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The effect of public pension expenditure on old-age poverty in Europe

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TABLE OF CONTENTS

1. Introduction	4
2. Theoretical Framework	6
3. Data	15
4. Methodology	20
5. Results	22
6. Discussion	26
7. Conclusion	29
References	31
Appendix A	36
Appendix B	37
Appendix C	38
Appendix D	39
Appendix E	40

Abstract

This study examines the difference in effects of public and private pension expenditure on old-age poverty. In more than 30 countries during the past 40 years, private pension systems have partially taken the place of public pensions. The goal of this study was to expand the model of van Vliet et al. (2012), who did not find that replacing public pensions by private pension schemes is associated with more poverty among the elderly. The original study is extended by examining a different time period, including additional countries and refining the model by integrating more control variables. A fixed effect model is conducted and panel data provided by a combination of Eurostat and OECD SOCX is utilized. In this thesis, 19 different European OECD countries are being investigated for the years 2005 up to 2017. The results indicate that there is a difference in public and private pension expenditure. It is found that public pension schemes are more effective in reducing poverty rates among the elderly than private pension schemes.

1. Introduction

The pension landscape is changing, not only in the Netherlands, but all over the world. The rising life expectancy and falling birth rates pose a challenge for pension systems. More and more people must be provided with an income for an increasingly longer period, when they are unable or no longer have to work. In member countries of the Organization for Economic Cooperation and Development (hereinafter referred to as “OECD”), the average poverty rate for older individuals is slightly higher than the rate for the general population. In 2021, 14.1% of the people aged 65 or older in OECD countries have a disposable income below half of the national median income. On average, 11.6% of the total population in OECD countries had an income less than 50% of the national median income. The relation between the rates of poverty among the elderly and the poverty rates among the total population, varies considerably across European OECD countries. In countries like Denmark, the Netherlands and Luxembourg, older people are less likely to be in poverty than the average total national population. However, in some countries, including Austria, Belgium and Germany, elderly people typically have higher poverty rates than the average total population (OECD, 2019).

It is plausible that these variations are due to the various compositions and structures of the countries' pension systems. In actuality, public and private social transfers make up two-thirds of older people's incomes (OECD, 2021). Given the apparent relation between pensions on the one hand and senior poverty and income inequality on the other hand, it is not unexpected that lots of research cover this topic. A recent report by the Dutch Centraal Planbureau (2022), showed that redistribution in the Netherlands mainly takes place through government expenditure, for example on pension expenditure, and much less through taxation, as is often believed. Public pension expenditure accounts for a large part of the total social expenditure of governments. For the year 2017, an average of 18.4 percent of total government spending was spent on public pension expenditure in OECD countries (OECD, 2021). Therefore, research into the role of social transfers and public pensions as a mechanism of deliberate or accidental redistribution remains relevant. In former literature, research that has been done into the distributive effects of public pension expenditure among the elderly mainly contain either cross-section analyses or longitudinal data studies for one single country (Milligan, 2008). In this thesis, panel data is used and country and time effects are combined.

In the Netherlands, the number of people aged 80 or older will rise from 800 thousand in 2021 to between 1.5 and 2.6 million in 2050. Almost all OECD countries can expect similar trends (CBS, 2021). In 2019, the number of people aged 65 years or older worldwide was 703 million. According to the United Nations Department of Economic and Social Affairs (2019), by 2050, this

amount will rise by more than 120 percent, reaching 1548.9 million people. Although increasing human life expectancy is a very positive development, ageing of the population and falling birth rates also cause policy implications that need to be taken into account (Bloom et al., 2015). Ageing of the population is resulting in a rise in retirees and a decline in the number of employed individuals. In other words, as the population ages, economic productivity declines and social spending on elderly care rises (Jang, 2018).

As previously mentioned, a significant share of social government expenditure is spent on the provision of public pensions. To provide decent living standards for older people, the financial burden on the government is rising. To keep their pension systems financially sustainable, countries are facing structural reforms regarding pension plans, such as increasing the retirement age. Another reform has been the adoption of private pensions, to replace parts of the state-provided pensions. A paradigm shift known as 'pension privatization' has developed throughout the years. Pension plans have steadily developed into a mix of public and private pension plans (Orenstein, 2011; Orenstein, 2013). More countries substitute parts of their public state-administered pensions for individual private pension systems. In countries such as Switzerland and the Netherlands, private pensions, which make up the second pension pillar, account for a large part of the total pension scheme. Globally, private pensions are becoming a larger part of the total pension mix (Jacques et al., 2021). Previous studies have shown that it is mainly public pension expenditure that redistributes income among the elderly and alleviates poverty (Clements et al., 2014; Murray, 1968). It is vital to evaluate the influence of public pensions on senior poverty, especially in the context of changing pension plans, where private pensions are becoming more dominant. Therefore, the research question of this thesis is:

What is the effect of public pension expenditure on poverty among people aged 65 years or older in European OECD countries?

The aim of this study is to further extend the study by van Vliet et al. (2012). The purpose of their study is to investigate the relation between both public and private pensions on old-age poverty separately. This thesis focuses mainly on the role of public pension expenditure on poverty among the elderly and examines whether public pensions are more effective in reducing old-age poverty than private pensions. Instead of examining 15 European countries, this paper examines 19 European OECD countries using data provided by Eurostat and OECD.

The research by van Vliet et al. (2012) studies the period starting from 1995 up to 2007. In this thesis, data from 1995 – 2003 is eliminated, since inclusion of data from these years would cause a structural break in time series. Indeed, until 2001, Eurostat retrieved data from European Community Household Panel surveys. Instead, this thesis observes the period from 2005 up to

2017, since these years only include data provided by the European Union Statistics on Income and Living Conditions. Additionally, van Vliet et al. (2012) only include a few control variables. In this study, poverty is measured in terms of the economy's median income and therefore it is essential to add multiple factors that influence the median income (Barro, 2000; Jacques et al., 2021). Additional control variables are therefore included in this thesis. The structure of this thesis is as follows: chapter 2 will discuss the theoretical framework regarding the relationship between pension expenditure and alleviating poverty among older people. Chapter 3 describes all used data for the fixed effects regressions and descriptive statistics. Chapter 4 explains the methodology used for the analysis. Chapter 5 shows the results of the analysis. In chapter 6, the limitations of this study will be discussed and in chapter 7 the conclusion will be given.

2. Theoretical Framework

2.1.1 Theoretical background on pensions

Around 1889, Germany was the first civilization to develop an old-age social insurance policy that most closely resembled modern pensions. This was commanded by Otto von Bismarck, who was the chancellor at the time. Current pension schemes still have several aspects that were typical for the Bismarckian pension scheme, which will be discussed in more detail later. Following World War II, pension systems saw a significant expansion. In nations where pensions were formerly limited to certain occupational areas, coverage was expanded to include all working people. Across several countries, eligibility expanded, alternatives for early retirement were created and retirement ages decreased. Eventually, pensions have evolved into a complete system of income support among the elderly (Kohli et al., 1999). However, pension-related expenditure during the 1960s and 1970s remained modest and did not yet account for a significant portion of the GDP. For example, in 1960, pension expenditure accounted for 3.7% of GDP in the Netherlands, 5.9% in Germany, and 1.2% in Spain (Kohli & Arza, 2011).

Human longevity has steadily increased over the past decades, which is praised. However, the rising life expectancy combined with lower fertility has resulted in ageing of the population and has major consequences in several areas. The old-age dependency ratio compares the amount of economically inactive people to the number of working people. To be specific, it shows:

$$\text{old – age dependency ratio} = \frac{\text{population aged } \geq 65}{\text{population aged } 20-64} * 100$$

In 2000, the average old-age dependency ratio in member countries of the OECD was 22,5%. According to projections by the OECD, this percentage will reach 53,2% in 2050, having more than doubled in the previous 50 years (OECD, 2017). These demographic developments, result in the fact that more and more people must receive a pension income and fewer people contribute to pension provision.

Pensions account for most income of Europe's elderly and hence it serves a critical role in preventing poverty among seniors (Kuitto et al., 2021). In most countries, older individuals typically get the majority of their income from government transfers and pensions rather than through income from employment. The rapidly increasing demographic ageing is the reason for pension reforms, as financial feasibility has become more difficult by the increasing demand side of pension income. Pension reforms are manifested in several ways. For example, raising the retirement age has been an indispensable item on the political agenda of almost every European country for years.

By and large, pensions have two main purposes. On the one hand, the aim of pensions is alleviating poverty among the elderly. On the other hand, the goal of pension systems is consumption smoothing, so that people maintain the standards of living after retirement as during their past employment (Barr & Diamond, 2008). In an imaginary economy, where individuals earn a sufficient amount of money and people are wise enough to save up for when they retire, there would be no need for redistribution. Under these conditions, individuals would be smoothing their consumption. However, if there are certain people who are unable to distribute their income to sustain an overall standard of living above the poverty threshold after they retire, the situation gets more complicated. One of the pension system's goals comes into play, namely, to avoid poverty among the elderly. The only strategy to alleviate old-age poverty is redistribution (Chybalski, 2018). Redistribution through pensions can take many distinct shapes. Bergh (2005) makes a distinction between either intraindividual and interindividual redistribution. The transfer of income across different income groups, from the rich to the poor, is referred to as the interindividual or vertical redistribution. In contrast, intraindividual or horizontal redistribution refers to changes in income during a person's lifecycle (Bergh, 2005). Moreover, redistribution can be intergenerational as well. For instance, the government can lower the contribution rate of the current generation. This would eventually force new generations to pay a higher rate or accept lower pension benefits (Barr & Diamond, 2008).

Nowadays, European pension systems have a dilemma of maintaining financially feasible while also providing enough retirement income to pensioners (Chybalski, 2018). Meeting these requirements is becoming more difficult due to the fast population ageing. The increasing ageing of the population raises questions about the financial sustainability and is putting pressure on the current structure of pension systems, as a significant portion of public spending goes toward pension payments (11.3% of GDP in the European Union in 2015). This probably also contributes to the current consensus that the main goal of public pension expenditure refers to poverty alleviation rather than consumption smoothing (EC, 2015).

2.1.2 Distinction of pension schemes

Given the wide range of pension systems, it's plausible to believe that differences in pension system characteristics explain at least part of the cross-country variance and trends in old-age poverty. Pension systems are different in a variety of ways, depending on the organization and regarding the relationship between contributions and benefits (Barr & Diamond, 2008). In all OECD member countries, pension schemes have altered during the previous 50 years to stay financially sustainable. Overall, pension payouts have been more closely tied to wages, which makes pension systems more personal. Defining pension plans has proven to be challenging. Yet there are certain characteristics in pension plans that separate them.

The first two pension schemes were established in the late 1800s and during World War II and laid the foundation for elements that we still know in the structure of today's pension systems. Regarding the first pension pillar, a distinction of public pension schemes can be made between Bismarckian and Beveridgean pension schemes. Bismarckian pension plans contain many of the same characteristics as the pension plan that was introduced by the former German chancellor Otto von Bismarck in 1889 (Kohli, 1987). The fundamental objective of this system is to maintain income after retiring. The Bismarckian concept implies that individuals only have an entitlement to pension income when they earn it through working. As a result, benefits are proportional to a person's income. Austria, Belgium, Germany, Greece, Italy, Luxembourg, Portugal, and Spain all had a Bismarckian type of pension scheme when they were founded (Queisser et al., 2007).

In the midst of World War II, in 1942, the Beveridge Report was introduced. William Beveridge, a British liberal economist, drafted the Beveridge report. This report would ultimately set the foundation for the establishment of the British welfare state and the implementation of a universal basic public pension. In contrast to the Bismarckian model, pension schemes in the Beveridgean pension model provide each citizen with a basic income (Kolmar, 2007). The system provides citizens flat-rate pensions, regardless of their past income or profession. The main objective of Beveridgean pension schemes is old-age poverty alleviation. Denmark, the Netherlands, and the United Kingdom have state pensions based on the Beveridgean tradition (Queisser, et al., 2007). As a result, different pension schemes have widely disparate redistributive impacts (Bonoli, 2003; Hinrichs & Lynch, 2010).

Another common approach to distinguish countries' pension schemes is to determine whether countries have a single pension scheme or a multi-pillar structure, in which various programs offer pensions. In 1994, the World Bank proposed the three-pillar categorization of pensions first, after which the International Labor Organization would adopt this classification too in 2018 (Ellison & Haux, 2020). The first pillar includes state-provided public statutory pensions. The

second pillar consists of occupational pensions, which are often created through employment agreements or collective union contracts. The third pillar includes non-mandatory, personal private pensions (ILO, 2018).

Instead of categorizing pension schemes into pillars, the OECD uses tiers, to describe each pension tier's principal goal. The first tier is mandatory and provided by the public sector. It is mainly the first tier that entails redistributive elements that are supposed to guarantee that retirees have a minimal level of living in comparison to the general population (Queisser et al., 2007). The first-tier plans can be thought of as safety nets against poverty among the elderly. There are several models that achieve this purpose inside the redistributive first tier and they can either be residence or contribution based. The OECD distinguished three types of redistributive models: minimum, basic and targeted. In a minimum pension scheme, a minimum pension income is ensured and is frequently linked to the second pillar. Within a basic pension scheme, the pension income depends upon the number of years of contribution or residence. However, the paid-out pension is unaffected by the income during a citizen's working years or years of residence. In targeted pension schemes, the public pension is determined by taking into account all assets and income sources of an individual. (See Appendix B for a comprehensive overview of the composition of the different pension systems of the countries studied in this study).

The second tier has a different objective. It serves as a form of savings and protection and hence has an insurance role. (OECD, 2005). The second tier's objective is to make sure that pensioners have a sufficient replacement rate. Similar to the first tier, the second tier is mandatory. On the contrary, the second-tier pension income can be provided publicly or privately or a mix of private and public provision and is earnings-related. The second tier is mandatory and related to someone's earnings. Within the second tier, a distinction can be made between defined benefits and defined contributions schemes. A defined contribution (DC) pension plan is depending on the amount of money people put into their pension pot and the return obtained on the invested money. A defined benefit (DB) plan is established by employers and provides employees with annual payouts, once they retire. This benefit is usually based on their last income or a career average. (See Appendix B for a comprehensive overview of the composition of the different pension systems of the countries studied in this study).

Pension benefits are, to some extent, a derivative of incomes from the working years, despite of whether a pension system has a defined-contribution or defined-benefit model. In the DB model, nevertheless, this relationship is considerably stronger. Individuals with poor salaries throughout their working years are more likely to remain poor in the DB model. On the contrary, people with great wages when they are employed can become poor after they retire under the DC model, when

they did not save personal capital (Chybalski, 2018). Within the second tier, employers began to shift their pension plans from DB to DC pensions (Bridgen & Meyer, 2005). The third tier is totally voluntary and private (OECD, 2017). Ebbinghaus (2011) presented a combined scheme based on these categories. The scheme encompasses both pillars and tiers by distinguishing them by supplier and in terms of function. The pension suppliers, which are the government, employers, or individuals themselves, are categorized by pillars, while the aims of the pension system are defined by tiers.

Table 1.
Tiers and pillars in pension systems (Ebbinghaus, 2011).

Tiers	Public pillar	Occupational pillar	Personal pillar
	(State)	(Social partners/employer)	Individual
First tier (minimum income)	Minimum & basic pensions		
Second tier (earnings-related)	Earnings-related pensions	Earnings-related pensions	
Third tier (topping up)			Private savings

2.1.3 Pension Privatization

Privatization refers to the transition from a publicly operated pension system to a pension that is privately managed. Over the past few years, some countries gradually shifted from pay-as-you-go (hereinafter referred to as “PAYG”) pension schemes to funded pension schemes (Ebbinghaus & Gronwald, 2011). A PAYG pension plan is a scheme wherein current state retirement payments are paid by contributions collected from current employees. On the other hand, under a funded pension plan, current payments are invested to cover future payouts with private pension saving accounts. A common thought is that with an ageing population, it becomes more difficult to sustain a PAYG pension system. This is because a decreasing number of employees must pay the pension for an increasing number of pensioners. However, in his paper *“Myths my grandpa taught me”*, Nicholas Barr (1979) cited that it is a myth that funded pension plans are less vulnerable to ageing of the population than PAYG pension schemes. He states that even within a funded private pension scheme, a disequilibrium will arise but in a less transparent way than in PAYG pension schemes. Under a funded pension scheme with demographic ageing, the desired pension contributions of the younger and smaller generation will be smaller than the intended spending of the older and larger generation, and an imbalance will arise. Some later articles once more emphasized that the need to reform PAYG systems and the benefit of future retirees putting some of their assets into privately funded pensions is a misconception (Orszag & Stiglitz, 2001).

However, in reality, the need and urgency of a shift to privately funded pensions, has been the subject of a significant discussion for some years now. Despite the possibility that this theory is a myth, there are still national and international authorities like the European Union, IMF and OECD that argue for a transition from PAYG pensions to funded private pension saving accounts. Between 1981 and 2007, PAYG pension systems were completely or substantially replaced in more than thirty nations across the world (Ebbinghaus, 2011).

There is a notable change in the international pension landscape, probably due to the rapid ageing of people. Latin America took the lead in structural adjustment of social security from unfunded defined-benefit systems to funded defined-contribution schemes. This is contradictory with Western Europe, where several countries decided not to privatize social insurance (Verbic & Spruk, 2014). In some European countries, such as the Netherlands, Switzerland and the United Kingdom, pension reforms have tried to limit the generosity of public pensions, favoring occupational and private solutions in the pension system mix (Anderson, 2019; Hinrichs, 2021). Although in some countries, mandated occupational pensions exist, where participation is tied to firm employment, some countries just supplement their public pension systems with voluntary private plans. Given the developments in the composition and provision of pensions, the question arises of how changes in the provision of pensions affect older people's income distribution and thus old-age poverty. Private pension systems do not redistribute retirement income over individuals, since they relate payments made and benefits received. This eventually results into higher inequality and poverty among the old. As a result, there is a more unequal distribution of income and more poverty among the elderly.

Although multi-pillarization softens the boundary between poverty alleviation and consumption smoothing, public pensions continue to play an important role, notably in alleviating old-age poverty. The progressive movement for privatization of pension schemes is partly founded on the belief that markets are usually a more effective means of distribution than the government (Orenstein, 2013). In general, most public pension schemes rely on flat-rate payouts, which relatively favor individuals with lower income more. As a result, public pensions are predicted to result in a more even income distribution and lower old-age poverty rates. Private pension plans, on the other hand, have a strong relation between contributions paid and benefits received, therefore no income redistribution is envisioned (Been, 2017). Privatization of pensions decreases redistribution within pension systems significantly, attaching pension payments firmly to individual contributions (Ebbinghaus & Gronwald, 2011).

2.2 Empirical evidence

In this part, previous literature regarding the relationship between public and private pension expenditure and old-age poverty will be discussed. As mentioned in the introduction, most literature on this topic are either cross-sectional studies or research with longitudinal data for one single country. Smeeding & Williamson (2001) performed a cross-sectional study and investigated the effectiveness of income programs on alleviating old-age poverty by studying different wealthy OECD countries, using Luxembourg Income Study data (hereinafter referred to as "LIS"). At one moment in time, 18 wealthy OECD countries are covered, and eventually the examination is narrowed down by focusing on 8 different countries. They focus on three Anglo-Saxon countries (United States, Australia and Canada) and five European nations (United Kingdom, France, Germany, the Netherlands and Sweden). They use half of the population median income as a poverty threshold. According to their results, it appears that well-targeted public pension expenditure is related with lower prevalence of old-age poverty.

Goudswaard & Caminada (2010) examine whether there is a relation between social expenditure and income inequality. They investigate this relation by performing multiple OLS regressions. OECD data of 25 different countries is used and the composition of these countries include all 19 European OECD countries that will be examined in this thesis. In their cross-sectional analysis, they study the degree of redistribution of both public and private social security and compare these. According to who manages the cash flows, which can be either public authorities or private institutions, the division between public and private social protection is established. A positive correlation between public social expenditure and income redistribution is discovered, as the income redistribution is the highest in countries with high public social expenditures. Furthermore, the allocation of the public social spending seems to be important, as public programs for retirees seem to be the most redistributive.

Another example of a cross-sectional study on this topic, is the paper by Brown and Prus (2004) who use LIS data on 7 intercontinental countries. An insight on policy decisions regarding public pension schemes is offered, through a comparison of income inequality levels between nations with various government pension systems. They assume an inverse relation between public pension payments and income inequality among elderly, because of the progressiveness of public pensions. Their findings indicate that the degree of pensioners' reliance on retirement earnings helps to explain the variations in the found relation between countries. For instance, in Sweden, governmental transfers make up a sizable amount of the elderly's income. Sweden has a low rate of income inequality among elderly. Retirees in the United States rely on government payments to a more limited extent. In the United States, substantially more income inequality among the elderly exists.

In a later paper by Brown and Prus (2006), they compare 7 industrialized OECD countries with diverse retirement income schemes including Canada, Germany, the Netherlands, Norway, Sweden, the United Kingdom and the United States, by using LIS data. In their study, they look at income disparity in later life and the strategies that can help to reduce this by testing two hypotheses. The first hypothesis states that income inequality decreases as people get older because public pensions cause more equal redistribution than income from employment. The second hypothesis states that countries with stronger public pension schemes have lower poverty rates among the elderly, because public pensions are more progressive than occupational or private ones. Both hypotheses are eventually supported by the results in this study.

The other category is country-specific studies. Goodman et al. (2007), try to simulate the effects of pension reforms in the United Kingdom that were proposed by the British government in 2006. Due to demographic developments regarding the world's rapidly ageing population, the British government published the '2006 Pensions White Papers', which included plans to reform the national pension scheme and structure. Along with these reforms, public pensions are being reduced, while the percentage of private pensions is rising. Additionally, pensions would become more closely linked to earnings. According to Goodman et al. (2007), the influence of pension systems on redistribution is reduced as state pensions become less generous. Additionally, people with disrupted careers and low-skilled employees face greater dangers.

There are only a few studies using panel data to investigate the relation between pensions and old-age poverty. The study by Jacques et al. (2021) examines the influence of first-pillar public pension spending on the occurrence of old-age poverty in 27 European nations in the period 1995-2014. To remove the national fixed effects, they apply a fixed effects model with several control variables. They use data from EU-SILC and all further data is provided by Eurostat. Their results show a positive, although, non-linear relationship between first pillar public pensions and a decreased old-age poverty rate. Furthermore, their findings indicate that when a "lower" poverty standard is utilized, the link between public pensions and senior poverty is stronger. The redistributive effect of public pensions is therefore higher when poverty is defined as income below 40% of the median national income than when it is defined as income below 60% of the national income. Based on the theories discussed above and the empirical findings in previous literature, the following hypothesis is formulated:

H1: Public pension expenditure has a negative relationship with poverty among old-age poverty.

Although the existing literature on the redistributive effect of public pensions and its influence on old-age poverty is fairly consistent, this is not the case for private pensions. Additionally, studies on the income consequences of private pensions are quite limited. In relation to the impact of pension privatization on old-age poverty, there seems to be a discrepancy in literature.

Some researchers have concluded that private pensions are associated with a higher level of poverty and income inequality among retirees. For instance, Jang (2018) seeks to understand how private pensions affect distribution among the elderly and therefore, he investigates how changes in the institutional structure of public pension systems could alter the way pensions affect income disparity among elderly. In order to do this, he conducts a random effects model for the period of 2005 to 2011 for 19 OECD nations using data from the OECD Social Expenditure Database (hereinafter referred to as “OECD SOCX”). Specifically, when public pensions are strongly related to earnings and have a low degree of coverage in general, he shows that increasing the share of private pensions is associated with an increase in income inequality.

Another panel data study is by Neugschwender (2014) who compares the regulation of pension systems across these countries and examines how the actual pension income is affected by this. In this study, Denmark, Finland, Germany, Italy, Sweden and the United Kingdom are analyzed by using data from the LIS database for the years 1992 up to 2010. He studies the evolution of private pension income coverage, in order to demonstrate which countries substantially rely on private pension provision. He conducts the study in the form of a cohort design. In this study, evidence is shown of increased income disparity and poverty among younger retired generations in comparison to older generations, due to greater reliance on private pension plans. In the aforementioned study by Goudswaard & Caminada (2010) regarding the distributional effects of public and private social programs, they conclude that private social security plans have a smaller degree of redistribution than public social security plans.

Au contraire, van Vliet et al. (2012) found no significant indication that the transition from public to private pension provision is connected with more old-age income inequality or poverty. Using a fixed effects regression, Van Vliet et al. (2012) study 15 European OECD countries for the years 1995-2007 and use data from Eurostat Statistics on Living and Income Conditions dataset (hereinafter referred to as “EU-SILC”). The difference in outcomes compared to other studies could be caused by the inconsistency in the utilized data. Since EU-SILC was initially introduced in 2003, the findings may vary since they use a combination of European Community Household Panel (ECHP) surveys and EU-SILC data. Van Vliet et al. also only employ just a few control variables, which could be a disadvantage within a fixed effects model. Given that the results of the other previous research regarding private pension expenditure are generally consistent and compatible with the theory discussed, the following hypothesis is formulated:

H2: Substitution of public pension schemes with private pension schemes in the total pension mix is associated with increasing old-age poverty.

3. Data

This thesis combines multiple datasets by the EU-SILC and OECD. Eurostat provides statistics on income and poverty in the Eurostat Statistics on Living and Income Conditions dataset. Starting from 1995, Eurostat annually provides data for most OECD countries. However, EU-SILC was only launched in 2003 and entered its legal basis in 2004. From 1995 up to 2003, the statistics were retrieved from the European Community Household Panel (ECHP) surveys. Since it is not possible to compare data from predecessors, this thesis will use data starting from 2005, due to lack of data from some countries in 2004. EU-SILC provides data on the poverty rate among elderly after pension income transfers, which is the dependent variable in this thesis.

The rate of poverty among older people is measured as the share of people, aged 65 or older, with a disposable income below 60% of the national median equivalized disposable income of all households. In the EU-SILC database, old-age and survivor pensions are considered as a component of social transfers. Social transfers have a sizeable effect on the differences in poverty rates between countries. In an international comparison on the effect of pension expenditure on poverty, it is useful to measure poverty after pension income after social transfers, as pension income significantly reduces poverty rates, since a lot of old people are very dependent on their pension income and do not have enough private savings to live (Kuitto, 2021).

Second, data on the explanatory variables are obtained from the OECD Social and Welfare Statistics. The OECD SOCX Database provides data on public and private pension expenditure on survivor and old-age pensions, measured as a percentage of GDP. A narrow definition of public pension expenditure is applied to ensure that the pension expenditure target the elderly (people of 65 years and older). To prevent aggregation bias, we defined public pension expenditure as a proportion of a country's GDP. The latest published data of public and private pension expenditure is of 2017. Therefore, the years used in this thesis are from 2005 up to and including 2017. Altogether, this combination of data represents 19 OECD countries with a sufficient number of observations (see Appendix A for a list of countries and abbreviations). Cross-national and temporal variance offers useful information.

For this study, 19 European OECD countries are chosen that represent various sorts of public-private pension mix. The pension schemes are ranging from a more Bismarckian model of preserving income through earnings-related state pensions to a Beveridge model of mixing public basic pensions with supplementary pensions. As mentioned before, Belgium, Italy and Germany most closely resemble Bismarckian public pension systems, with significant earnings-related state pensions very modest private pension development. The Netherlands, the United Kingdom and Denmark more resemble the Beveridgean model with basic flat-rate pensions, but also different public and private earnings-related additional pensions. (Ebbinghaus, 2011). The

Netherlands, UK and Switzerland have the most mature multi-pillar pension schemes. In countries with advanced multi pillar pension schemes, state pensions typically offer a flat-rate minimal payout which is enough to meet basic necessities. Because the state has relatively constrained involvement in pension provision, private or occupational pensions have a more prominent role in these pension schemes (Bonoli, 2003).

Various factors can cause variations in expenditure and poverty ratios, such as the number of retirees as a result of an ageing society or changes in business cycles which may determine the generosity of public expenditure by the government. The selection of control variables comes from a combination of van Vliet et al. (2012), Jacques et al. (2021) and Kuitto et al. (2021). The choice of the included control variables will separately be explained in more detail later. In order to proxy for the number of people per country receiving pension income, an old-age ratio is included, which measures the national proportion of people aged 65 or older over the entire population. A high proportion of retirees over the total population puts the pension system under constrain and forces to reduce the public pension generosity in order to remain financially sustainable. Additionally, whether there is an economic crisis may be connected to the financial status of older people. GDP per capita is a good indicator of economic growth, which reduces poverty. Generally speaking, the probability of poverty decreases with increasing GDP growth (Antczak & Zaidi, 2016). To ensure a normal distribution of the error term, GDP per capita in logarithm terms is added as a control variable to the model (van Vliet et al., 2012). The GDP per capita is measured in 2010 Euros (Eurostat, 2022). The original model by van Vliet et al. (2012) only included the former two mentioned control variables. It must be acknowledged, that the macroeconomic consequences of economic crises mostly affect individuals who are still working and have limited impact on the financial situation of retirees (Antczak & Zaidi, 2016).

Table 2

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Old-age poverty rate	245	15.131	6.476	4.7	32.8
Public pension	247	9.006	3.347	3.133	17.088
Private pension	242	1.442	1.57	.049	5.291
Severe deprivation	245	3.904	4.544	0	24.6
Elderly ratio	247	17.102	2.528	10.764	22.522
Unemployment	242	8.636	4.727	2.558	27.492
DEBTtoGDP	247	78.828	39.193	17.138	274.756
Ln(GDP)	247	2.336	0.003	2.331	2.341
Social expenditure	247	37.478	5.602	22.487	60.064

Note. The old-age poverty rate measures the proportion of people aged 65 or older that has an income below 60% of the national median equivalized income. Public and private pension as well as social expenditure are measured as a percentage of GDP.

To account for structural differences between countries, control variables that proxy for economic and demographic characteristics of a country are added to the model (Jacques et al., 2021). To proxy for the business cycle, the unemployment ratio is added. This variable measures the amount of unemployed people over the total labor force (Christiano et al., 2016). All these data are retrieved from Eurostat. According to Nolan & Ive (2011), these three control variables are most important in a cross-country context. To further control for the financial features of a country, government debt and total government spending are added as control variables. The debt-to-GDP ratio and the social government expenditure ratio are all indicators of the financial sustainability of public pension expenditure (Jacques et al., 2021). Caminada & Goudswaard (2010) find that social expenditure is strongly negatively related to poverty. Each percentage point of social investment reduces poverty by 0.7 percentage points in both European and non-European countries. One of the most important areas of governmental social spending is pensions. Therefore, (because government expenditure related to pensions is already treated separately) the social expenditure variable is measured by taking all social public pension expenditure as a percentage of GDP minus total pension expenditure as a percentage of GDP. In order to be comparable with the data on public pension expenditure, data on social expenditure is also retrieved from the OECD SOCX dataset.

Table 3
Changes in public and private pension provision.

Country	Public pension (% GDP)		Private pension (% GDP)	
	2005	2017	2005	2017
AUT	11,95	12,98	0,49	0,71
BEL	8,93	10,51	1,30	1,06
CZE	6,65	7,70	0,20	0,38
DNK	6,46	8,03	3,35	4,65
FIN	8,05	11,84	0,50	1,06
FRA	12,02	13,64	0,40	0,40
DEU	11,17	10,20	0,14	0,22
GRC	11,36	15,49	0,07	0,120
IRL	3,13	3,72	1,51	0,95
ITA	13,67	15,64	0,19	0,37
LUX	7,84	8,52	0,07	0,18
NLD	4,63	5,19	3,19	4,61
NOR	4,76	6,87	0,91	1,22
PRT	10,02	12,73	0,82	1,37
SVK	6,03	7,29	0,07	0,12
ESP	7,96	10,90	0,53	0,57
SWE	7,16	7,19	0,94	1,06
CHE	6,23	6,67	4,67	5,17
GBR	5,01	5,63	2,65	2,70
Total	8,06	9,51	1,16	1,42

Figure 1 graphically depicts the trends in the old-age poverty rate over the years 2005 to 2017 for all different countries. In almost all countries the at-risk-of-poverty rate is decreasing. The at-risk-of-poverty rates among people aged 65 years and older are highest in Switzerland and the United Kingdom. 60 percent of the national median equivalized income is used as the poverty line. (See appendix C for means per country). Czech Republic and Luxembourg have the lowest old age at-risk-of-poverty rates.

Figure 1.
Developments in old-age poverty rates (% of elderly population) 2005 – 2017

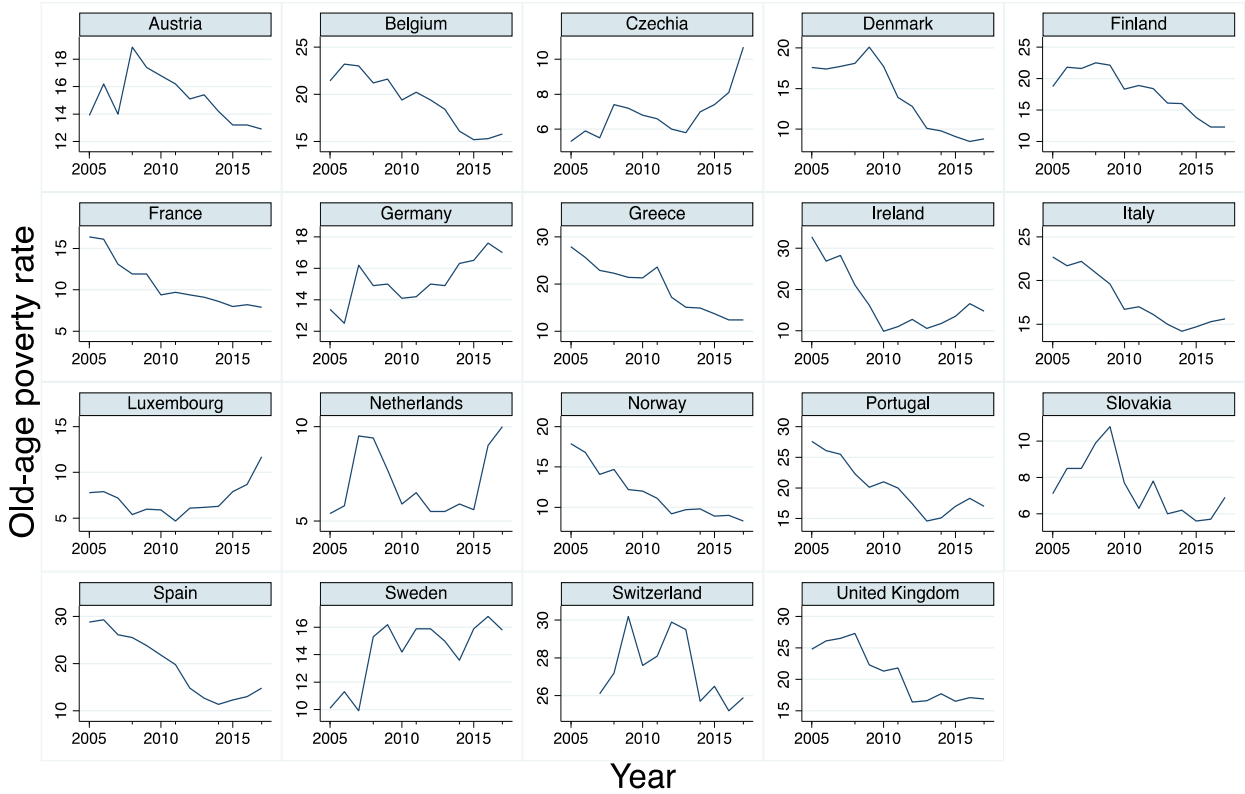
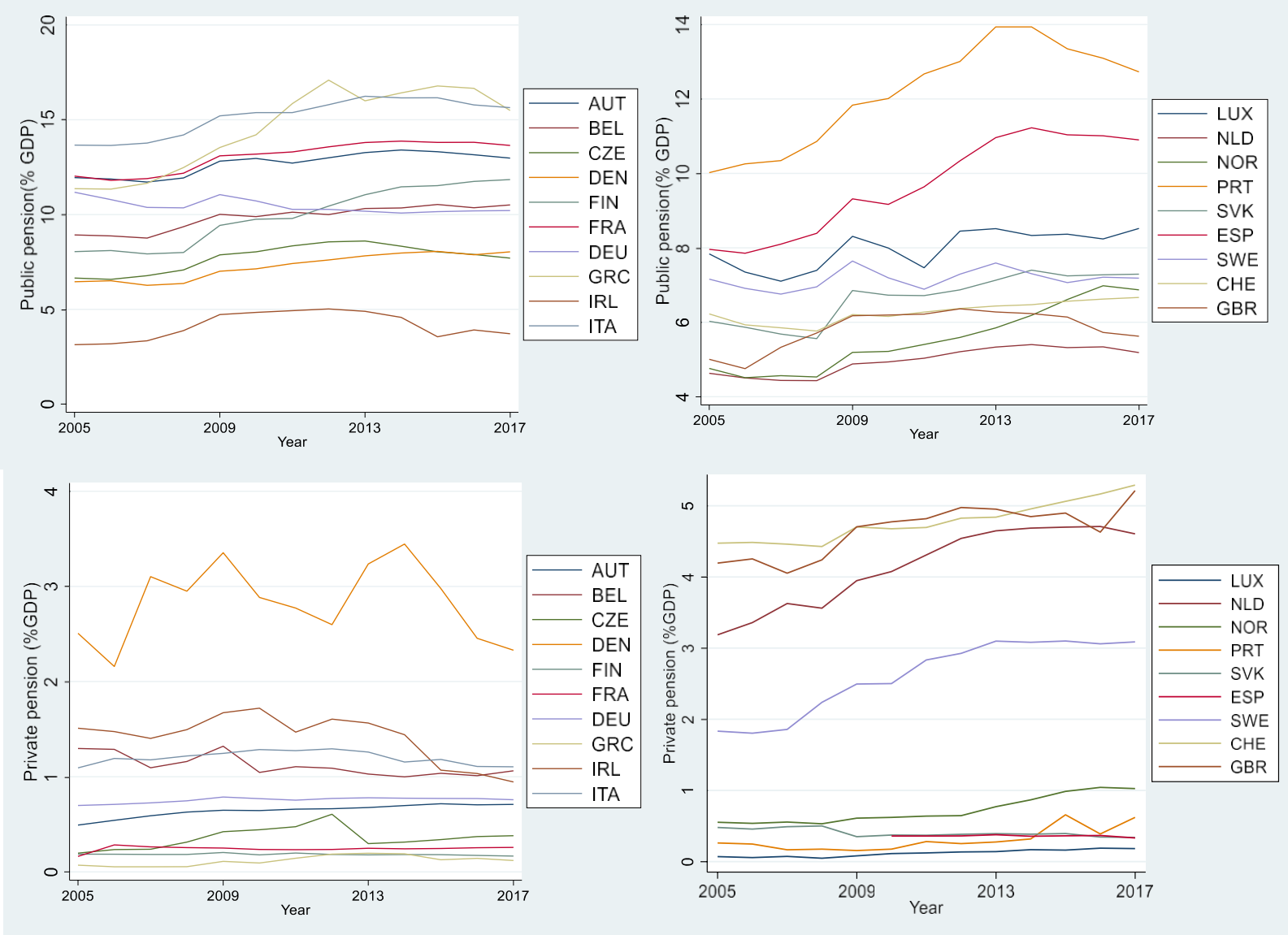


Table 3 shows 4 columns which depict the level of the public and private pension expenditure as a percentage of GDP. These data are shown for the years 2005 and 2017 to show how pension expenditure has changed over the investigated years in this study. In all investigated countries, public pension expenditure as a percentage of GDP increased over the years, the only exception is Germany. This contradicts the literature and OECD reports that state that public pensions are becoming less generous. However, upon studying the statistics, it is discovered that, in many countries, public pensions have slightly decreased as a proportion of GDP since 2013. Furthermore, between 2005 and 2017, the ageing population rose from 15,8% to 18,8% implying that demand for pension incomes rose, which in turn also affects the supply of public pension income.

During the research period, the private share of pensions grew from 1.16 to 1.42 percent. The countries with highest private pension expenditure are Switzerland, Denmark and the Netherlands. These three countries are the only ones having a quasi-mandatory private pension plan (Appendix C provides an extensive overview of the current pension schemes). This indicates that the descriptive statistics are consistent with the present structure of the Swiss, Danish, and Dutch pension plans. Germany, Luxembourg and Slovakia have lowest private pension expenditure. Because there is a lot of variation in GDP per capita across countries, the natural logarithm of GDP per capita is used to assure a normal distribution. Figure 2 shows a graphical overview of trends in both public and private pension spending as a percentage of GDP, over the years 2005 up to 2017.

Figure 2.
Developments in public and private pension expenditure (% of GDP) 2005 – 2017.



4. Methodology

In this part, the methodology used for the analysis will be explained. When dealing with panel data analysis, different approaches can be used. Pooled ordinary least squares estimation, fixed effects model, and random effects model are the three essential techniques to panel data analysis (Greene, 2015). In order to determine whether a random or fixed effects model is more appropriate, a Hausman test can be used. The null hypothesis of the Hausman test states that the random effects model is appropriate and the alternative hypothesis states that the fixed effects model is appropriate. A value of $0.0001 < 0.05$ is found, which means the null hypothesis is rejected and makes the fixed effects model the preferred model.

First, a linear regression model using ordinary least squares (OLS) with robust standard errors will be used, followed by a fixed effects model. There are various conditions that must be satisfied in order to derive robust estimations from panel data. Because there are so many factors that influence the risk at poverty rate of a country, incorporating all these factors in a model will be extremely challenging (Greene, 2011). Countries are very likely to be prone to fixed effects. Country fixed effects include all characteristics that differ between countries, are time-invariant, and are not captured through the explanatory variables. In order to account for country heterogeneity, the fixed-effect model is widely adopted to account for country-specific characteristics that have remained constant throughout time. The poverty rate in a country is partly determined by the economic and demographic characteristics of a country. In terms of demographic characteristics, institutional elements and historical heritage, that are roughly time-invariant, every country is unique.

Additionally, year fixed effects are added to the model to control for time specific effects, so a time and country fixed effects regression will be performed. In countries like Switzerland and the Netherlands where private occupational pensions play an important role, the distinction between social security and private pensions is important. Because of the dependent variable, which is poverty with a relation to median income, it is important to include additional control variables that could impact the median income. Therefore, this model includes all the control variables mentioned in the data section. The regression is formulated as:

$$P_{it} = \beta_0 + \beta_1 publicpension_{it} + \beta_2 totalpension + \beta_x Z_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Where $i = 1, \dots, 19$ and $t = 2005, \dots, 2017$.

P_{it} measures the poverty rate among people above 65 years old for a given country i and year t as a percentage of the population. This is a proportion of the older population, with a disposable income below 60% of the national median income. $publicpension_{it}$ measures the public pension expenditure as a percentage of GDP for a given country i and year t . $totalpension_{it}$ measures the total pension expenditure which is the sum of public pension expenditure as a percentage of GDP and private pension expenditure as a percentage of GDP for a given country i and year t . A bundle of control variables is captured by Z for a given country i and year t . This bundle exists out of the aforementioned control variables *Elderly ratio*; *ln(GDP per capita)*; *unemployment*; *government debt* and *social expenditure* for a given country i and year t . μ_i is a country fixed effect and λ_t is a year fixed effect and they control for unobserved year and country specific effects. ε_{it} is the robust standard error.

Another way of formulating the relation between old-age poverty and pension expenditure is:

$$P_{it} = \beta_0 + \beta_1 publicpension_{it} + \beta_2 totalpension + \dots + \varepsilon_{it} \quad (2)$$

$$P_{it} = \beta_0 + \beta_1 publicpension_{it} + \beta_2 (public + private) + \dots + \varepsilon_{it} \quad (3)$$

$$P_{it} = \beta_0 + \beta_3 publicpension_{it} + \beta_4 privatepension_{it} + \dots + \varepsilon_{it} \quad (4)$$

Regarding private pension expenditure, combining equation 3 and 4 implies that:

$$\beta_2 = \beta_4 \quad (5)$$

Regarding public pension expenditure, combining equation 2, 4 and 5 implies that

$$\beta_1 + \beta_2 = \beta_3 \Leftrightarrow \beta_1 = \beta_3 - \beta_2 = \beta_3 - \beta_4 \quad (6)$$

For the regression in equation 1, this means that coefficient β_1 measures the difference between public and private pension expenditure as β_3 measures public pension expenditure and β_4 measures private pension expenditure. Coefficient β_2 , which is before the total pension expenditure will give the same coefficient as the private pension expenditure, as the public part in the total pension expenditure variable is already captured by coefficient β_1 . Equation 1 would give the same coefficient for total pension expenditure as it would for only private pension expenditure.

In order to check for robustness, sensitivity analyses are performed by using different dependent variables to measure poverty. In fact, a distinction is made between two different measures of poverty. The at-risk-of-poverty rate measures the relative amount of people in a country that has a disposable income after pension income, below 60% of the median income. The at-risk-of-poverty rate is used to measure relative poverty, since this rate depends on the national median income (Chybalski, 2018). For sensitivity analysis purposes, the relative poverty rate will also be measured by disposable incomes below 50% of the median income and below 40% of the median income. In addition, another variable is used to measure the absolute poverty: the severe

material deprivation ratio (Chybalski, 2018). The severe material deprivation rate measures the percentage of the population aged 65 years or older, that are not capable of affording at least four of the 9 following items: to pay their rent, mortgage or utility bills; to keep their home warm; to face unexpected expenses; to eat meat, fish or proteins on a regular basis; holidays; a television set; a washing machine; a car; a telephone (EC, 2012).

5. Results

5.1 Baseline results

In this section, the fixed effects regression findings will be presented and discussed. The fixed effects regression with both country and year fixed effects is probably the best fitting model and has the highest R^2 . However, in order to provide a complete overview, other models are included as well. In table 4, the results of the fixed effects regression are shown. In four steps, the main regression with year and country fixed effects is estimated. In column (1), a simple OLS regression is performed with the demographic control variable, elderly ratio, included, to account for ageing of the population. This is done to proxy for the number of pensioners. The number of retirees as a percentage of the national total population is included to give an indication of the relative demand for pension income. Column 1 shows a negative significant relationship (1% significance) between public pension expenditure and old-age poverty. As this coefficient measures the difference between the effect of public pension expenditure and private pension expenditure (as mentioned in the methodology), the negative significant result indicates that public pensions are more effective in alleviating poverty among elderly than private pensions. This is in line with the first and second hypothesis. Additionally, column 1 depicts that the elderly ratio control variable is positive towards the old-age poverty rate and is significant at a 5% level. This is consistent with findings by Jang (2018) and Van Vliet et al. (2012).

In column (2), an OLS regression is performed with additional demographic and economic control variables. The inclusion of the extra control variables makes the coefficient on the relationship between public pension spending and the poverty rate among the elderly increase. The negative coefficient of the main explanatory variable increases from -0.891 to -0.403 and is significant at a 5% level, which means the difference between public and private pension expenditure is significant. These findings demonstrate once more that public pensions are superior to private pensions in reducing elderly poverty. Furthermore, column 2 shows that not all control variables are significant. Control variables government debt and social expenditure are both significant at a 1% level. All other control variables are insignificant towards the old-age poverty rate. Nevertheless, it's worth noting that, even with the inclusion of numerous control variables, the results of an OLS regression are prone to omitted variable bias. Factors that are not observed in

the data but still have an impact on the dependent variable are referred to as omitted variables (Woolridge, 2015).

In column (3) a country fixed effects regression is performed, with the inclusion of all the control variables. The coefficient of the main explanatory variable public pension spending is significant at a 1% level and is negative. This tells us that the coefficients between public and private pension expenditure are significantly different. According to this outcome, public pension spending is more effective in reducing poverty than private pension spending, which fits our hypotheses. The coefficient of the total pension expenditure is significant at a 5% level and positive towards old-age poverty. From these results, it can be said that private pension spending has a smaller impact on eliminating poverty among elderly, because the coefficient for total pension expenditure is the same for private pension expenditure. These findings support both the first and second hypotheses. The control variables elderly ratio, unemployment and $\ln(\text{GDP})$ have become significant, and all three variables have a negative relation towards poverty among older people.

In column (4), year-fixed effects are introduced. Column 4 shows the most highly regarded model, which includes several control variables as well as both country and year fixed effects. It is the model with the highest R^2 as it is the most advanced model with the most control variables and dummies included. The inclusion of year fixed effects results in a decrease of the public pension coefficient. The coefficient is significant at a 1% level and shows that there are significant differences in the coefficients between public and private pension expenditure. The total pension coefficient, which is the same as the private pension coefficient increases as well. A positive significant relation is found towards old-age poverty. This supports the second hypothesis. Public pension expenditure is more redistributive than private pension schemes and hence serves a better role in alleviating poverty among retirees. Regarding the control variables, taking into account the year-fixed effects does not result in large changes. Although at a reduced level, unemployment and $\ln(\text{GDP})$ are still significant. Please see appendix D for an extensive version of table 4 with separate coefficients for every year.

Both the models with country-fixed effects only and the model with country- and year-fixed effects combined support the first and second hypotheses. The results are contradictory with van Vliet et al. (2012), as in their study no proof was found that switching from public to private pensions causes older individuals to live in greater levels of poverty.

Table 4*Regression results*

VARIABLES	(1)	(2)	(3)	(4)
Public pension	-0.891*** (0.306)	-0.403** (0.161)	-3.301*** (0.929)	-3.374*** (0.904)
Total pension	0.758** (0.371)	-0.160*** (0.059)	2.297** (0.992)	2.499*** (0.835)
Elderly ratio	0.093** (0.188)	0.260 (0.165)	-0.810** (0.283)	-0.740 (0.626)
Unemployment		-0.023 (0.067)	-0.437*** (0.096)	-0.439*** (0.106)
Government debt		0.042*** (0.009)	0.012 (0.014)	0.013 (0.015)
Ln(GDP)		0.012 (0.007)	-0.123** (0.045)	-0.100* (0.048)
Social expenditure		-0.165*** (0.056)	-0.074 (0.045)	-0.080 (0.053)
Constant	0.0943*** (0.024)	0.041 (0.082)	1.642*** (0.468)	1.388** (0.525)
Observations	245	216	242	242
R-squared	0.068	0.135	0.582	0.590
Number of countries			19	19
Country FE	NO	NO	YES	YES
Year FE	NO	NO	NO	YES

Note. Robust standard errors in parentheses. The dependent variable is the at-risk-of-poverty rate (60% median) among people aged 65 and older. Public pension, total pension, unemployment, government debt and social expenditure are measured as a percentage of GDP. See appendix D for an extensive version of column 4 including year dummies. *** p<0.01, ** p<0.05, * p<0.10

5.2 Sensitivity analysis

Although the results are consistent with both the first and second hypothesis, a variety of sensitivity tests will be performed to verify the reliability of these results. Given that the findings are different from the study by van Vliet et al. (2012), it is important to test the robustness of these findings. The models of column 3 and 4 (with country fixed effects only and both country and year fixed effects) from table 4 will be reperformed for a sensitivity test with different dependent variables. The poverty rate depends on national median income. The results are being tested by means of using different dependent variables that measure the risk of poverty among elderly.

First, it is tested whether our findings are affected by changes in the poverty line definition. We do this by setting the poverty line at 50% of national median income and at 40% of national median income. The results of the two different poverty thresholds are shown in respectively columns 1, 2, 3 and 4 of Table 5. Secondly, the replacement of the independent variable by using severe deprivation as an absolute measure of poverty, serves as an extra robustness check. The results of this regressions on severe deprivation are shown in columns 5 and 6 of Table 5. Please see appendix E for an extensive version of column 2, 4 and 6 of table 5 with individual coefficients for all years. The results regarding the relation between public pension expenditure and old-age poverty remain stable for all 3 different models, using a different dependent variable as a measure of poverty. The results of the robustness checks indicate that public pensions seem to be more effective than private pensions in alleviating old-age poverty. In terms of (the risk of) old-age poverty among the elderly, the sensitivity analysis results indicate that the difference between the coefficients of public and private pension spending is significant. Public pension schemes seem to have a stronger (negative) effect on old-age poverty and thus public pensions are more effective in reducing poverty among older people than private pensions.

All sensitivity checks, in column 1,2 3 and 4 of Table 5, using relative measures of at-risk-of-poverty rates indicate a significant difference between the impact of public and private pension expenditure on old-age poverty. This is in line with the baseline results and the first and second hypotheses. It is still contradictory with van Vliet et al. (2012) who did not find an increase of old-age poverty as a result of pension privatization. The findings from the baseline results and the sensitivity checks of this thesis are in line with the findings by Been et al. (2017). They discovered that higher levels of old-age poverty are linked to the increased relative relevance of private pensions.

It is remarkable that in the regression with severe deprivation as a dependent variable (shown in columns 5 and 6 of Table 5), no significant differences of the impact between public and private pension expenditure are found. When including both country and time fixed effects (column 6) and using the absolute measure of poverty, severe deprivation, the coefficient of public pension

expenditure changes its sign and becomes positive. However, this coefficient is insignificant. When using the absolute measure of poverty among the elderly, no significant findings regarding public or private pension spending and the difference between these two, are found. Additionally, it should be noted that the R^2 in models with severe deprivation as an outcome variable, is significantly lower than models with the relative measure of poverty. The results using severe deprivation as the dependent variable are quite contradictory with respect to the use of the relative poverty measure.

Another finding that is contradictory with research by van Vliet et al. (2012) and Jacques et al. (2021) is the fact that public pensions do not seem to get even more effective in reducing poverty than private pensions, when the poverty line is dropped. Both van Vliet et al. (2012) and Jacques et al. (2021) find that the reducing effect of public pensions on old-age poverty is stronger when the poverty threshold is lower, so when fewer but poorer people are included in the old-age poverty rate. In their studies, the magnitude of the negative relationship between public pensions and old-age poverty actually decreases as the poverty line tightens. In this study, this is not the case.

6. Discussion

The results of this thesis build on existing evidence from Been et al. (2017) who found a positive significant relationship between public pensions and old-age poverty and a negative significant relation between private pensions and poverty. This is in line with our findings, which indicate that public spending is more effective in alleviating poverty than private pensions. This result is also consistent with findings by Jang (2018). However, the conclusion that public pensions are found to be more effective in reducing poverty than private pensions is contradictory with findings by van Vliet et al. (2012). Van Vliet et al. (2012) did not find a significant relation between private pension expenditure and old-age poverty.

The utilized data may be an aspect that explains the discrepancy in the results. In the research by van Vliet et al. (2012), data by OECD SOCX is utilized, which is the same source of data as in this study. Nevertheless, the findings of this study should be studied carefully as data starting from 1995 is used. In their research data is provided by three different sources, which makes the comparability of these data questionable. The European Community Household Panel (ECHP) provided data on poverty from 1995 until 2001. From 2004 until now, these data on poverty are provided by EU-SILC (Eurostat). In the intervening period (2001-2005) data was provided by

Table 5*Regression results sensitivity analysis*

VARIABLES	(1) Poverty rate (50%)	(2) Poverty rate (50%)	(3) Poverty rate (40%)	(4) Poverty rate (40%)	(5) Severe deprivation	(6) Severe deprivation
Public pension	-1.944*** (0.399)	-1.931*** (0.423)	-0.714*** (0.200)	-0.713** (0.255)	-0.239 (0.652)	0.249 (1.204)
Total pension	0.931** (0.417)	0.913* (0.478)	0.202 (0.220)	0.111 (0.272)	-1.360 (1.125)	-1.224 (1.117)
Elderly ratio	0.040 (0.210)	0.194 (0.548)	0.179 (0.119)	0.057 (0.271)	0.962** (0.453)	1.189 (0.917)
Unemployment	-0.263** (0.112)	-0.263** (0.120)	-0.063 (0.047)	-0.075 (0.049)	0.214 (0.182)	0.083 (0.156)
Government debt	-0.012 (0.013)	-0.011 (0.013)	-0.005 (0.004)	-0.006 (0.005)	-0.051 (0.056)	-0.055 (0.057)
Social expenditure	0.027 (0.044)	0.018 (0.044)	0.048** (0.017)	0.045** (0.019)	-0.323 (0.253)	-0.286 (0.211)
Ln(GDP)	-0.065* (0.036)	-0.055 (0.044)	-0.019 (0.015)	-0.029 (0.019)	-0.266*** (0.076)	-0.223 (0.134)
Constant	0.837** (0.369)	0.137 (0.087)	0.224 (0.156)	0.361 (0.222)	3.037*** (0.816)	2.500 (1.460)
Observations	242	242	242	242	242	242
R-squared	0.516	0.526	0.299	0.324	0.053	0.091
Number of countries	19	19	19	19	19	19
Country FE	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES

Note. Robust standard errors in parentheses. Columns 1, 3 and 5 include country fixed effects only. In column 2, 4 and 6 country and year fixed effects are used.

***p<0.01, ** p<0.05, * p<0.10

local entities. The main purpose of EU-SILC is international comparability, so it is advantageous for a cross-country study to limit the data on poverty to this source (Eurostat, 2005).

The sensitivity test findings differ from the basic regression's initial results. Furthermore, the sensitivity check findings do not match those of van Vliet et al. (2012) or Jacques et al. (2021). According to both investigations, public pensions are even more effective in reducing poverty than private pensions, when the poverty line is dropped (instead of using 60% of the national equivalized median income, 50% and 40% is used instead). This means that the poverty criterion is tightened, implying that the definition of older people living in poverty is changed and narrowed down to the poorest people. The findings of this study reveal that as the group of older individuals in poverty becomes smaller yet poorer, the redistributive impact declines. No evidence is found that public pensions become more effective than private pensions when the poverty line is lowered, which contradicts van Vliet et al. (2012).

A serious drawback to this limitation of suitable and comparable data is the fact that the number of years that can be included in the study is very limited. For the fixed effect model using panel data, it would have been more beneficial to study more than 13 years. However, due to the lack of data from EU-SILC before 2005, this was not possible.

At first sight, it seems unusual that unemployment has a negative and significant (at a 1% level) relationship with old-age poverty. This can be explained by the use of a relative measure of poverty in old age. Unemployment is used as a proxy for the business cycle of a country, which means that if the level of unemployment rises, the economy deteriorates and the national median income falls. The incomes of older people mainly exist of public pensions and private savings, what is, on average, less sensitive to economic cycles. However, the old-age poverty rate is defined as the proportion of pensioners with earnings below 60% of the median income. This results into a decrease in the number of people living below the poverty line i.e. a decline of the poverty rate.

It should be noted that for this study, the fixed effects model has not turned out to be the most ideal model. Unobserved time-invariant national characteristics are controlled for in the fixed effects model. However, according to Bell and Jones (2014) fixed effects models do not operate well with variables that change very slowly over time. The central issue is whether the explanatory variables may be considered as slowly changing variables. The public pension expenditure has increased with 1,45 percentage point from 8,06% of GDP in 2005 to 9,51% of GDP in 2017. This amounts to an average annual increase of 0.11 percentage point rise on an annual basis. More of a slowly changing to nearly invariant variable is the private pension expenditure variable. Private pension expenditure as a percentage of GDP has increased from 1,16% of GDP in 2005 to 1,42% of GDP in 2017, which amounts to an average annual increase of

0,02 percentage point. A more applicable model might be the random effects model since time-invariant variable effects can be estimated by using this model. However, the random effects model assumes that the effects of each individual are uncorrelated with the explanatory variables. For this research, the random effects model is not the most suited model either since this condition cannot be established in our investigation.

Another limitation is the measure of the independent variable: the at-risk-of-poverty rate. Using a relative measure for the poverty rate, conditional on the national median income, might be considered as a shortcoming in this study, since this kind of measure is very affectable by other economical characteristics that might not have been controlled for. Additionally, using a threshold dependent on the national median equivalized income, makes the rate of old-age poverty very country-specific (Antczak & Zaidi, 2016).

Aside from the public-private pension balance, the institutional design of pension systems is important. Pension system's qualitative aspects, as whether the private pensions are mandatory or not, were not considered. Private pensions are quasi-mandatory in the Netherlands, Sweden, Denmark, and the United Kingdom. A pension system may be classified as quasi-mandatory because when it serves over 90% of the population. A possible differentiation to this study is to make a distinction between countries with mandated occupational and private pension plans and countries without mandatory private elements. As a result of these mandatory factors, the redistributive effect may change significantly. Another issue with this distinction is that the structure of pension schemes varies significantly over time (See appendix B for a comparison of pension schemes of the investigated countries in 2005 and 2017).

7. Conclusion

The purpose of this study was to investigate the impact of public pension expenditure on poverty among the elderly and to examine whether public pensions are more effective than private pensions in reducing old-age poverty. The intention was to extend the model by van Vliet et al. (2012) by integrating several control factors that might have an impact on the poverty rate, which is determined by the national equivalized median income. Furthermore, a new period is investigated with a different group of countries. The main independent variables were the percentages of public and private pension spending as a proportion of GDP. The statistics on pension spending came from the OECD SOCX database, and the data on old-age poverty is provided by EU-SILC. This study includes 19 countries and covered a 13-year period from 2005 to 2017.

The theoretical foundations and assumptions established throughout the analysis were built based on a review of relevant economic theory and literature. Due to the substantial redistributive

effect that is a characteristic of public pensions in particular, economic theory and past research expected that a negative relation between public pension expenditure and old-age poverty would be found. The findings of this study back up this idea. This study supports the theory that public spending on pensions has a stronger redistributive effect. It is found, that spending on public pensions works significantly better in reducing poverty than private pensions. Public spending implies a lower level of poverty among the elderly, which is in line with the first hypothesis. This result is also confirmed by most of the sensitivity checks. Furthermore, there seems to be support for the second hypothesis, as a positive coefficient for total pension expenditure, which is the same as for private pensions, is found.

To ensure the accuracy and reliability of the results, robustness checks are performed. The sensitivity analysis confirms that public pensions are more efficient in alleviating poverty than private pensions. Because of the limitations of this study, additional research into the effects of both public and private pension spending is recommended. A possible differentiation would be to make a distinction between countries with similar pension structures. In addition, a selection of countries that are more comparable in terms of economic and demographic characteristics could also be made. Despite the limitations of this study, the results of this thesis confirm that public pensions are more productive in reducing poverty among the elderly than private pensions. Given the current pension reforms, which are partly caused by the increasing ageing of the population, these findings should be taken into account in policy considerations.

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Appendix A

Table 6

List of countries and abbreviations

Country	Classification ISO 3166-1
Austria	AUT
Belgium	BEL
Czech Republic	CZE
Denmark	DNK
Finland	FIN
France	FRA
Germany	DEU
Greece	GRC
Ireland	IRL
Italy	ITA
Luxembourg	LUX
Netherlands	NLD
Norway	NOR
Portugal	PRT
Slovakia	SVK
Spain	ESP
Sweden	SWE
Switzerland	CHE
United Kingdom	GBR

Note. Countries codes in ISO 3166-1

Appendix B

Table 7.

After-retirement income structure in 2021

Country	First tier			Second tier	
	Targeted	Basic	Minimum	Public	Private
AUT	X			DB	
BEL	X	X	X	DB	
CZE		X	X	DB	
DNK	X	X		DB/DC	DC
FIN	X			DB	
FRA	X		X	DB + points	
DEU	X			Points	
GRC	X		X	DB	
IRL	X	X			
ITA	X			DC	
LUX		X	X	DB	
NLD		X			DB
NOR	X	X		Points	
PRT	X		X	DB	
SVK			X	Points	
ESP			X	DB	
SWE	X			DC	DB/DC
CHE	X		X	DB	DC
GBR	X	X	X	DB	

Table 8.

After retirement income structure in 2021

Country	First tier		Second tier	
	Residence-based	Contribution-based	Public	Private
AUT		Minimum	DB	
BEL		Minimum	DB	
CZE		Basic + minimum	DB	
DNK	Basic + targeted		DC	DC*
FIN	Targeted		DB	
FRA		Minimum	DB + points	
DEU			Points	
GRC	Basic		DB + DC	
IRL		Basic		
ITA			DC	
LUX		Basic + minimum	DB	
NLD	Basic			DB*
NOR	Targeted		DC	
PRT		Minimum	DB	
SVK		Minimum	Points	
ESP		Minimum	DB	
SWE	Targeted		DC + DC	DC*
CHE		Minimum	DB	DB
GBR		Basic		DC*

Note. * Refers to quasi-mandatory pension schemes, this refers to private pension plans that cover at least 85% of their employees. DB: Defined benefit. DC: Defined contribution.

Appendix C

Table 9

Means per country: 2005 - 2017

Country	Poverty rate (60%)	Public pension	Private pension
AUT	15.19	7.785	7.9
BEL	19.25	6.476	4.7
CZE	6.90	3.347	3.133
DNK	13.97	1.57	0.049
FIN	17.91	4.544	0
FRA	10.75	2.528	10.764
DEU	15.20	4.727	2.558
GRC	19.29	39.193	17.138
IRL	17.41	0.482	9.207
ITA	17.82	15.155	1.20
LUX	7.06	7.99	0.119
NLD	7.05	4.973	4.150
NOR	11.82	5.560	0.723
PRT	20.15	12.157	.305
SVK	7.46	6.666	0.406
ESP	19.55	9.687	0.359
SWE	14.30	7.167	2.61
CHE	27.45	6.275	4.774
GBR	20.87	5.830	4.657
Total	15.13	9.01	1.44

Appendix D

Table 10

Extensive regression results with year fixed effects

VARIABLES	(1) Poverty rate (60%)
Public pension	-3.374*** (0.904)
Total pension	2.499*** (0.835)
Elderly ratio	-0.740 (0.626)
Unemployment	-0.439*** (0.106)
Government debt	0.013 (0.015)
Ln(GDP)	-0.100* (0.048)
Social expenditure	-0.080 (0.053)
2006.Year	-0.00188 (0.00586)
2007.Year	-0.00828 (0.00859)
2008.Year	-0.0102 (0.0113)
2009.Year	-0.00643 (0.0116)
2010.Year	-0.00628 (0.0114)
2011.Year	-0.00436 (0.0116)
2012.Year	-0.00637 (0.0139)
2013.Year	-0.00849 (0.0169)
2014.Year	-0.0101 (0.0184)
2015.Year	-0.0117 (0.0201)
2016.Year	-0.00953 (0.0217)
2017.Year	-0.0111 (0.0111)
Constant	1.388*** (0.525)
Observations	242
R-squared	0.590
Number of countries	19
Country FE	YES
Year FE	YES

Note. Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.10

Appendix E

Table 11

Extensive regression results sensitivity analysis

VARIABLES	(1) Poverty rate (50%)	(2) Poverty rate (40%)	(3) Severe deprivation
Public pension	-1.931*** (0.423)	-0.713** (0.255)	0.249 (1.204)
Total pension	0.913* (0.478)	0.111 (0.272)	-1.224 (1.117)
Elderly ratio	0.194 (0.548)	0.057 (0.271)	1.189 (0.917)
Unemployment	-0.263** (0.120)	-0.075 (0.049)	0.083 (0.156)
Government debt	-0.011 (0.013)	-0.006 (0.005)	-0.055 (0.057)
Social expenditure	0.018 (0.044)	0.045** (0.019)	-0.286 (0.211)
Ln(GDP)	-0.055 (0.044)	-0.029 (0.019)	-0.223 (0.134)
2006.Year	-0.000 (0.003)	0.001 (0.002)	0.0123 (0.014)
2007.Year	-0.003 (0.004)	-0.000 (0.002)	0.009 (0.009)
2008.Year	-0.004 (0.006)	0.000 (0.004)	-0.022 (0.030)
2009.Year	-0.001 (0.007)	0.002 (0.004)	-0.028 (0.038)
2010.Year	-0.003 (0.009)	0.003 (0.004)	-0.008 (0.035)
2011.Year	0.000 (0.009)	0.005 (0.005)	-0.020 (0.037)
2012.Year	-0.001 (0.012)	0.005 (0.006)	-0.016 (0.033)
2013.Year	-0.002 (0.014)	0.006 (0.007)	0.017 (0.016)
2014.Year	-0.003 (0.014)	0.007 (0.007)	0.001 (0.021)
2015.Year	-0.008 (0.016)	0.004 (0.008)	-0.003 (0.032)
2016.Year	-0.006 (0.019)	0.008 (0.010)	-0.038 (0.056)
2017.Year	-0.009 (0.021)	0.006 (0.010)	-0.031 (0.051)
Constant	0.137 (0.087)	0.361 (0.222)	2.500 (1.460)
Observations	242	242	242
R-squared	0.526	0.324	0.091
Number of countries	19	19	19
Country FE	YES	YES	YES
Year FE	YES	YES	YES

Note. Robust standard errors in parentheses. The dependent variables in columns 1 and 2 are relative measures of the poverty rate. The poverty thresholds in columns 1 and 2 is set at respectively 50% and 40% of the national median disposable income. The dependent variable in column 3 is an absolute measure of the poverty rate and measures severe deprivation. *** p<0.01, ** p<0.05, * p<0.10