income inequality on renewable energy consumption. *Journal of Environmental Management, 299*, 113635. https://doi.org/10.1016/j.jenvman.2021.113635

Tesch-Römer, C., Motel-Klingebiel, A., & Tomasik, M. J. (2008). Gender differences in subjective well-being: Comparing societies with respect to gender equality. *Social Indicators Research, 85*, 329–349. https://doi.org/10.1007/s11205-007-9133-3

Turkish Statistical Institute (TurkStat). (2019). 2019 Household budget statistics micro dataset.

Van Dalen, H. P., Henkens, K., & Hershey, D. A. (2010). Perceptions and expectations of pension savings adequacy: A comparative study of Dutch and American workers. *Ageing and Society, 30*(5), 731–754. https://doi.org/10.1017/S0144686X09990651

van Hekken, A., Hoofs, J., & Brüggen, E. C. (2022). Pension participants' attitudes, beliefs, and emotional responses to the new Dutch pension system. *De Economist, 170*(1), 173–194. https://doi.org/10.1007/s10645-022-09396-7

van Vliet, O., Been, J., Caminada, K., & Goudswaard, K. (2012). Pension reform and income inequality among older people in 15 European countries. *International Journal of Social Welfare, 21*(1), S8–S29. https://doi.org/10.1111/j.1468-2397.2012.00873.x

von Weizsäcker, R. K. (1988). Age structure and income distribution policy. *Journal of Population Economics, 1*(1), 33–55. https://doi.org/10.1007/BF00171509.pdf

Walker, A., & Foster, L. (2006). Caught between virtue and ideological necessity. A century of pension policies in the UK. *Review of Political Economy, 18*(3), 427–448. https://doi.org/10.1080/09538250600797990

Wang, Q., & Timonen, V. (2021). Retirement pathways and pension inequality in China: A grounded theory study. *International Journal of Sociology and Social Policy, 41*(13/14), 96–111. https://doi.org/10.1108/IJSSP-09-2020-0454

Wei, X., Allen, N. J., & Liu, Y. (2016). Disparity in organizational research: How should we measure it? *Behavior Research Methods, 48*, 72–90. https://doi.org/10.3758/s13428-015-0585-0

Westerhout, E., Ponds, E., & Zwaneveld, P. J. (2021). Completing dutch pension reform. Network for Studies on Pensions, Aging and Retirement (NETSPAR). https://research.tilburguniversity.edu/files/56490115/CPB_Background_Document_Completing_Dutch_pension_reform.pdf

Whitehouse, E. (2007). *Pensions panorama retirement-income systems in 53 countries: Retirement-income systems in 53 countries*. World Bank.

Wildman, J. M., Goulding, A., Moffatt, S., Scharf, T., & Stenning, A. (2022). Intergenerational equity, equality and reciprocity in economically and politically turbulent times: Narratives from across generations. *Ageing & Society, 42*(10), 2284–2303. https://doi.org/10.1017/S0144686X21000052

Wroński, M. (2021). The Impact of the Public Pension System on Wealth Inequality: The Distribution of Augmented Wealth in Poland. *Applied Economics Letters*. https://doi.org/10.2139/ssrn.3839373

Zagorski, K., Evans, M. D., Kelley, J., & Piotrowska, K. (2014). Does national income inequality affect individuals' quality of life in Europe? Inequality, happiness, finances, and health. *Social Indicators Research, 117*, 1089–1110. https://doi.org/10.1007/s11205-013-0390-z

Zhu, H., & Walker, A. (2018). Pension system reform in China: Who gets what pensions? *Social Policy & Administration, 52*(7), 1410–1424. https://doi.org/10.1111/spol.12368