



# Pan-European pension plans as a way to cope with the risks of ageing, automation and new forms of work

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## Abstract

The pan-European personal pension product (PEPP), introduced by the European Union in March 2022, offers a flexible and portable supplementary pension option for individuals across EU member states. The objective of this report is to investigate individuals' willingness to engage with PEPP and its potential impact on voluntary pension plans. The report is divided in two parts: the first investigates the drivers of voluntary pension plans, focusing on mobility and technological change; and the second examines the attitudes towards voluntary portable pension plans. We use microdata from well-established European surveys such as SHARE, EU-SILC, and HFCS and an specifically designed survey of workers (and cross-border workers) in Luxembourg that includes a discrete choice experiment. The report highlights several results. Mobility within the EU27 has increased over time, indicating a future rise in the mobile workforce. SHARE data show that many mobile workers spent five or more years abroad, underscoring the importance of voluntary pensions for this group. EU-SILC data indicate a negative relationship between voluntary pension contributions and being born in another EU country, with higher routine task intensity further reducing contributions due to lower incomes. Demand for portable pension plans depends on the share of foreign-born EU individuals and the development of voluntary pension systems. The results from the new survey in Luxembourg reveal that workers who perceive their jobs as vulnerable to technological change may be more likely to invest in voluntary pensions, with notable gender and age-related differences. The discrete choice experiment indicates that individuals may be willing to accept a higher cost for pension management services if the pension plan is portable across the EU. On average, individuals could accept an additional loss of 3.6% in their pension funds for portability. However, there are also important heterogenous effects.

## 1. Introduction

The rise of non-standard jobs (e.g. part-time work, temporary work, seasonal work, self-employment, and homeworkers), the increasing automation of tasks and the increasing mobility of workers across countries pose a challenge to the future old age security of some workers. In such jobs, pension contributions tend to be infrequent and/or low, and the portability of pension rights (including private voluntary pension plans and corresponding tax treatment) across countries is limited. In this context, the pan-European personal pension product (PEPP) emerges as a potential solution. The PEPP is an initiative of the European Union that aims to provide individuals with a supplementary pension option that offers flexibility and portability across EU member states. It was established to address the challenges faced by workers, in particular by those with non-standard employment arrangements, such as part-time, temporary, or self-employment, who often struggle to access traditional pension plans due to their mobility and varying income levels. The PEPP framework, which became effective in March 2022, allows individuals to contribute to a personal and voluntary pension account that is portable across EU countries. This enables individuals to continue contributing to and accumulating pension savings even if they relocate to a different EU country. The PEPP is not linked to any specific job or employer, providing individuals with greater flexibility and control over their retirement savings.

Recent pension reforms in Europe aim to address the fiscal challenges posed by ageing populations, as highlighted by Castellino *et al.* (2020) and Ebbinghaus (2021). However, Hinrichs (2021) notes that these reforms have not adequately addressed the growing significance of non-standard and highly mobile employment arrangements. In 2017, the European Commission (EC) and in 2019, the Organisation for Economic Co-operation and Development (OECD) released reports advocating for the development of new pension plans that cater to the unique needs of workers in such roles (OECD, 2019). The PEPP is a promising solution to this challenge. However, little has been studied about the willingness and attitudes of workers towards this type of pension product. Hence, it is crucial to examine the preferences of individuals engaged in non-standard jobs to take part in a product like the PEPP and discuss the potential effect of this pioneering pension product on their retirement welfare.

The objective of this report is to address this gap in the existing literature by conducting one of the first examinations of individuals' willingness to take up a pension product with portability. We aim to provide detailed insights into individuals' attitudes and preferences towards embracing this pension product. The analysis focuses on the evolving landscape of employment structures including new forms of work, automation and retirement planning within the European context.

For this purpose, this report is divided in two parts. The first part discusses the features of the private voluntary pension plans and provides an overview of the extent and length of multi-country careers within the EU. We use several well-established EU surveys: the Survey of Health, Ageing and Retirement in Europe

(SHARE), the EU Statistics on Income and Living Conditions survey (EU-SILC), the EU Labour Force Survey (EU-LFS), and the Household Finance and Consumption Survey (HFCS). We characterise industries and occupations where people are most likely to work outside their country of birth. We then go on to discuss the potential implications of a product like the PEPP by relating pension income (state and private/voluntary) and pension wealth to (historical) length of careers outside one's country of birth. This part covers three different analyses.

The first analysis uses SHARE and EU-LFS data to investigate change in mobility over time and cohorts, and concentration of mobile workers in economic activities and occupations today. The second analysis uses two data sources: the EU-SILC data set (2020-2022) and the HFCS from the ECB (2020-2022) to study the determinants of the probability to contribute to the voluntary pension plans. We are especially interested in the influence of routine task intensity (RTI) and being born in another EU country on the incidence to contribute to the voluntary pension plans. Finally, we conducted our own survey (henceforth: WeLaR survey) in April 2024 to study the willingness to take portable pension plans and to investigate the relationship between the taking up voluntary pension plans and technological change. This survey includes a discrete-choice experiment in Luxembourg that allows us to investigate the individuals' attitudes towards portability in pension plans. The data are also useful to provide a fresh perspective on how technological innovation prompts greater interest in securing future financial stability through voluntary pension contributions.

The second part of the report analyses the discrete-choice experiment from our WeLaR survey, which allows us to measure the value individuals assign to the portability feature of voluntary pension plans. This is a distinctive characteristic of the new PEPP. Our aim is to uncover valuable insights into the factors driving or impeding the broader adoption and uptake of pension products like the PEPP. We pay particular attention to the heterogeneity of the effects of the portability attribute in terms of worker demographics such as age, gender, educational background, job status and the degree of automation of occupational tasks. The empirical findings may help us to gain a deeper insight into the factors that influence the adoption of portable pension plans. This will provide policymakers and stakeholders with valuable insights that are essential for promoting the optimal design and implementation of this innovative cross-border pension initiative.

Results of the first part show that mobility within the EU27 has increased significantly over time, indicating a growing share of mobile workers in the future. Data from SHARE reveal that many mobile workers spent five or more years abroad, making voluntary pension private products (VPPP) crucial for them. EU-SILC data indicate a negative relationship between contributing to VPPP and being born in another EU country, with higher RTI also reducing the likelihood of contributions due to lower income. Demand for PEPP depends on the share of foreign-born EU individuals and the development of voluntary pension systems, with Luxembourg and Germany leading. Our survey in Luxembourg shows that workers who see their jobs as vulnerable to technological change are more inclined to invest in voluntary pension plans, with notable gender and age-related differences.



Results of the second part, based on the discrete choice experiment in the WeLaR survey reveals that individuals are willing to accept an average additional loss of 3.6% in their pension funds for portability across the EU. Sub-groups more likely to be mobile in the future, such as non-homeowners, those planning to work abroad, individuals with multi-country work experience, and younger participants, showed a higher tolerance for increased management fees in exchange for portability. Smaller yet significant differences in the willingness to pay for portability were observed across gender, contingent on gender and the existence of a voluntary pension plan.

The rest of the report is organised as follows. Section 2 provides the theoretical framework. Section 3 provides the description of the data sources we draw on. Section 4 presents the analysis on the link between mobility and voluntary pension plans across EU countries. Section 5 presents the analysis in the link between portability and voluntary pension plans using our survey experiment in Luxembourg and its cross-border countries. Section 6 offers a discussion of the findings and concluding remarks.

## 2. Theoretical framework

### 2.1. Mobility, portability and voluntary pension plan

Existing research on the determinants of voluntary pension plans highlights several crucial factors, including demographic, socio-economic, and behavioural influences (Cupák *et al.*, 2019). The income level emerges as a critical determinant, with higher-income individuals more likely to participate due to greater disposable income and financial literacy (Castro-González *et al.*, 2020; Clark & Mitchell, 2022). Occupational characteristics also play a significant role, as those in stable, higher-paying jobs with access to employer-provided occupational pension plans show greater inclination towards voluntary pensions. Behavioural factors such as risk aversion and time preference further impact retirement savings behaviour, with individuals displaying lower risk aversion and long-term orientation more likely to invest (Lusardi & Mitchell, 2018). Additionally, policy frameworks and incentives like tax benefits and matching contributions enhance the attractiveness of voluntary pension schemes, thereby increasing participation rates (OECD, 2018).

Despite this comprehensive understanding, the impact of mobility and the portability of pension plans on voluntary pension plans remains under-researched. Drawing on existing literature, a theoretical argument emerges for investigating the potential link between mobility, portability, and the adoption of voluntary pension plans. Research consistently shows a positive relationship between financial literacy and participation in such pension plans (Castro-González *et al.*, 2020; Clark & Mitchell, 2022; Cupák *et al.*, 2019). Moreover, studies indicate that immigrants often have lower financial literacy levels compared to native-born individuals, influenced by factors like educational backgrounds, language proficiency, and familiarity with host country financial systems (Rostamkalaei & Riding, 2019). In addition, behavioural economics research highlights that features like flexibility and accessibility significantly influence savings behaviour, potentially

making portable plans more attractive to mobile workers (Lusardi & Mitchell, 2011). Integrating these insights, we hypothesise a substantial impact of portability and mobility on the adoption of voluntary pension plans.

## 2.2. Voluntary pension plan and technological change

The impact of technological change on voluntary pension plans remains understudied. Several arguments may be put forward to explain this link. Firstly, technological change, including innovations in smart technology, artificial intelligence (AI), robotics, algorithms, digitalisation, and automation, may increase the attractiveness of voluntary pension plans. This technological dynamic fosters a climate of uncertainty and anxiety, particularly among mid-career and older workers and women who may find it challenging to keep pace with the evolving skill requirements (Alcover *et al.*, 2021). The fear of job displacement and the potential obsolescence of existing skills may prompt individuals to consider to take up a private pension plan, which could be a good product to complement their potentially low pensions calculated with intermittent contributions. Furthermore, these pensions offer flexibility for contributions, are investment-oriented and involve tax incentives.

Secondly, there is evidence in the empirical literature that technological change has an effect on early retirement (Solem *et al.*, 2023; Lakomý, 2023; Casas & Román, 2023) thereby generating a possible impact on participating in voluntary pension plans. Indeed, technological change may result in job displacement and skill obsolescence, leading to an increasing number of workers opting for early retirement as a means of escaping the uncertainties and pressures of a rapidly evolving job market. This may subsequently increase their willingness to take up voluntary pension plans to attenuate the losses of lower pensions due to early retirement.

Finally, the decision to take up pension plans is often influenced by the perception of the plan's complexity or the individual's financial literacy, which may not be sufficient to enable them to make informed financial decisions (OECD, 2018; Lusardi & Mitchell, 2017; Castro-González *et al.*, 2020). The flexibility, control, and advanced financial management tools thanks to technological advancement make voluntary pension plans an attractive option for individuals seeking to navigate the uncertainties of a rapidly changing technological landscape. Advanced financial technologies facilitate seamless enrolment processes, real-time tracking of investments, and access to personalised financial advice through platforms. These tools may facilitate individuals' decisions about their retirement savings, increasing their confidence in managing their financial future.

### 3. Data sources

Data sources on people who have moved within the EU are scarce. Regular EU-wide comparative surveys, such as EU-LFS, EU-SILC and HFCS, contain information on people who were born and/or are citizens of another EU country other than the one they currently reside in. These surveys provide a snapshot of the activities of mobile EU citizens at the time of the survey but little, if any, information on previous movements within the EU (see Sections 3.2-3.4). The fact that these surveys only give current 'mobility status' also implies that the effective sample size of mobile EU citizens is low.

#### 3.1. SHARE

The regular SHARE survey waves share the above mentioned limitations and focus only on persons aged 50+. However, SHARE Wave 3 (2009) and Wave 7 (2018) included a SHARELIFE<sup>1</sup> module asking respondents to recall their complete employment history, including in which country they worked. For each respondent, his or her entire mobility history is available up to the age at the time of the survey. Additional information is available about the industry of employment. The total mobility history is particularly important in the context of the impact of labour mobility on pensions and, therefore, the importance of the PEPP scheme. The retrospective nature of the SHARELIFE module raises some concerns about the data. We only observe 'survivors' in each country. This is less of a problem for younger cohorts (e.g. around the age of 50) but could be an issue for older cohorts. If mortality is related to variables influencing mobility decisions (e.g., chronic illnesses), this could bias our estimate of mobility prevalence. A second issue is that of recall accuracy.<sup>2</sup> For most individuals, living and working in a country other than the one in which they were born is likely a memorable event that can be dated accurately enough for our purposes. However, the recall is likely less accurate for individuals moving many times between countries. We use the SHARELIFE module to look at past mobility, estimate cohort specific mobility and the distribution of years living in another EU country among those persons with mobility experience.

#### 3.2. EU-LFS

The EU-LFS provides harmonised and comparable data on the labour market situation across the European Union and its member states since 2000, covering a wide array of topics including employment, unemployment, education, training, income, and working conditions. The EU-LFS also collects information of country of birth and nationality.

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<sup>1</sup> The SHARE data can be accessed in <https://share-eric.eu/data/>.

<sup>2</sup> There is some evidence that career events are recall with reasonable accuracy Howard (2011).

For our purposes, the EU-LFS has the major advantage of a large sample size. This is important as we are primarily interested in mobile workers, and mobile workers in most EU countries constitute a small share of the number of people in employment. We use the EU-LFS to look at labour mobility by sector and occupation and for the calculation of cohort-specific mobility rates.

### 3.3. EU-SILC

The analysis relies on the Survey of income and living conditions (EU-SILC) database. EU-SILC provides data on individual and households characteristics, all sources of labour and non-labour income, including contributions to the individual private pensions and it is the main data source for poverty, social exclusion and inequality in EU and EU candidate countries.<sup>3</sup> It provides harmonised data to help understand the extent to which the decision to pay for voluntary pension plans depends on whether someone was born in the country where they currently reside and other observable characteristics (e.g. education, age, gender, residence area, employment characteristics, etc.). Additionally, it allows us to determine the impact of technological progress and automation on these trends by integrating the data with other sources. The survey collects data on income and living conditions, as well as occupational data, distinguished by the 2-digit ISCO codes (International Standard Classification of Occupations). Furthermore, the 2-digit ISCO codes are also used to classify the routine task intensity (RTI) variable (see Appendix 4), which allows us to integrate these two datasets. The RTI data is derived from worker-level, survey-based measures of task content within jobs, as described in Lewandowski *et al.* (2022). These assessments highlight the distinctions between routine and non-routine cognitive and manual tasks within different occupations. Importantly, they are consistent with widely used occupation-specific measures based on the O\*NET database,<sup>4</sup> which provides detailed information on job tasks, skills, and abilities across a wide range of occupations.

We use pooled EU-SILC datasets for 24 EU countries and three years: 2020, 2021, and 2022 (there is not available data on private voluntary pensions for Hungary, Romania and Bulgaria). The dependent variable 'contributions to voluntary pension plans' takes a value of 0 if an individual does not contribute to the voluntary pension plan and 1 if an individual contributes to a voluntary pension plan, no matter the contribution amount.<sup>5</sup> The main explanatory variable of interest is EUFOR, which indicates the country of birth to distinguish between citizens living in their birth country and those born in another EU country. In Estonia, Latvia, and Slovenia, there is no distinction in the data between those born in another EU country and those born elsewhere. In Italy, data for voluntary pensions is not available for the year 2020, therefore we used

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<sup>3</sup> <https://ec.europa.eu/eurostat/web/income-and-living-conditions/overview>

<sup>4</sup> <https://www.onetcenter.org/database.html>

<sup>5</sup> The variable of interest in the dataset is PY035. Contributions made to individual private pension plans during the income reference period refer to the pension policies taken out by individual households on their own initiative and for their own benefit, independently of their employers or government and outside any social insurance scheme.

Italian data for 2021 and 2022. Our data sample has in total 420,631 observations, whereas there is 88,569 contributing to the voluntary pension plan.

We also control for other observable characteristics that may influence voluntary pension savings: education, age, sector of economic activity, years of working experience, employment status, gender, presence of children, degree of urbanisation and equivalised disposable household income quintile. The description of variables is provided in Appendix 1. We focus in our analysis on the country of birth and routine task intensity.

### 3.4. HFCS

We exploit the last available wave of the Household, Finance and Consumption survey (HFCS).<sup>6</sup> This is a nationally representative survey implemented in all Eurozone countries every three years that includes detailed information on wealth, portfolio composition, income and a rich set of sociodemographic variables. The central banks of each country are responsible for managing the survey, which is finally disseminated by the European Central Bank. The survey is highly harmonised, which allows for cross-country comparisons. The last publicly available wave is the 4<sup>th</sup> wave, which was fielded between 2020 and 2021. The analytical sample comprises 66,280 working individuals aged 25-59 in 22 countries.

The HFCS asks for all the pension plans to which the adult members of the household are registered. The survey distinguishes pension plans that are: (i) public, (ii) occupational, (iii) voluntary pension scheme, (iv) whole life insurance, (v) other. According to the methodological documents of the survey, voluntary pension schemes are pension plans that are not linked to an employment relationship. Individuals are free to enrol in these plans and choose the conditions without any interference from their employers. In addition, whole life insurance refers to products that include both an insurance component and the accumulation of savings that the policyholder can redeem or borrow against. Standard life insurance is excluded from this definition.

For our analysis, we consider a voluntary pension plan to be a pension plan with a standard savings component, i.e., the plan could be a standard voluntary pension plan or a whole life insurance plan as defined by the HFCS. Furthermore, we only consider plans to which the person is currently contributing.

### 3.5. WeLaR survey on voluntary pension plans, portability and technological change

In addition to utilising European data to examine the relationship between mobility and voluntary pension plans, a new survey was conducted specifically for the present WeLaR report by LISER using Luxembourg

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<sup>6</sup> [https://www.ecb.europa.eu/stats/ecb\\_surveys/hfcs/html/index.en.html](https://www.ecb.europa.eu/stats/ecb_surveys/hfcs/html/index.en.html)

as a case study. Almost 70% of the country's workforce comprising immigrants or cross-border workers. The diversity of Luxembourg's labour force may facilitate labour mobility, but also may be the result of labour mobility, making Luxembourg a particularly pertinent case for elucidating the unexplored relationship between mobility, portability and voluntary pension plans. The online survey was collected in April 2024 from a panel of subjects administered and maintained by the Luxembourg Institute of Socio-Economic Research (LISER). LISER collates and retains contact details of individuals who have participated in other surveys it manages (notably, HFCS, EU-SILC, etc.) and have consented to be contacted for further surveys. The targeted population were individuals aged 25 to 60 who reside in Luxembourg, Belgium, France or Germany and have previously worked in Luxembourg. The survey was announced through a press release and a social media campaign. The sample (1,127 individuals) was randomly collected, but not necessarily is representative of the targeted population. As pointed out by Lehdonvirta *et al.* (2021), such non-probability samples enable quick, cheap, and easy access to individuals but can also suffer from topical and economic self-selection, leading to differences between the sample and the studied population. However, LISER provided calibration weights to ensure that the distribution of key variables are similar between the sample and the targeted population. These variables are country of residence (with a distinction between nationals and foreigners residing in Luxembourg), gender, age and economic activity.

Our dependent variable (Voluntary pension plan) takes value 1 when the individual is entitled to voluntary pension plan(s). The survey also include information about individual characteristics (age, gender, nationality, country of residence, education, size of household, etc.); financial situation, risk aversion, and savings management (self-perceived longevity, self-perceived risk-taking, expected time horizon for savings, intention to move to another country for work, owning a paid house/apartment, etc.); pension plans (old age public pension, private occupational pension, life insurance plan).

The survey results show that 47% of the sample are entitled to voluntary pension plan(s), the average age is 43.5, and 45% of individuals are female. The sample comprises individuals who are from Luxembourg (38.6%), France (26.5%), Belgium (10.2%), Germany (7.2%) and other country (17.4%). See Appendix 2 for variables description and Appendix 3 for descriptive statistics.

### 3.5.1. Portability

The WeLaR survey included a discrete-choice experiment designed to elicit preferences for the portability of voluntary pension savings. Specifically, we asked respondents to choose between two pension plans (each respondent was asked to compare a total of four plans), one of which was portable and the other non-portable. Portability was traded off against differences in management fees randomly assigned, but with fees being larger for the portable pension options. Box 1 provides an example of the text accompanying the choice experiment.

### Box 1. Example text for choice experiment

*Here are two types of voluntary pension plans with different characteristics.  
If you had to decide between them, which would you choose?*

	<i>Plan A</i>	<i>Plan B</i>
<i>The plan is portable across the European Union:</i>	<i>Yes</i>	<i>No</i>
<i>Plan management fees reduce pension savings by:</i>	<i>7%</i>	<i>4%</i>

### 3.5.2. Technological change

Data is collected on the use of technologies and the perceptions of the consequences of technological change. In order to investigate the relationship between technological change and voluntary pension plans, several variables controlling for technological change are employed in the estimation models.

First, we determine the variable 'Sum of digital tools' as the total number of computing devices and computerised machinery used by employees for their main job is reported, including 19 variety of tools such as communication devices, digital handheld devices, computer numerically controlled (CNC) machine tools, robots and 3D printers (see Appendix 2).

Second, we assess employees' concerns regarding the accelerated advancement of smart technology, artificial intelligence, robotics, and algorithms (STARA) in the workplace, using the question 'thinking about the impact of smart technology, artificial intelligence, robotics and algorithms on the future of your job, to what extent do you agree with the following statements?' The answers can be 'I'm worried that my job could be replaced by STARA' and/or 'I'm worried that some of my current tasks could be done instead by STARA'. The answers are recorded on a Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree).

31% of the representative sample indicated that they are not at all concerned about the perspective for their jobs to be replaced by STARA. Conversely, 18.5% of the respondents expressed some level of concern, while 13.6% indicated that they are highly worried about this possibility. Similarly, 25% of the representative sample stated that they are not at all concerned about the potential for their tasks to be replaced by STARA. 14% of the respondents reported some level of concern, while 33.4% indicated that they are highly worried about this possibility. In general, respondents expressed greater concern about the potential for their tasks to be replaced by STARA than about their jobs being replaced.

Finally, we employed a self-report measure of the impact of technological change on primary job tasks. This was achieved through the use of the following question: The respondents were asked to indicate their level of agreement with a series of statements regarding the computer or computerised machinery they used in

their main job. The responses are recorded on a Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). Three variables were constructed.

1. *Technological change - doing different or new tasks*: reflecting whether employees are currently performing different or novel tasks.
2. *Technological change - doing tasks faster*: indicating whether employees are completing some tasks at a faster pace than before.
3. *Technological change - stopped performing certain tasks*: capturing whether employees have ceased performing tasks they previously did.

The data shows that 54% of respondents agree (and strongly agree) that they are currently engaged in tasks that are either different or novel in nature due to the implementation of new computer programs, software, or computerised machinery. 62% reported that they are completing tasks at a faster pace than before, and 48% have ceased undertaking tasks that they previously performed.

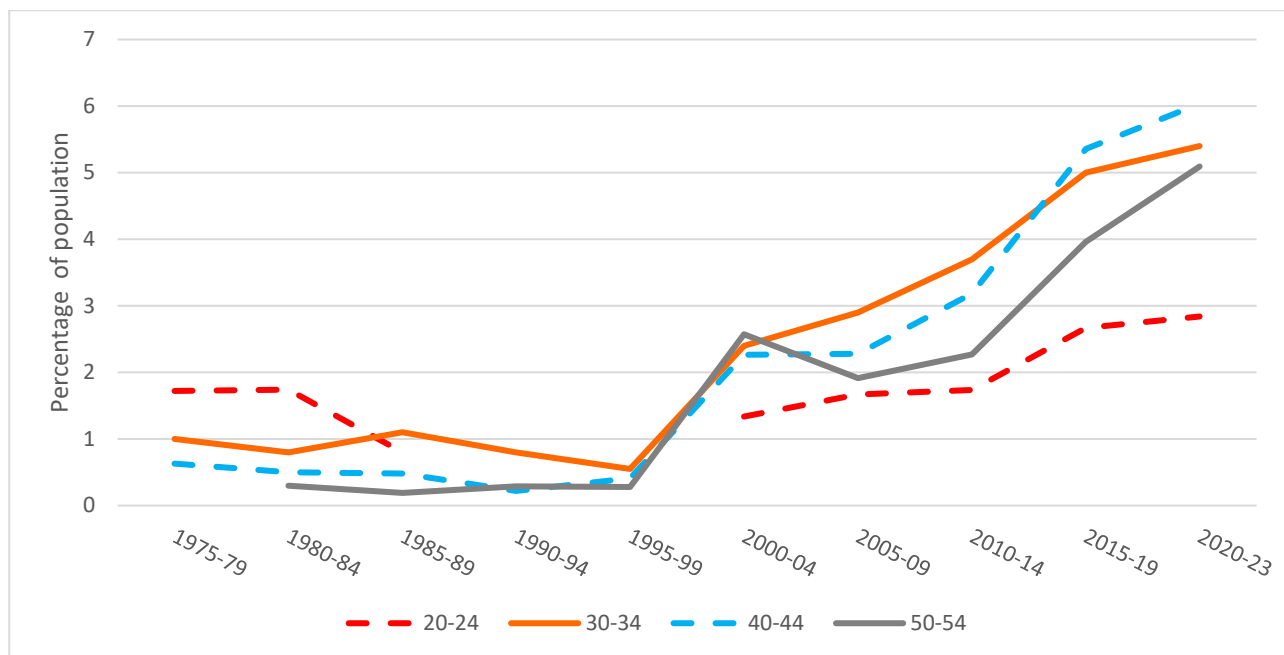
## 4. Mobility, technological change and voluntary pension plans across EU countries

### 4.1. Increase in intra-EU mobility

The share of people living in another EU27 country than the one they were born in has increased sharply for all age groups in the working-age population over the past two decades (Figure 1). For all age groups, there was an increase in mobility in the period from 1995-99 to 2000-04 related to the accession of 10 new member states in 2004. Since then, the share of people living in another EU country has kept rising.



**Figure 1.** Share of people by age group living in another EU country than the one they were born in (EU27)—annual average over 5-year intervals



*Note:* The figure shows the percentage of people in each age group living in another EU country (EU27) other than the one they were born in. Annual average over each 5-year interval. Data is not available for the 20-24 year-olds in the periods 1990-94 and 1995-1999.

*Source:* Eurostat, EU-LFS (table: lfsa\_pgacws) for data from 2000-04. SHARELIFE (Share wave 7) for the period 1975-1999

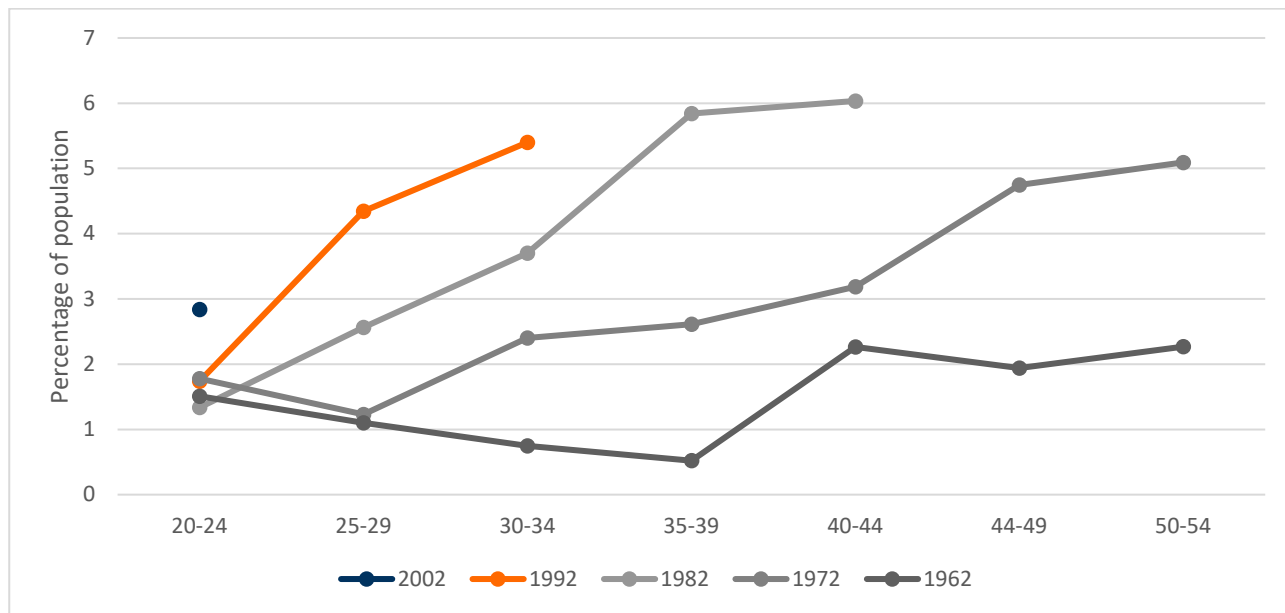
Based on cohort-specific mobility rates, each European can expect to live - on average - around 1.5 years in another EU country from the age of 20 to 55, an increase from 0.5 years in 2002. However, for each birth cohort, more people spent time outside their country of birth at a given age than in the previous cohort, implying that the cohort born in the five-year interval between 2000 and 2004 will likely, on average, spend several years outside their country of birth (Figure 2).

Concerning voluntary pension plans, looking at the distribution of years people spend in another EU country is interesting. If the number of years spent outside one’s country of birth is equally distributed, such that most people spend, say, one or two years working in another country, the impact of voluntary pension plans would be benign. On the other hand, if a sizable share of mobile workers works five or more years in a different country than the one they retire in, and if portable voluntary pension plans options are missing, this could impact the size of voluntary pension plans at pension age.

No harmonised EU-wide data set has year-by-year information on how many years respondents have been outside their country of birth. However, through the retrospective questions in the SHARELIFE module of the SHARE survey, we can see the historical distribution of years working in another EU country (Figure 3). For the group of people aged 61-75 in 2017 (the survey year of SHARE wave 7) having lived in another country

for at least one year, around 50 per cent stayed for 5 or more years. For this group of people, barriers to voluntary pension plans could result in lower pension wealth at the time of retirement.

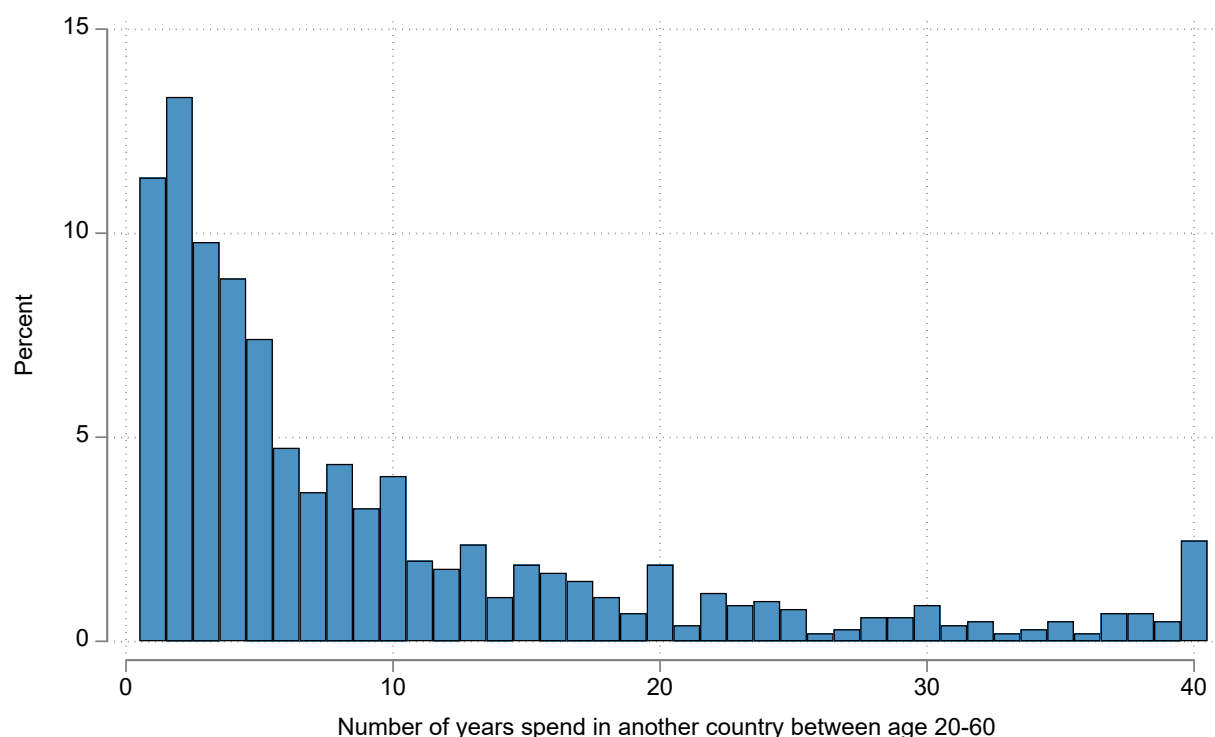
**Figure 2.** Share of people by age group living in another EU country than the one they were born in (EU27) by cohort—annual average over 5-year intervals]



*Note:* The figure shows the percentage of people in each of the five cohorts living in another EU country (EU27) other than the one they were born in at different ages. Annual average over each 5-year interval.

*Source:* Eurostat, EU-LFS (table: lfsa\_pgacws) for data from 2000-04. SHARELIFE (Share wave 7) for the period 1975-1999

**Figure 3.** Distribution of years living in another EU27 country between the ages of 20 and 60 years (61-75 year olds)



*Note:* The figure shows the distribution of years spent living abroad for the sample of people who have lived at least one year in another EU27 country.

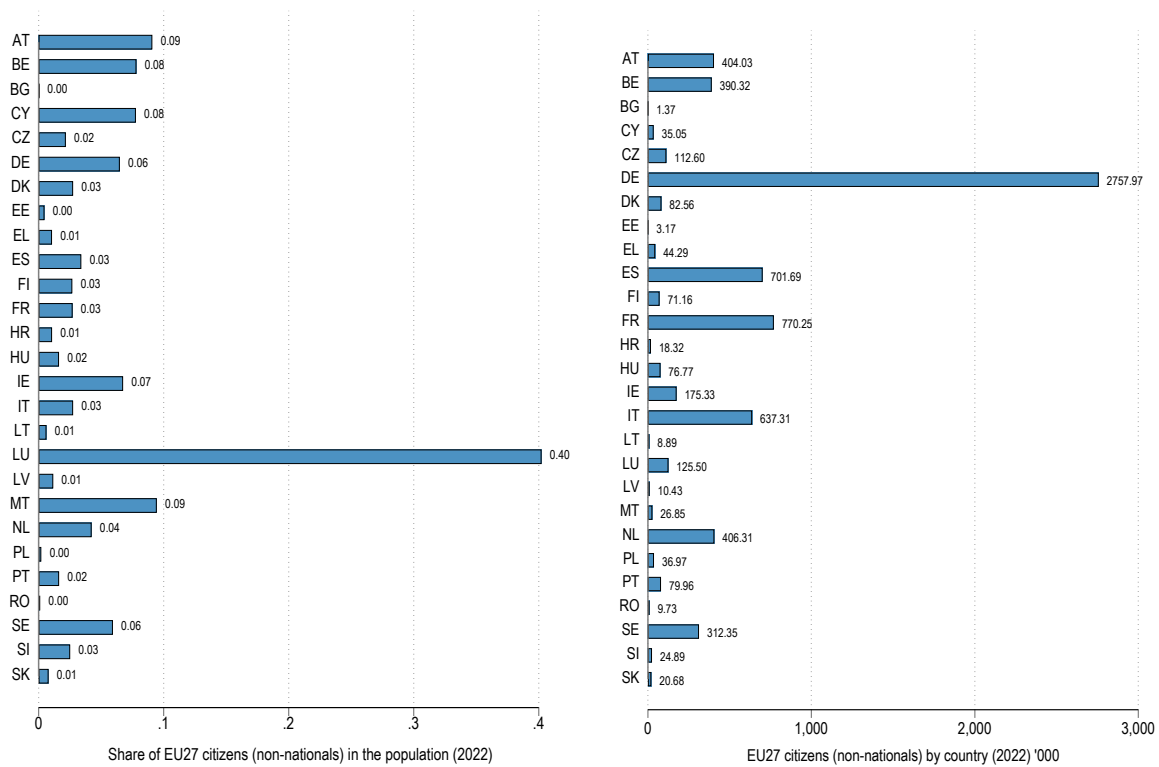
*Source:* SHARELIFE (SHARE wave 7). Persons born between 1942-57

#### 4.1.1. Sectoral and occupation differences in labour mobility

In 2022, 3.6% of the EU27 population were EU27 nationals who lived in a country other than the one they were born in. The share of EU27 nationals differs across countries (Figure 4). Except for Luxembourg, where the share is 40%, the share is below 10% in all other countries. The share is highest in Austria and Malta (9%) and Belgium and Cyprus (8%). In terms of the absolute number of EU27 nationals working in another EU country, the large countries (Germany, France, Italy and Spain) also have the largest number of EU27 nationals working there. Germany has around 2.7 million employed EU27 nationals. Austria, Belgium, the Netherlands and Sweden also have sizeable populations of EU27 nationals in terms of absolute numbers.

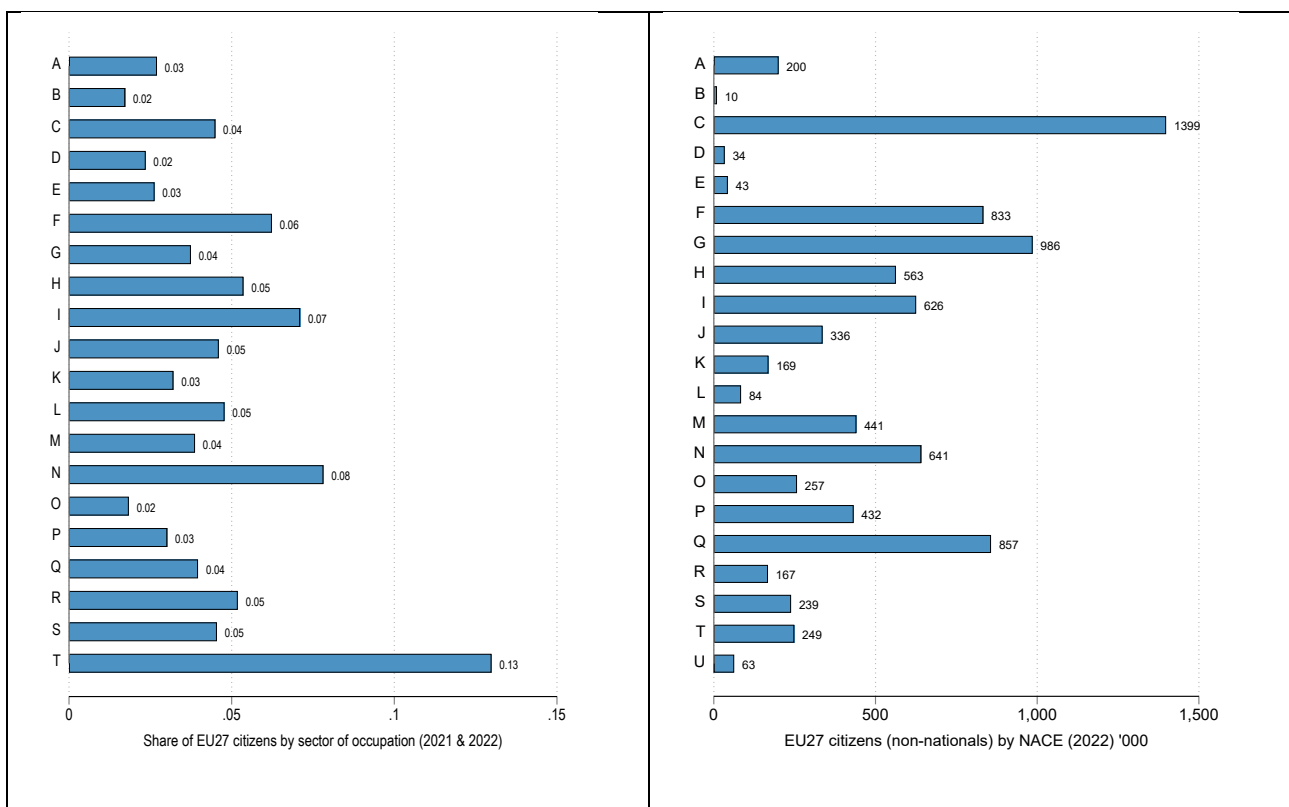
Mobile workers are employed in all sectors of the economy in EU27 (Figure 5). Their share of employment, however, remains low (less than 10 per cent) in most sectors. Exceptions are the sectors of 'Activities of household as employers (Nace T)' (13%) and 'Activities of extraterritorial organisations and bodies (Nace U)' (40%, not shown in the figure). Economic sectors differ in terms of employment numbers, and it is therefore of interest to look at absolute number of mobile workers in each sector across EU27 (Figure 5, right graph). The most important sectors in term of number of employees are manufacturing (Nace C), wholesale and retail trade (G), human health and social work activities (Q), and construction (F). In total, these four sectors employ around half of all mobile workers across EU27.

**Figure 4.** Share and total number of other EU country nationals in each EU country (2022)



Source: EU-LFS 2022

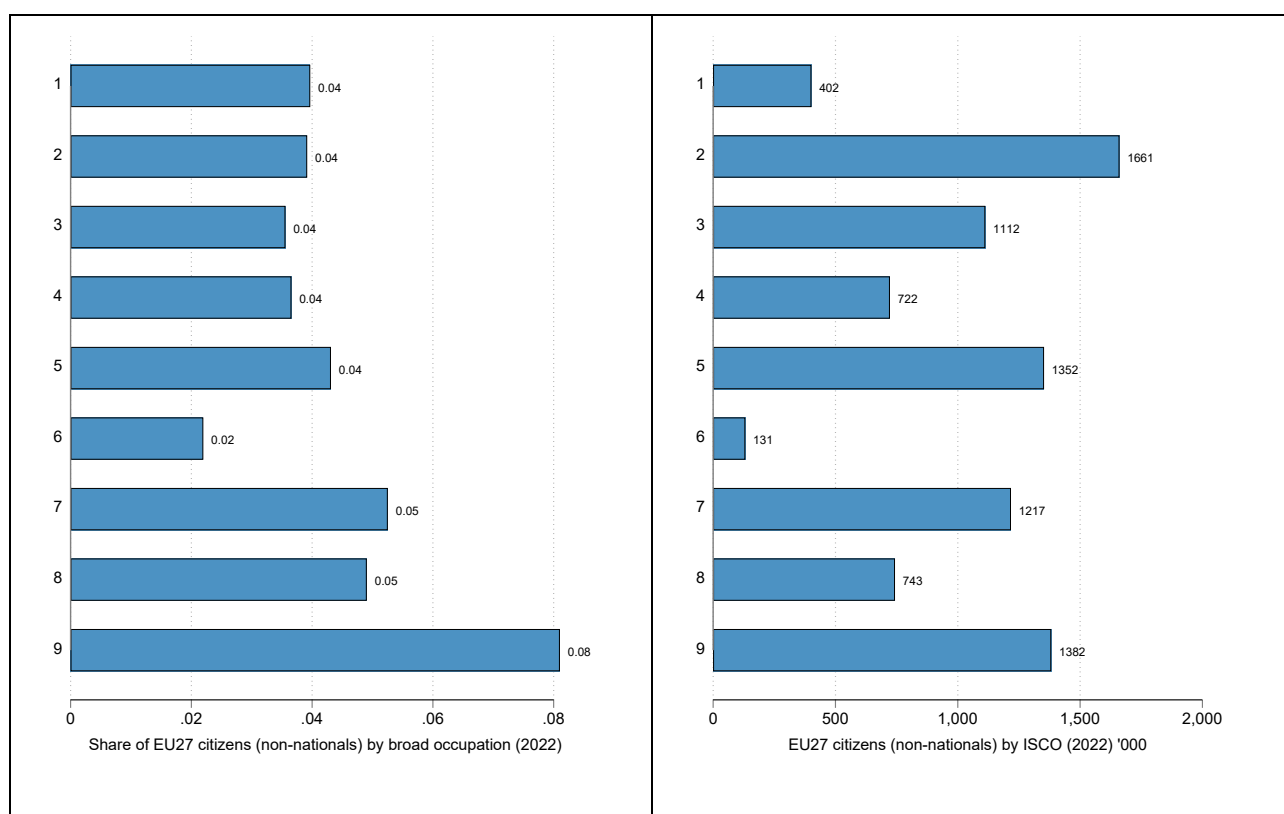
**Figure 5.** Share and total number of other EU country nationals by economic sector (2022, EU27)



Source: EU-LFS 2022

Looking at the share of mobile workers in broad occupational categories (ISCO 1 digit), we find that mobile workers are roughly equally distributed among occupations (Figure 6). The exceptions are a lower share of 'Skilled agricultural, forestry, or fishery workers (ISCO 6)' and a higher share of mobile workers in 'Elementary occupations (ISCO 9)'. In terms of absolute numbers of workers, the most important occupational group is 'Professionals (ISCO 2)', followed by workers in 'Elementary occupations (ISCO 9)', and 'Service and Sales workers (ISCO 5)'.

**Figure 6.** Share and total number of other EU country nationals by broad occupation (ISCO) (2022, EU27)



Source: EU-LFS 2022

## 4.2. Mobility and voluntary pension plans in the EU

In this section, we investigate the association of workers' mobility and voluntary pension plans in the EU (see Sections 3.3 and 3.4). Two data sources were drawn upon: the EU-SILC data set and the HFCS from the ECB.

### 4.2.1. Results from EU-SILC

By examining harmonised data on income and living conditions, and occupational details - distinguished by the 2-digit ISCO codes - we aim to understand how the country of birth and the routine task intensity (RTI)

of one's occupation are associated with voluntary pension contributions. We assume that countries with a higher share of EU foreign born workers will be leaders in the contributions to the Pan-European Pensions Plans (PEPP). Additionally, if a significant share of workers contributes on a voluntary basis to the voluntary pensions in a current country of residence, workers may observe PEPP as a substitute for the current system, especially if they plan to move inside Europe for a longer time span. Therefore, exploring the relationship between contributing to voluntary pension plans and country of birth reveals potential demand for PEPP. RTI changes shape current and future work and, consequently, the welfare state. By exploring the association between RTI and voluntary pension contributions, we aim to uncover insights into how working in occupations with higher RTI is associated with different income levels and indirectly individuals' decisions to engage in retirement planning. Since occupations with high RTI are typically lower-paid occupations, we assume that the association between RTI and voluntary pension plan contributions is negative due to the negative income effect. Individuals in occupations with lower RTI, typically associated with more cognitive and non-routine tasks, might have more stable and potentially higher incomes. Consequently, they may feel more financially secure and less compelled to contribute to voluntary pension plans.

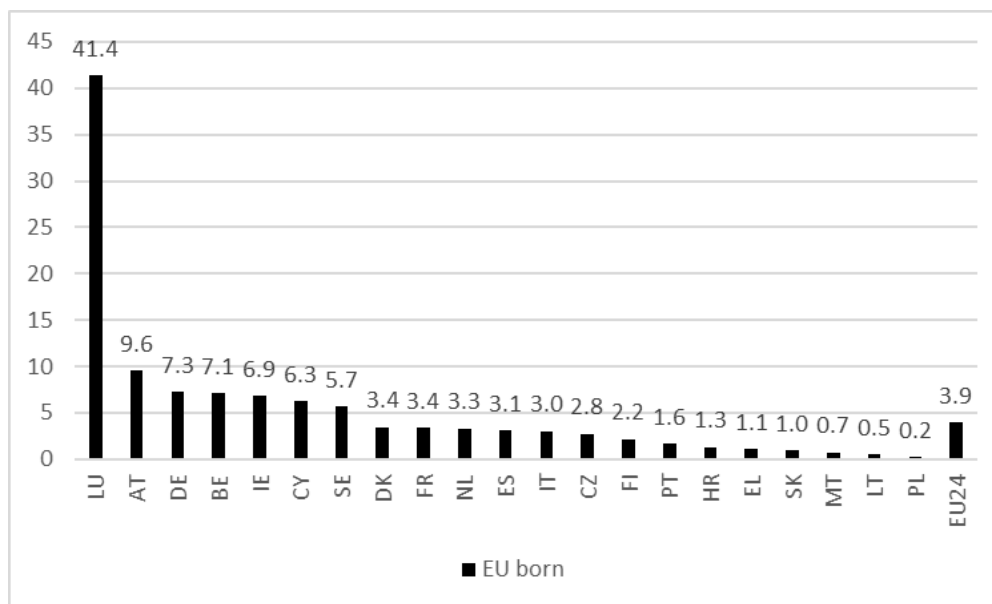
The study spans over three years (2020–2022) and 24 countries and focuses on two main independent variables: EUFOR, which distinguishes between individuals born in their current country of residence and those born in another EU country, and RTI, reflecting the intensity of routine tasks in their occupations (see Appendix 4). Using a Probit model, which is suitable for the binary nature of the dependent variable, we estimate the likelihood of individuals contributing to voluntary pension plans. This comprehensive approach allows us to assess the broader implications of technological progress and automation on pension contributions and provides insights into the role of birthplace and occupational characteristics in financial decision making.

### Labour mobility

In the total population, the percentage of individuals born in a foreign country, specifically another EU country, is very low both in the entire sample and in most individual countries (Figure 7). Only 3.9% of the total population was born in another EU country. Additionally, in some countries - Estonia, Latvia, and Slovenia - a different definition of the variable is applied, reporting only whether or not an individual was born in the country where they currently reside, without specifying if the country of birth is an EU or non-EU country. Luxembourg stands out with an exceptionally high share of foreign, EU-born individuals in the sample, exceeding 40%. Other countries with a relatively high percentage of foreign, EU-born individuals include Austria (9.6%), Belgium (7.1%), Cyprus (6.3%), Germany (7.3%), Ireland (6.9%), and Sweden (5.7%).

In the remaining countries, this percentage is below four and even below one percent in certain countries, such as Poland, where the percentage of foreign, EU-born individuals is only 0.2%.<sup>7</sup>

**Figure 7.** Percentage of foreign EU-born individuals



Source: Authors' calculation based on EU-SILC data

We restrict our sample to employed persons aged 25–59 years in the analysis. The number of observations for voluntary pension contributions and EUFOR by countries are presented in Appendix 1. The share of those contributing to the voluntary pension plan is low in Cyprus, Greece, Croatia, Italy, Poland, Portugal and Sweden, less than 10%. However, in the Czechia and Belgium, the share amounted to 60%, and it is around 50% in Germany and 40% in Austria. Significant variations are observed between local-born, i.e. natives and those born in another EU country. In the pooled sample, 21.9% of local-born individuals pay contributions to voluntary pension plans, compared to 16.4% among those born in another EU country. In Austria, 43% of local-born individuals and 27% of EU-born individuals pay contributions to voluntary pension plans. In Belgium, this disparity is more pronounced, with 64% of local-born individuals and 30% of EU-born individuals contributing to voluntary pension plans. Significant differences are also observed in Germany, where 51% of local-born individuals and 23% of EU-born individuals pay into voluntary pension plans, and in the Czechia, with 60% and 47%, respectively. A lower difference, but statistically significant, is also observed in Spain, Finland, France, Ireland, Italy, Malta, Netherlands and Portugal. Conversely, in many countries, such as Greece, Cyprus, Croatia, Poland, and Sweden, the shares of individuals paying contributions to voluntary

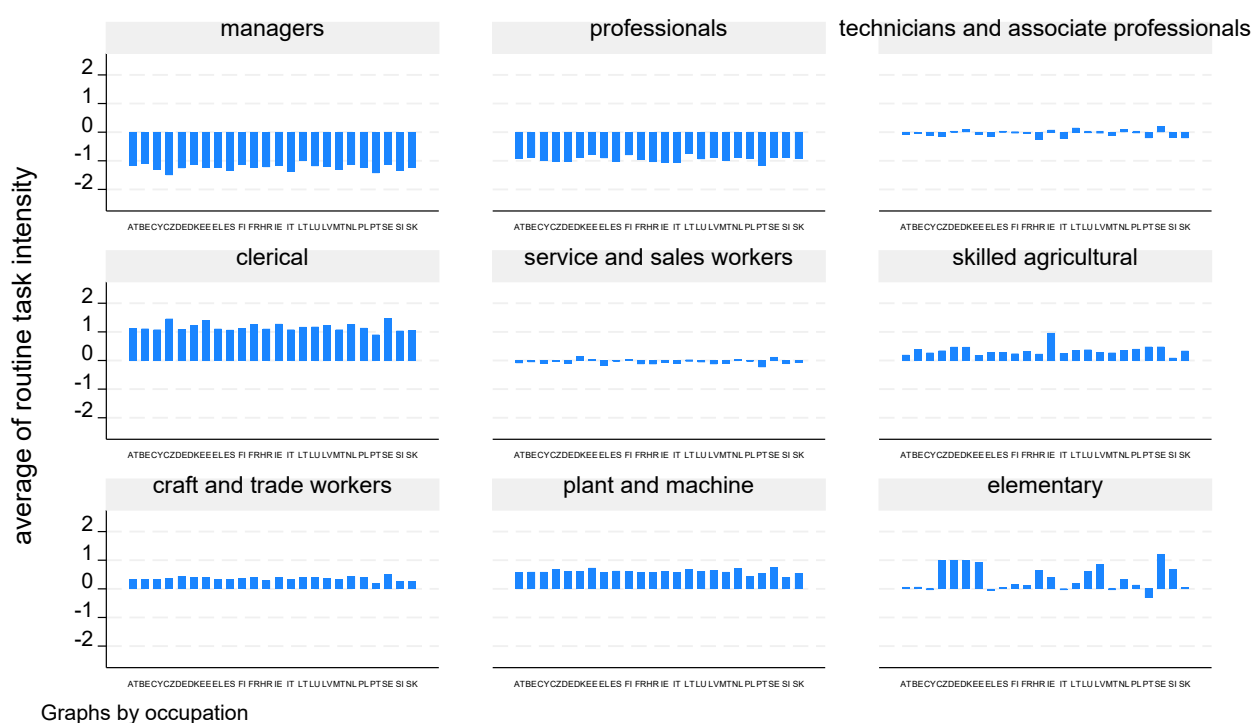
<sup>7</sup> Note that data on Figure 4 and Figure 7 differ since the data are from different sources. Figure 4 is LFS and Figure 7 SILC data.

pension plans are very low.<sup>8</sup> Although contributions to the voluntary pension plans are generally low in Italy, there is a statistically significant difference between local and EU-born individuals.

### Routine task intensity

In order to investigate the association between RTI and VPPP, we first investigate the differences between countries in RTI by occupations. The lowest RTI in all countries is observed by managers and professionals (Figure 8). The occupations with the highest risks of automation are clerical support workers and plant and machine operators and assemblers. The most variations are observed among elementary occupations between countries, with the high average RTI being observed in Sweden, Czechia, Denmark, Germany and Estonia. In Ireland, we observe a high average RTI among skilled agriculture, forestry and fishery workers.

Figure 8. Average RTI by occupations and countries



Source: Authors' calculation based on O\*NET database. See Appendix 4 for RTI source

The highest share of people employed in occupations with low RTI is observed in the Netherlands, where 45% of employed is among managers and professionals. A high share of managers and professionals is also observed in Denmark, Lithuania and Belgium, 41–42%. The lowest share is observed in Slovakia, around 20%. Poland has the highest share of plant and machine operators, assemblers, skilled agriculture and elementary occupations. Therefore, the risk of automation in the labour market is the highest in countries

<sup>8</sup> The appropriate interpretation of these differences requires deeper understanding of the legal and organisational differences in the pension systems in different countries, which is not the aim of this study.



where a significant share of workers is concentrated in plant and machine operators, assemblers, skilled agriculture and elementary occupations.

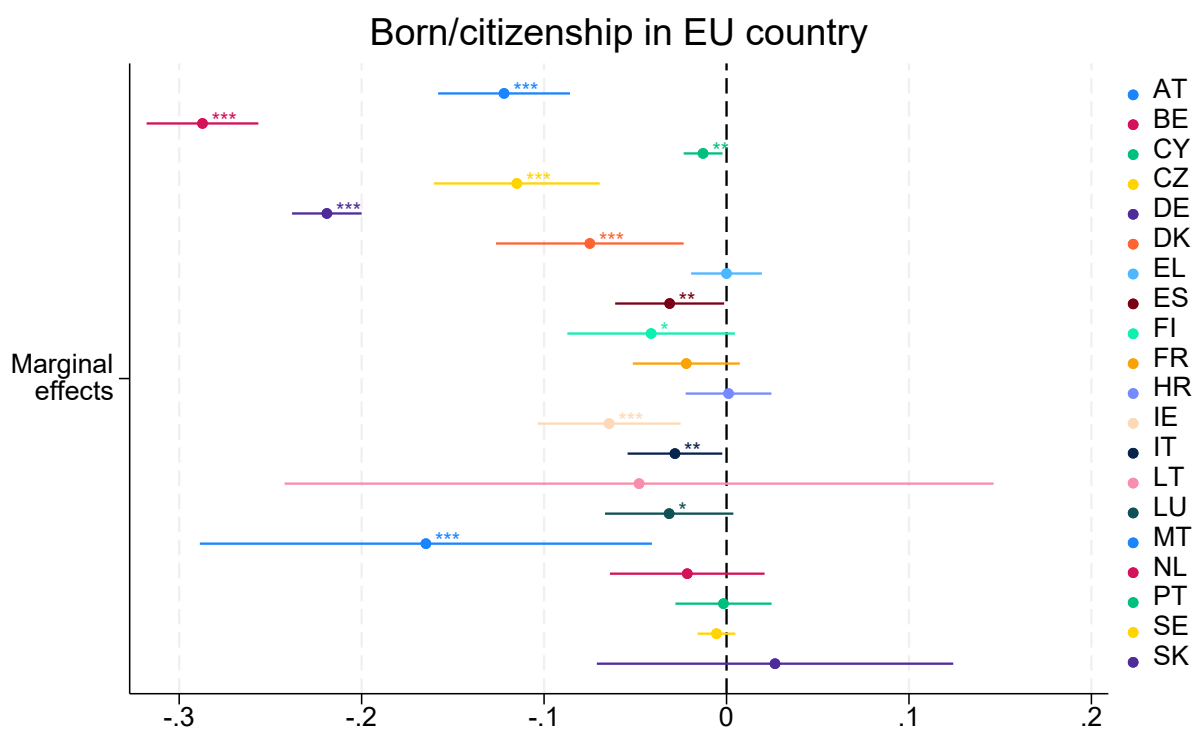
Differences in the contributions to VPPP are observed between the age groups and education groups, as well as between the countries. A quarter of employees in age groups 50–54 and 55–59 contribute to voluntary pension plans. Among employed with high education levels, 25% contribute to VPPP, compared to only 10% among low educated. Although the difference in proportions in contributing to the voluntary pension plans is small between self-employed and employees, it is statistically significant. Significant heterogeneity is observed among countries. For example, in Denmark and the Netherlands, the share of self-employed contributing to voluntary pensions is 25 percentage points (pp) and 28 pp lower compared to those employed, respectively. In Slovakia, the share of self-employed is higher than the share of employed, for 18 pp. As expected, the share of voluntary pension plan contributions is the highest among those living in households in the fourth quartile of equivalised disposable household income.

#### [Impact of mobility and RTI on voluntary pension savings](#)

We investigate the association between contributing to the voluntary pension plan and EUFOR variable (EU if the country of birth is another EU country and local if the country of birth corresponds to the country of residence) and RTI (see measure of RTI in Appendix 4). Since our dependent variable - contributions to voluntary pension plans - is binary, we use a Probit model. We analyse the likelihood of individuals contributing to voluntary pension plans based on their country of birth and the RTI of their occupation. We estimate marginal effects, in order to quantify the marginal contribution of covariates on the probability to pay voluntary pensions. We control for other explanatory variables and year dummies.

Figure 9 shows the impact of the country of birth on the decision to contribute to a VPPP in case the country of birth differs or not from the country of residence. Even though variations are present among the countries, in general, the marginal effect is negative, meaning that if an individual is born in another EU country other than their country of residence, the probability of contributing to a voluntary pension plan is smaller. Marginal effects are near 0 and not statistically significant for several countries, including Greece, Croatia, Portugal and Sweden. The marginal effects are significant and negative for the majority of countries, namely, Austria, Belgium, Czechia, Germany, Denmark, Ireland, and Malta. Therefore, controlling for other observable characteristics the difference in paying contributions between EU and local born individuals does not change for most of the countries comparing with results of descriptive statistics (see Appendix 1). The only country with a positive marginal effect is Slovakia, although not statistically significant.

Figure 9. Marginal effects of probability to contribute to the VPPP for the EUFOR variable

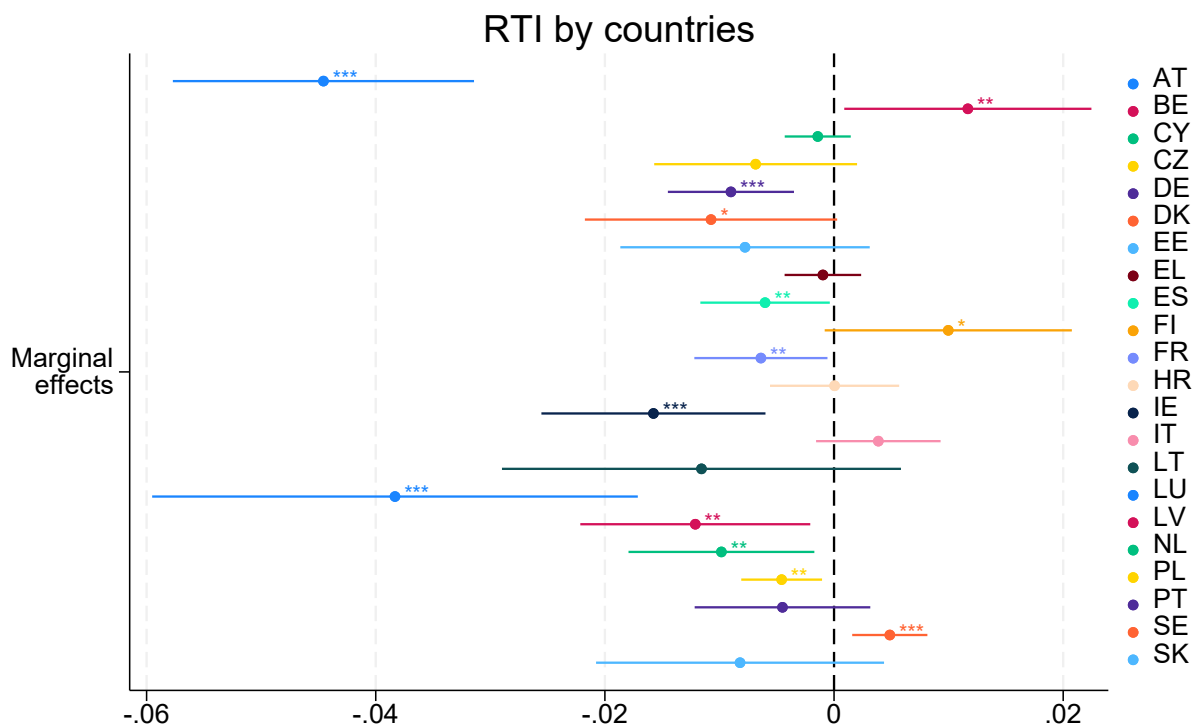


Note: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001.

Source: Authors' calculation based on O\*NET database. See Appendix 4 for RTI source

The picture is different and more diverse when it comes to the marginal effect of RTI variables (Figure 10). The marginal effects are mostly negative, which means that the probability of contributing to a VPPP decreases with an increase in the value of the RTI index, which is in line with the initial assumption on the negative income effect. Marginal effects are negative and significant for Austria, Germany, Denmark, Spain, France, Ireland, Luxembourg, Latvia, Netherlands, and Poland. On the contrary, the marginal effects are positive and statistically significant for Belgium, Finland, and Sweden. In these countries, the probability of contributing to a voluntary pension plan increases with an increase in the value of the RTI index.

Figure 10. Marginal effects of probability to contribute to the VPPP for the RTI variable



Note: Data is not available for Malta and Slovenia because the ISCO classification was expressed in one-digit units.  
 Source: Authors' calculation based on O\*NET database. See Appendix 4 for RTI source

In summary, the findings show that individuals born in another EU country than their country of residence generally have a lower probability of contributing to voluntary pension plans. This negative marginal effect was statistically significant in several countries. We may assume that those born in another EU country (other than the country of current residence) do not contribute to the voluntary pension plans but will have the incentive to contribute to the Pan-European Pension Plans due to its portability. The impact of routine task intensity (RTI) on pension contributions presents a more complex and varied picture. Predominantly, the marginal effects are negative, indicating that an increase in RTI generally correlates with a lower probability of contributing to a voluntary pension plan. This trend is statistically significant in over half of the sampled countries. However, there are notable exceptions where the marginal effects are positive and significant, suggesting that in these countries, higher RTI is associated with an increased likelihood of voluntary pension contributions.

A low number of observations for contributions to voluntary pension plans and/or EU-born individuals observed in EU-SILC data for some countries is a significant constraint of this research. Countries having a negligible share of EU-born individuals (outside the current country of residence) are, in general, not target countries for Pan-European Pension Plans. Also, countries that do not have developed voluntary pension systems are less likely to embrace the Pan-European Pension Plan, at least in the short run, since it takes time to change preferences towards voluntary pensions as a saving instrument.

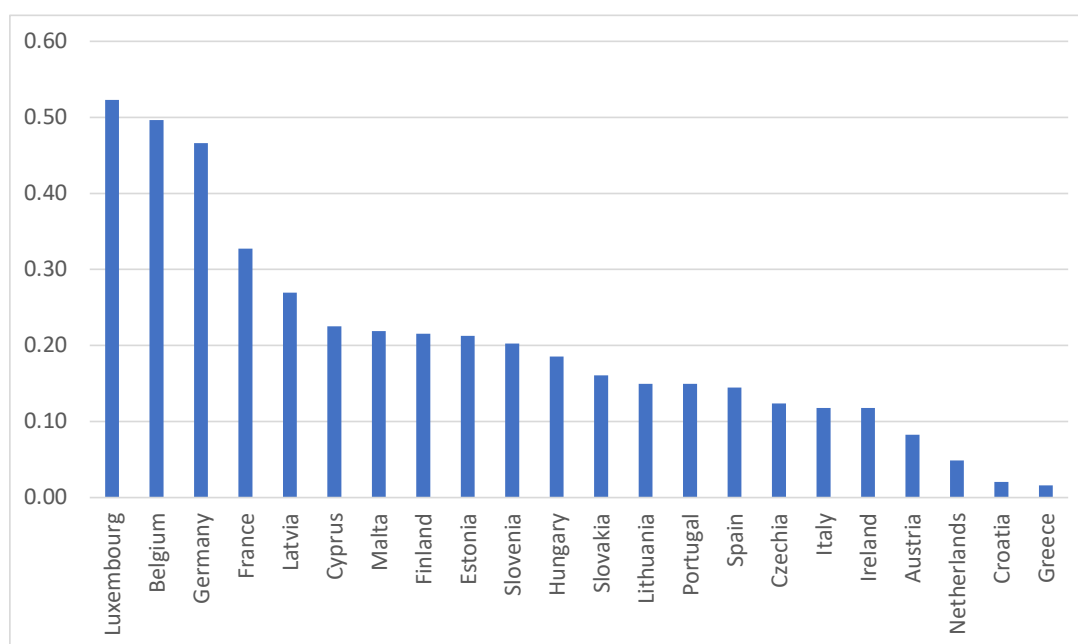
## 4.2.2. Results from the HFCS

We exploit the pooled cross-sections of all 22 countries participating in the fourth wave of the HFCS. We employ Probit model regressions to estimate the predictors of participating in a pension plan product. The dependent variable takes value one if the person contributes to a voluntary pension plan product and takes value zero otherwise (see Section 3.5). The regressions include country fixed effects and survey weights. The standard errors are clustered by country.<sup>9</sup>

### Impact of mobility and routine task intensity on voluntary pension plans

Figure 11 illustrates the proportion of working individuals contributing to a voluntary pension product across countries. Luxembourg, Belgium, and Germany stand out as the countries with the highest incidence of participation in pension plans among the countries studied (47-52%), while Croatia and Greece show the lowest incidence at 2%.

**Figure 11.** Share of employed people aged 25 to 59 contributing to voluntary pension products



*Note:* The figure shows the proportion of working individuals aged 25-59 who contribute to a voluntary pension product, comprising standard voluntary pension plans and whole life insurance plans (which encompass both an insurance component and the accumulation of savings). The data are drawn from the fourth wave of HFCS (2020/2021).

Table 1 presents the estimated marginal effects of Probit regression models. The first model specification includes the main covariates of the analysis. We have taken advantage of the survey's household wealth variables to include them in the second model. Given that there is no substantial difference in the estimated

<sup>9</sup> The HFCS includes five sets of variables, which are also considered in the estimation of descriptive statistics and regressions.

coefficients between the two specifications, we have opted to use the second model to gain further insight into the role of household wealth.

**Table 1.** Determinants of contributing to voluntary pension products

Variable	Mg. Effects	S.E.	Mg. Effects	S.E.
Female	-0.009	(0.010)	-0.010	(0.009)
Age 30-34	0.041***	(0.013)	0.040***	(0.015)
Age 35-39	0.079***	(0.015)	0.080***	(0.016)
Age 40-44	0.087***	(0.019)	0.078***	(0.020)
Age 45-49	0.092***	(0.020)	0.073***	(0.021)
Age 50-54	0.086***	(0.027)	0.056**	(0.028)
Age 55-59	0.078**	(0.032)	0.043**	(0.031)
Married	0.020***	(0.007)	0.003	(0.006)
Education: Medium	0.075***	(0.009)	0.049***	(0.006)
Education: High	0.100***	(0.010)	0.051***	(0.016)
Born in other EU country	-0.101***	(0.020)	-0.087***	(0.018)
Born in a non-EU country	-0.154***	(0.033)	-0.114***	(0.028)
Labour experience	0.003***	(0.000)	0.003***	(0.001)
Self-employed	0.044***	(0.014)	0.014	(0.012)
Routine Task Intensity (RTI)	-0.055***	(0.006)	-0.032***	(0.006)
Household size	-0.005**	(0.002)	-0.014***	(0.003)
2nd wealth quintile			0.101***	(0.012)
3rd wealth quintile			0.136***	(0.015)
4th wealth quintile			0.187***	(0.015)
5th wealth quintile			0.246***	(0.015)
R2	0.167		0.191	
Observations	66,280		66,280	

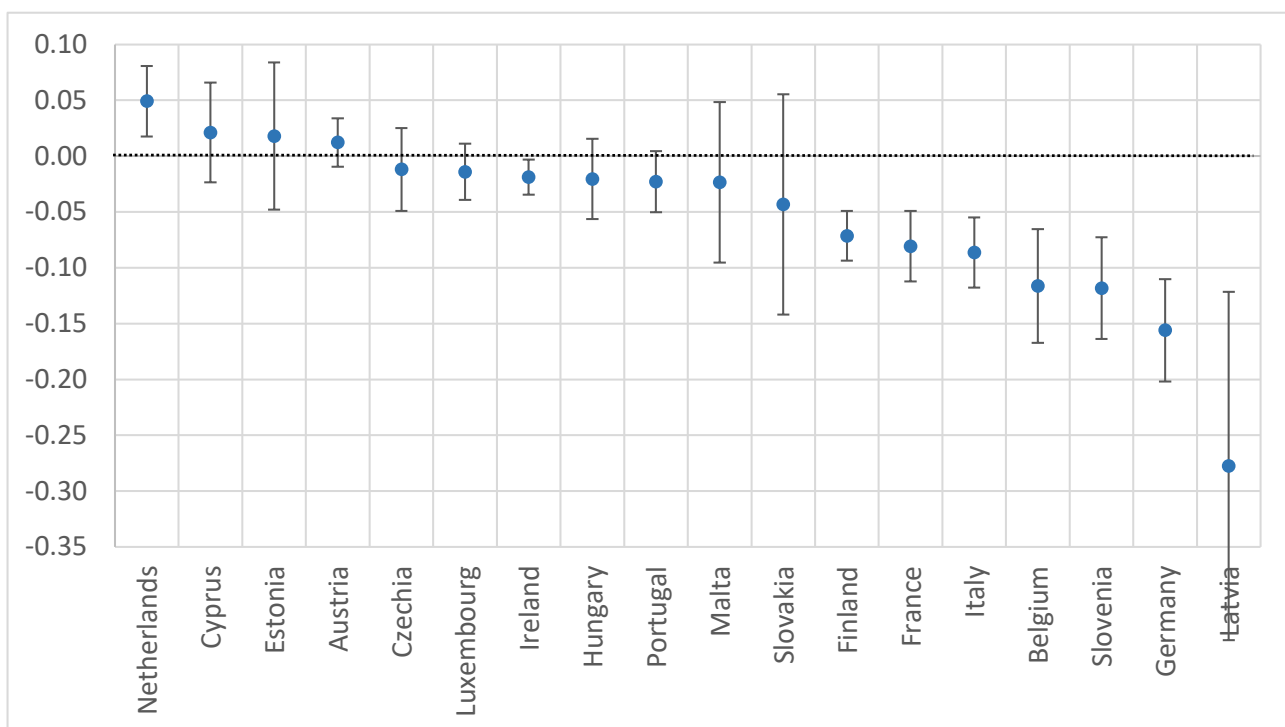
*Note:* The data are drawn from the wave 4 of HFCS (2020-2021) and include 22 European countries whose currency is the Euro. The dependent variable takes value one if the individual contributes to a voluntary pension plan or a life insurance saving product and takes zero otherwise. The coefficients are the marginal effects evaluated at means from Probit regression models. All regression models include country fixed effects and utilize survey weights. Robust standard errors are in parenthesis and are clustered at the country level. \* $p < 0.1$ , \*\* $p < 0.05$ , and \*\*\* $p < 0.01$  indicate significance levels. The reference value for education is low education (lower secondary, primary or none). The reference value for country of birth is the surveyed HFCS country. The 25-29 age group and the first wealth quintile are the reference values for the age groups and the wealth quintiles.

Our findings indicate a positive correlation between age and the propensity to contribute to voluntary pension plans. However, the relationship exhibits an inverted-U shape. The probability of contributing first increases with age, but declines for older groups. Those with higher levels of education are more likely to contribute to pension plans. Individuals born abroad (as opposed to being a native) have a lower probability of contributing; the reduction is larger for individuals born in a non-European country than for individuals born in a European country. There is a positive association between the number of years of total labour experience and the probability of pension plan contribution. This is to be expected given the positive relationship between experience and income. In the first model specification, self-employment status is statis-

tically significant and positively related to the probability of pension plan contribution. However, this is not the case in the second specification when we add wealth. As self-employment is often correlated with wealth and income, it is possible that our wealth variables are reducing the explanatory power of being self-employed. As anticipated, RTI is negatively correlated with pension plan contribution, as jobs with a higher intensity of routine tasks are typically associated with lower income levels.

Furthermore, we have conducted country-specific regressions to gain insight into the heterogeneity of some of our key covariates across countries. The results are reported in Figures 12 to 15. Note that some countries are not reported because there is not statistical convergence in the country-level estimation models.

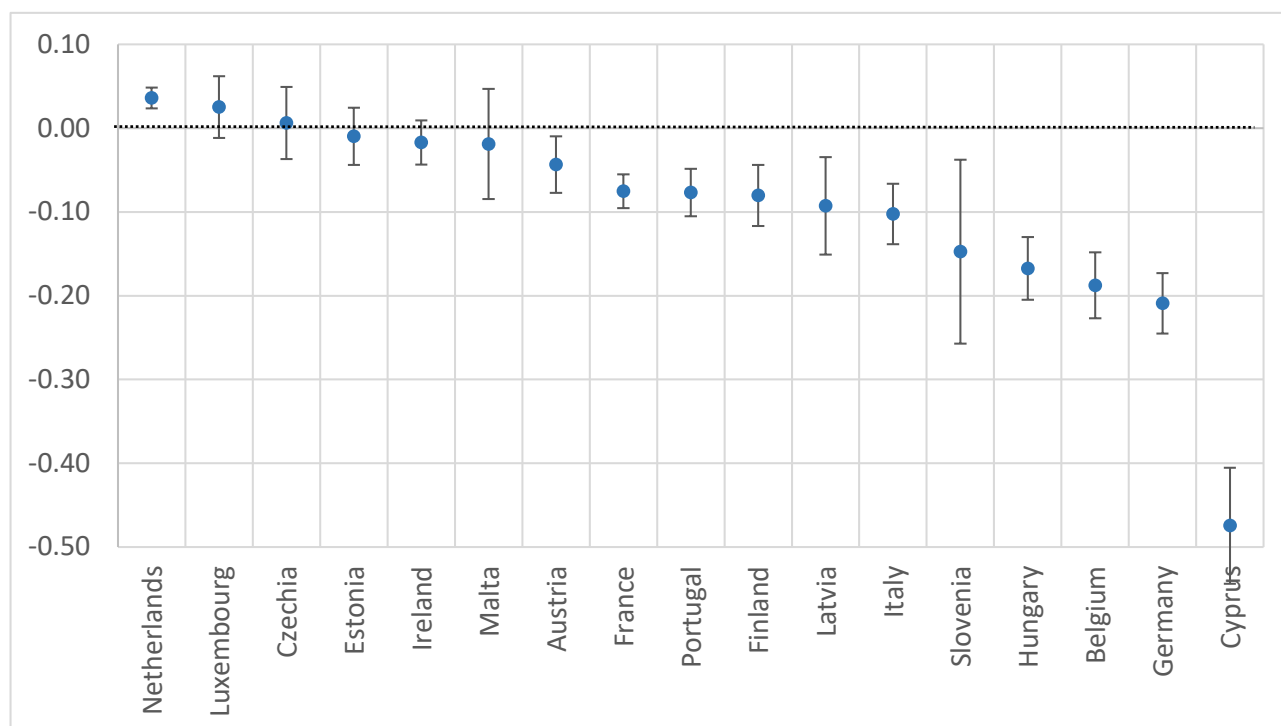
**Figure 12.** Estimated coefficients for ‘Born in other EU country’



*Note:* The figure plots the estimated coefficients of separate country regressions for the variable ‘Born in another EU country’. The estimates include 10% confidence intervals. The data are drawn from the fourth wave of HFCS (2020/2021).

Figure 12 illustrates the country-specific association between the likelihood to contribute to a pension plan and the country of birth, specifically whether it is an EU country other than the one where the survey was conducted. In the case of the Netherlands, this association is positive and statistically significant. In 10 countries, the association is not statistically significant. However, in 7 countries, it is negative and statistically significant. Similar to Figure 12, the Figure 13 reports the association between the likelihood to contribute to a pension plan and the country of birth, specifically whether it is a non-EU country. As before, the Netherlands stands out as the only country where the association is positive and statistically significant. This association is also positive in Luxembourg but not statistically significant. For 11 countries, the association is negative and statistically significant.

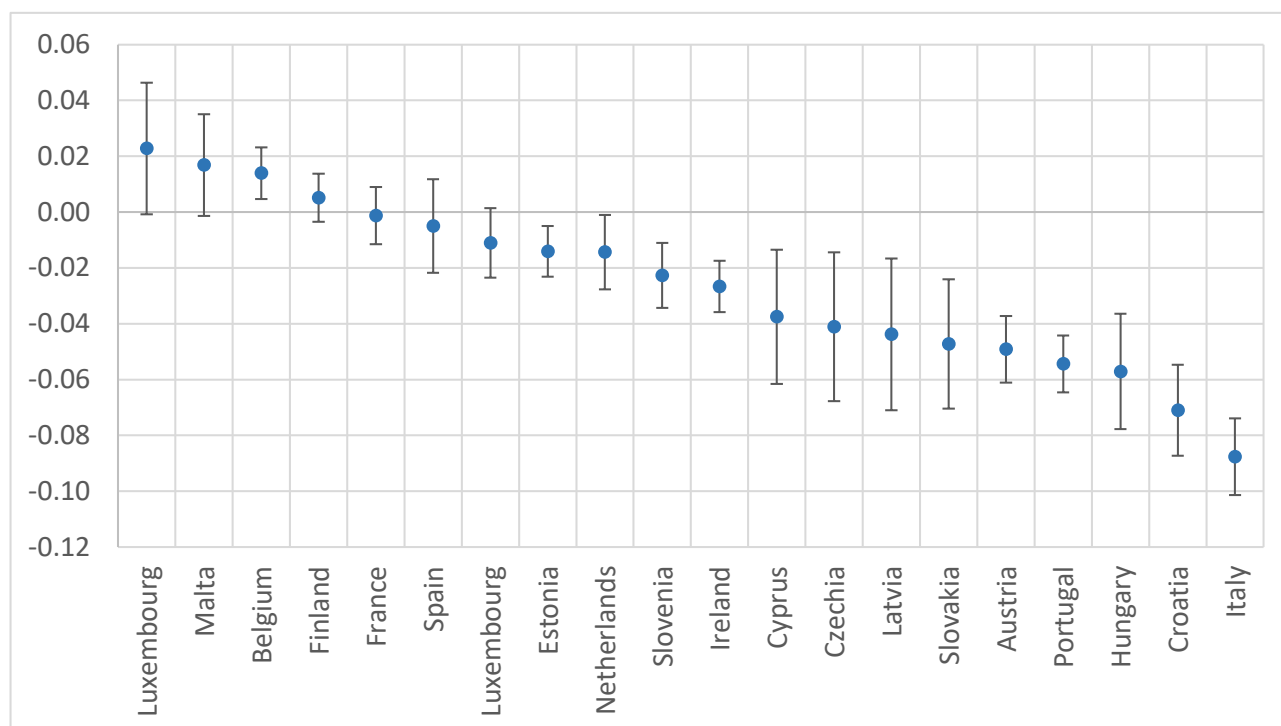
**Figure 13.** Estimated coefficients for 'Born in a non-EU country'



*Note:* The figure plots the estimated coefficients of separate country regressions for the variable 'Born in non-EU country'. The estimates include 10% confidence intervals. The data are drawn from the fourth wave of HFCS (2020/2021).

Figure 14 illustrates the correlation between the propensity to contribute to a pension plan and RTI per country. The correlation is negative and statistically significant for 13 countries. In Belgium, however, we observe a positive and statistically significant relationship.

Figure 14. Estimated coefficients for 'RTI'

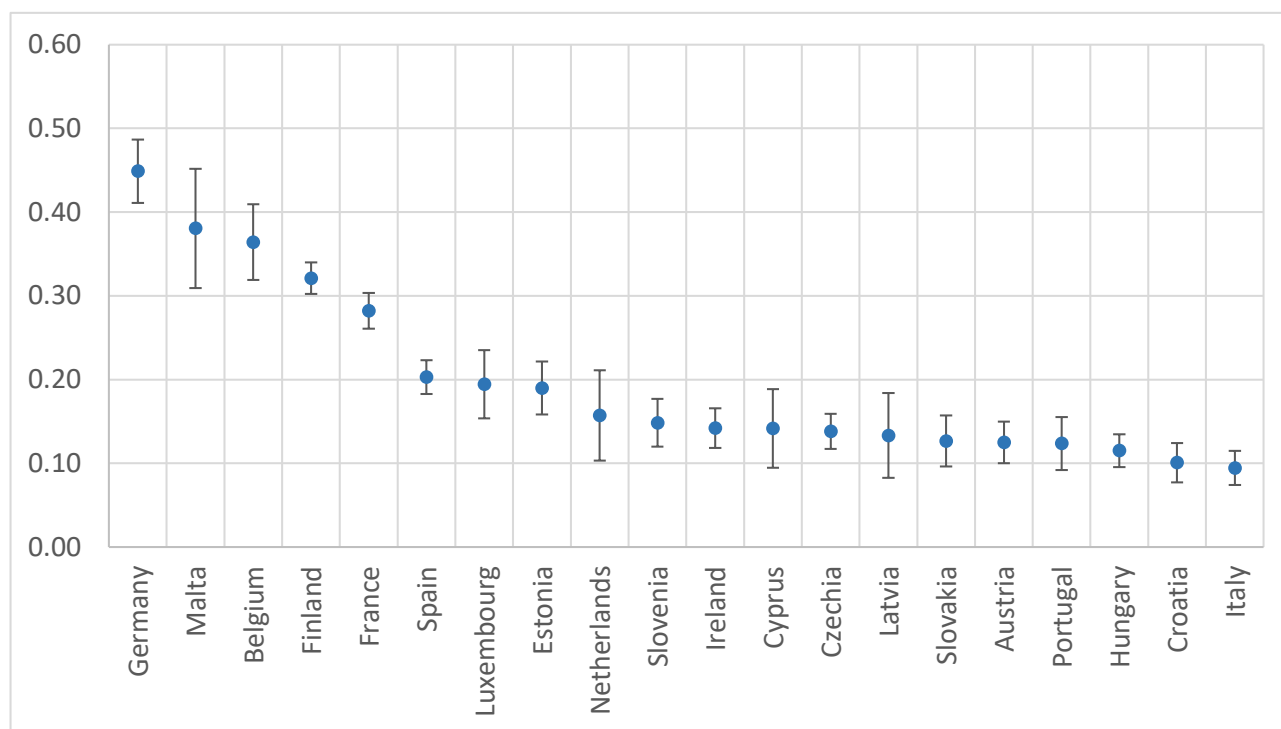


*Note:* The figure plots the estimated coefficients of separate country regressions for the variable 'RTI'. The estimates include 10% confidence intervals. The data are drawn from the fourth wave of HFCS (2020/2021).

Figure 15 shows a positive correlation between belonging to the highest wealth quantile and the likelihood of participation in a pension plan. This is to be expected, given that individuals with greater economic resources are more likely to enrol in pension or life insurance products that could enhance their retirement income. It is notable that in some countries, this correlation is particularly pronounced. This is the case in Germany, Malta, Belgium, Finland and France.



Figure 15. Estimated coefficients for '5th wealth quintile'



Notes: The figure plots the estimated coefficients of separate country regressions for the variable '5th wealth quintile'. The estimates include 10% confidence intervals. The data are drawn from the fourth wave of HFCS (2020/2021).

### 4.3. Technological change and voluntary pension plans

As our dependent variable (*Voluntary pension plan*) is a binary measure of whether the employee has a voluntary pension plan or not, we estimate Probit models. Table 2 shows the marginal effects. Model 1 is a simplified representation of the individual characteristics. Model 2 is augmented by a number of variables that describe the financial situation, risk aversion, and savings management. These include household income, ownership of a house or apartment, and a number of self-perceived risks in savings or spending. These cover self-perceived descriptions of the amount of financial risk when saving or making investments, as well as self-perceived most important periods in planning saving and spending. Models 3 and 4 progressively include a number of variables describing the use of technologies and perceptions of the consequences of technological change for performing tasks and in terms of potential replacement. Job characteristics, such as sector of activity, size of the firm in which the employee has his/her main job, working time (part-time vs. full-time), and tenure are included in Models 2, 3 and 4.

#### Use of technologies and perceptions of the consequences of technological change and voluntary pension plan

In order to assess the impact of the use of technologies and perceptions of the consequences of technological change on employee savings behaviours, we have developed various new indicators, introduced in Models 3

and 4. First, we measure the number of digital tools used. Second, we measure the employees' self-perception of the impact of smart technology, artificial intelligence, robotics, and algorithms (STARA) on their future job prospects with two variables: 'Worried of tasks replaced by STARA' and 'Worried of job replaced by STARA', regardless of whether they use these technologies. Third, and only in Model 4, we added individuals' perceptions about the new computer programs or software or new computerised machinery they use in their main job regarding 'doing different or new tasks', 'doing tasks faster' and 'stopped performing certain tasks'.

The results for the *Sum of digital tools* used in Model 3 (Table 2) show no evidence of a significant association with the likelihood of taking voluntary pension plans. The results about employees' self-perception of the impact of smart technology, artificial intelligence, robotics, and algorithms (STARA) indicate that the variable *Worried of tasks replaced by STARA* is statistically significant and positive, suggesting a positive association between the propensity to have voluntary pension plans and individuals' self-perception of the impact of STARA technologies in replacing certain tasks within their job. In contrast, there is no significant evidence regarding the variable *Worried of job replaced by STARA*. This indicates that there is no evidence to suggest that individuals are worried that STARA could replace their job. This suggests that worries about job displacement may not directly influence voluntary retirement planning behaviour.

One possible interpretation is that this disparity suggested by all results linked to digitalisation lies in the differential impact of task-specific digitalisation concerns versus broader job displacement fears on individuals' retirement planning behaviours. Specifically, individuals who express concerns about the potential replacement of specific tasks by STARA technologies may perceive retirement planning as a secure strategy for dealing with future job requirements and maintaining employability in a technologically dynamic environment. These individuals may view voluntary pension plans as a means of financial preparedness for potential job transitions or upskilling challenges necessitated by technological advancements. In contrast, unlike concerns about specific task replacement, which may prompt individuals to engage in proactive financial planning, concerns about job replacement, could evoke a sense of uncertainty that overshadows retirement planning. Furthermore, the fear of job replacement by STARA technologies may also be perceived as a distant or hypothetical risk compared to concerns about task automation, which result in a weaker association with retirement planning behaviour.

Finally, Model 4 incorporates three additional variables that assess the employees' subjective perception of the impact of new computer programs, software, and new computerised machinery they use for their main job or tasks. These variables pertain to the fact that these technologies enable employees to perform different or novel tasks (*Technological change - doing different or new tasks*), to perform tasks at a faster pace than before (*Technological change - doing tasks faster*), and to perform tasks or jobs that they did not do before (*Technological change - stopped performing certain tasks*).

The results indicate that individuals' perceptions about the digital tools and computerised machinery they use in their main job are positively related to the investment in a voluntary pension plan but only when they declare that technologies cause them to stop performing certain tasks. This finding demonstrates the impact of specific perceptions of job change resulting from technological change on retirement planning in line with the result of the variable '*Worried of tasks replaced by STARA*'. Individuals who perceive themselves unable to perform tasks previously executed because of new technology are more inclined to engage in retirement planning. This is likely due to the fear of potential impacts on the labour market. This highlights the importance of individuals' perceptions of future job changes in shaping their retirement planning behaviours.

## Other controls

### Individual characteristics

In examining the individual characteristics associated with voluntary pension plans, our findings indicate that older workers aged 50 and above have a higher propensity to have such plans. This result is in line with the research highlighting age as a strong determinant of voluntary pension plans (Fernandez *et al.*, 2015; Greenwald *et al.*, 2020). According to the perspective based on individuals' perceived temporal distance to delayed outcomes, as individuals age and approach retirement, their awareness of the importance of financial security increases, leading them to prioritise saving for retirement (Lusardi & Mitchell, 2011). Additionally, older individuals may benefit from accumulated wealth and assets over their lifetime, enabling them to contribute more significantly to retirement savings plans.

The variable *Single* is not significantly associated with the decision to take up voluntary pension plans, suggesting that marital status plays a limited role in shaping retirement planning behaviour. In addition, the results also indicate that there is gender heterogeneity in the propensity to take up voluntary pension plans, as variable *Women* is significant and negative. Women exhibit a lower propensity to take up voluntary pension plans compared to their male counterparts. This may be partially explained by the gender gaps in certain individual characteristics, such as those related to risk aversion, financial literacy, income, and employment status (Fernandez *et al.*, 2015; Lusardi & Mitchell, 2007, 2011).

Furthermore, Household composition, as indicated by the number of persons living in the household, is not significantly associated with the propensity to have a voluntary pension plan. Moreover, nationality emerges as a discernible factor, with employees of French, Luxembourg, and Belgian nationality exhibiting heightened odds of participating in voluntary pension plans. Surprisingly, Education and type of tasks, e.g. routine cognitive tasks; routine and non-routine manual tasks are not significant.

### Financial situation, risk aversion and savings management

Results in Table 2 also indicate a significant and positive association between high income and the probability of having voluntary pension plans. Specifically, the household income category of 8,000-12,500 euros

emerges as significant in Models 2, 3 and 4, indicating a higher propensity for participation in voluntary pension plans among individuals in this income category. This is consistent with the literature showing income as one of the main driving forces of the decision to have more savings for retirement, as individuals have more economic resources to take up additional private pension plans (Huberman *et al.*, 2007; Torricelli *et al.*, 2016; Fernández *et al.*, 2015). However, this significance is less when considering technological change (Models 3, 4). This suggests that while income plays a role in retirement planning decisions, the influence of technological factors on voluntary pension plans may attenuate the significance of income levels.

Results in models 2, 3 and 4 also show consistent results that private occupational pension (pension plan proposed by the employer) and Life insurance plan are significantly and positively associated with the propensity to have a voluntary pension. This finding suggests that individuals who already have access to employer-provided pension plans may be more financially secure and accustomed to saving for retirement, making them more inclined to participate in additional voluntary pension plans. Additionally, individuals with life insurance plans may prioritise long-term financial planning and risk management, making them more likely to seek out additional retirement savings options such as voluntary pension plans. This finding is consistent with existing literature highlighting the role of the country's social model in individuals' retirement savings decisions, where the benefits the employees anticipate from public old-age pensions and occupational influence employees' propensity to save for retirement (Huberman *et al.*, 2007). Finally, familiarisation with occupational pension plans or life insurance plans will facilitate the development of employees' financial planning skills, potentially resulting in increasing their retirement savings rates (Sundén & Surette, 1998; Papke, 2003).

The variable Expected time horizon for savings is positive and significant, suggesting that individuals who prioritise longer-term financial planning horizons, such as saving for needs beyond the next 5-10 years or longer than 10 years, are more inclined to participate in voluntary pension plans. This may reflect a broader propensity towards forward-looking financial decision-making and a higher awareness of the importance of long-term retirement savings. Individuals who prioritise distant future financial goals may perceive voluntary pension plans as an effective means of accumulating wealth over an extended period, thereby reinforcing their retirement savings. Surprisingly, Owning a paid house/apartment is not significantly associated with the propensity to have a voluntary pension plan. This result contrasts with the literature highlighting that wealth positively affects the decision to participate in voluntary pension plans (Torricelli *et al.*, 2016).

**Table 2.** Determinants of voluntary pension plan – impact of technological change

	Model 1	Model 2	Model 3	Model 4
<b>Individual characteristic</b>				
Age 50+ (ref. less than 50)	.113(.050)**	.126(.060)**	.126(.059)**	.127(.058)**
Nationality	.063(.021)***	.069(.020)***	.068(.020)***	.063(.020)***
Residence	.034(.019)*	.030(.024)	.030(.025)	.031(.025)
Women	-.128(.042)***	-.100(.051)**	-.103(.051)**	-.103(.049)**
Single	-.037(.031)	.009(.031)	.012(.032)	.013(.032)
Household composition: 2 persons (ref. 1)	.069(.058)	.058(.062)	.058(.062)	.065(.062)
Household composition: 3 persons	.068(.057)	.039(.058)	.058(.059)	.064(.058)
Household composition: 4 and more	.087(.055)	.057(.063)	.058(.062)	.067(.061)
Education	.042(.051)	.032(.050)	.010(.059)	.006(.059)
Routine cognitive tasks (ref. non-routine cognitive tasks)	-.051(.049)	.017(.037)	.019(.038)	.018(.040)
Routine and non-routine manual tasks	-.178(.075)*	-.103(.081)	-.090(.083)	-.078(.082)
<b>Financial situation, risk aversion and savings management</b>				
Self-perceived longevity		.001(.001)	.001(.001)	.001(.001)
Self-perceived risk aversion		-.035(.026)	-.036(.026)	-.031(.027)
Expected time horizon for savings		.060(.014)***	.059(.014)***	.060(.014)***
Intention to move to another country for work		.024(.078)	.016(.075)	.010(.073)
Intention to move to another country for retirement		.003(.062)	-.007(.060)	-.009(.059)
Income: 4,000 - 6,000 euros (Ref. 2,000 - 4,000 or less)		.108(.083)	.100(.080)	.093(.081)
Income: 6,000 - 8,000 euros		.018(.071)	.010(.070)	-.000(.071)
Income: 8,000 - 12,500 euros		.164(.080)***	.158(.077)*	.144(.079)*
Income: greater than 12,500 euros		.060(.102)	.061(.099)	.054(.099)
Owning paid house/apartment (Ref. no house/apartment)		.072(.049)	.070(.049)	.061(.047)
Owning not paid house/apartment		.070(.051)	.071(.053)	.065(.050)
Public old age pension		.091(.056)	.090(.053)*	.084(.053)
Private occupational pension		.101(.035)***	.104(.036)***	.108(.036)***
Life insurance plan		.198(.039)***	.198(.039)***	.196(.039)***
<b>Job characteristics</b>		Yes	Yes	Yes
<b>Use of technologies and perceptions of the consequences of technological change</b>				
Sum of digital tools			.002(.007)	-.002(.012)
Worried of job replaced by STARA			-.020(.031)	-.026(.030)
Worried of tasks replaced by STARA			.034(.016)**	.032(.016)*
Technological change - doing different or new tasks				-.013(.016)
Technological change - doing tasks faster				.024(.018)
Technological change - stopped performing certain tasks				.032(.018)*
Observations	1,127	1,127	1,127	1,127

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Standard errors in parentheses

Source: WeLaR survey

## Heterogeneity analysis

Table 3 shows that there is gender difference in response to technological change, particularly regarding the impact of doing different or new tasks. Indeed, among women, the estimate of 'Technological change - doing different or new tasks' is significantly negative while for men, the estimate is statistically insignificant. This indicates that changes in job tasks due to technology do not significantly influence men's likelihood of opting for a voluntary pension plan. Gender difference is also observed for 'Technological change - stopped performing certain tasks' as the estimate for women is significant and positive while for men, the estimate is not significant.

We also observe varying impacts of technological change among women, where 'Technological change - doing different or new tasks' shows a significantly negative effect, while 'Technological change - stopped performing certain tasks' is significant and positive. This suggests that women may perceive technological changes that alter their job tasks as threats to job security, pushing them to seek future financial security through pension planning.

The estimate of *Worried of job replaced by STARA* is statistically significant positive at the 5% level among the 50 years old and more while it is statistically significant negative at the 10% level among those less than 50 years old. The result reveals age-related differences in how concerns about job replacement by smart technology, artificial intelligence, robotics, and algorithms (STARA) are associated with the likelihood of taking a voluntary pension plan. For individuals aged 50 and above, a higher level of worry about job displacement by STARA is associated with a significantly increased likelihood of opting into a voluntary pension plan, suggesting that older individuals may seek financial security as a precautionary response to perceived job threats. Conversely, for those under 50, greater concern about job replacement by STARA correlates with a decreased likelihood of taking a voluntary pension plan, indicating that younger individuals might prefer to adapt through upskilling or seeking new job opportunities rather than securing their financial future through a pension plan. This contrast underscores how technological anxiety influences financial planning differently across age groups.

However, within the group of workers aged less than 50, Table 3 shows nuanced results. The estimate of *Worried of job replaced by STARA* is significantly negative, indicating that anxiety about complete job replacement by STARA is linked to a decreased likelihood of opting for a voluntary pension plan, suggesting a preference for career adaptability and upskilling. In contrast, the estimate of *Worried of tasks replaced by STARA* is significantly positive, implying that concerns about specific tasks being automated drive younger workers to seek financial security through a voluntary pension plan. Additionally, the negative estimate of *Technological change - doing different or new tasks* suggests that younger workers view new tasks due to technological changes as career growth opportunities, further reducing their need for a pension plan.

Together, these results highlight how different dimensions of technological change influence the financial planning decisions of younger workers.

**Table 3.** Determinants of voluntary pension plan – impact of technological change by gender and age

	Women	Men	Less 50	50 and more
<b>Use of technologies and perceptions of the consequences of technological change</b>				
Sum of digital tools	-.006(.012)	-.007(.007)	-.002(.007)	.002(.012)
Worried of job replaced by STARA	-.009(.036)	-.023(.029)	-.049(.025)*	.069(.032)**
Worried of tasks replaced by STARA	.017(.027)	.024(.016)	.034(.020)*	-.037(.028)
Technological change - doing different or new tasks	-.041(.015)***	.015(.020)	-.025(.011)**	.010(.027)
Technological change - doing tasks faster	.007(.020)	.016(.022)	.024(.014)*	-.001(.028)
Technological change - stopped performing certain tasks	.054(.017)***	.007(.021)	.022(.017)	.044(.025)*
Controls	Yes	Yes	Yes	Yes
Observations	509	618	850	277

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Standard errors in parentheses

Source: WeLaR survey

### Interpretation

We present an analysis examining the link between the use of technologies, perceptions of the consequences of technological change, and employees' propensity to invest in voluntary pension plans. Several key findings emerged. First, employees who perceive their job tasks as being susceptible to be replaced by smart technology or experiment stopping performing certain tasks exhibit a higher likelihood of engaging in voluntary pension planning. Nevertheless, concerns about the potential for job displacement due to technological advances do not significantly influence pension plans.

The heterogeneity analysis highlights substantial gender differences in how technological changes influence financial planning decisions. Women are notably more likely to perceive alterations in job tasks due to technology as threats to job security, leading them to prioritise financial stability through pension planning. This contrasts with men, for whom these changes do not significantly impact pension decisions. This result aligns with existing empirical research indicating that men tend to be more optimistic than women (Filippin, 2022). Specifically, Bjuggren and Elert (2019) found that men have a more positive perception of their future economic situation, while Dawson (2017) observed that women are generally more pessimistic about their future earnings compared to men. Age-related differences reveal that older individuals tend to prioritise financial security through pension plans in response to concerns about job displacement by technology, whereas younger workers may favour career adaptability and skill enhancement. These insights into how age and gender shape responses to technological anxiety are crucial for designing

targeted policies that support diverse financial planning needs across demographic groups in the evolving workforce landscape.

Finally, older age is strongly associated with a higher propensity for voluntary pension plan participation, reflecting a greater awareness of the importance of retirement savings as individuals approach retirement age. Additionally, gender, nationality, and occupational skill level also play significant roles in shaping retirement planning behaviours. Variables such as household income, ownership of property, and access to employer-provided pension plans and life insurance are positively associated with voluntary pension plan participation. These findings highlight the importance of financial security and familiarity with financial planning tools in retirement planning decisions. Finally, individuals who prioritise longer-term financial planning horizons are more likely to participate in voluntary pension plans, indicating a forward-looking approach to retirement savings.

## 5. Preferences for portability of voluntary pension plans

Our WeLaR survey on voluntary pension plans in Luxembourg contained a discrete-choice experiment to elicit willingness to incur additional management fees in order to have portability (versus non-portability) of voluntary pension savings. We carried out the experiment to better understand the trade-off individuals make between paying higher management fees and having the freedom to move their pension savings. Each participant responded to four independent and randomly assigned vignettes. Each vignette compares two pension plans, one with and one without the portability feature (see Section 3.5). Each pension plan shows what the cost of the management fees would be in terms of the loss in the final balance of the pension fund. The loss rates vary between 5% and 12% and are randomly assigned to each plan, with the portable plan having the lowest rate, such that each choice of pension plan has a trade-off between portability and lower management fees.

There are 1,132 participants with valid answers, which implies a total of 4,528 observations for all the evaluated pairs of pension plans. We use the following equation to estimate the value that individuals assign to the portability feature:

$$y_i = \beta_0 + \beta_1 p_i + \beta_2 r_i + \varepsilon_i$$

Where  $y_i$  is a variable indicating whether a given plan is chosen by individual  $i$ . It takes the value one if the individual chooses the given plan; otherwise, it takes the value zero. The portability feature is indicated by the variable  $p_i$ , which takes a value of one if the plan is portable and zero otherwise.  $r_i$  represents the percentage of pension savings that would be reduced due to the cost of management fees (the loss rate). Since the individuals observe two hypothetical pension plans with different loss rates, we use the difference between these rates in our regressions. That is, we consider how much additional loss the individual is willing to tolerate in order to have a portable pension plan (we call it 'loss rate differential'). We estimate the equa-



tion with linear regressions for simplicity (Probit regressions provide very similar results) and consider robust standard errors. Once the coefficients are estimated, we compute the marginal rate of substitution between the portability condition and the loss rate:

$$MRS = \beta_1/\beta_2$$

This metric indicates the extent to which the individual - on average - is willing to accept a reduction in their pension fund in exchange for a portable plan. The MRS can also be viewed as indicating the loss rate - in percentage points - at which the individual becomes indifferent between the portable and non-portable options.

Table 4 presents the results of the linear estimates for pension plan choice. We obtain that individuals are, in average, willing to accept an additional loss of 3.64% in their pension funds in order to opt to pay for a portable pension plan. The estimate is highly statistically significant ( $z=-12.0$ ) and is similar to the estimate we obtain if we include control variables in the regression or if we control for individual fixed effects. To give some context to this number, consider the following example. Assume a pension plan of 20 years with an annual return rate of 5%. A management fee of 1% will reduce the final pension balance by 10.82%, while a management fee of 0.65% will reduce it by 7.20%. The difference of these losses is 3.63%, which is similar to our estimated MRS. In other words, the individual could be indifferent between a portable pension plan with a management fee of 1% and a pension plan with no portability and a management fee of 0.65%.

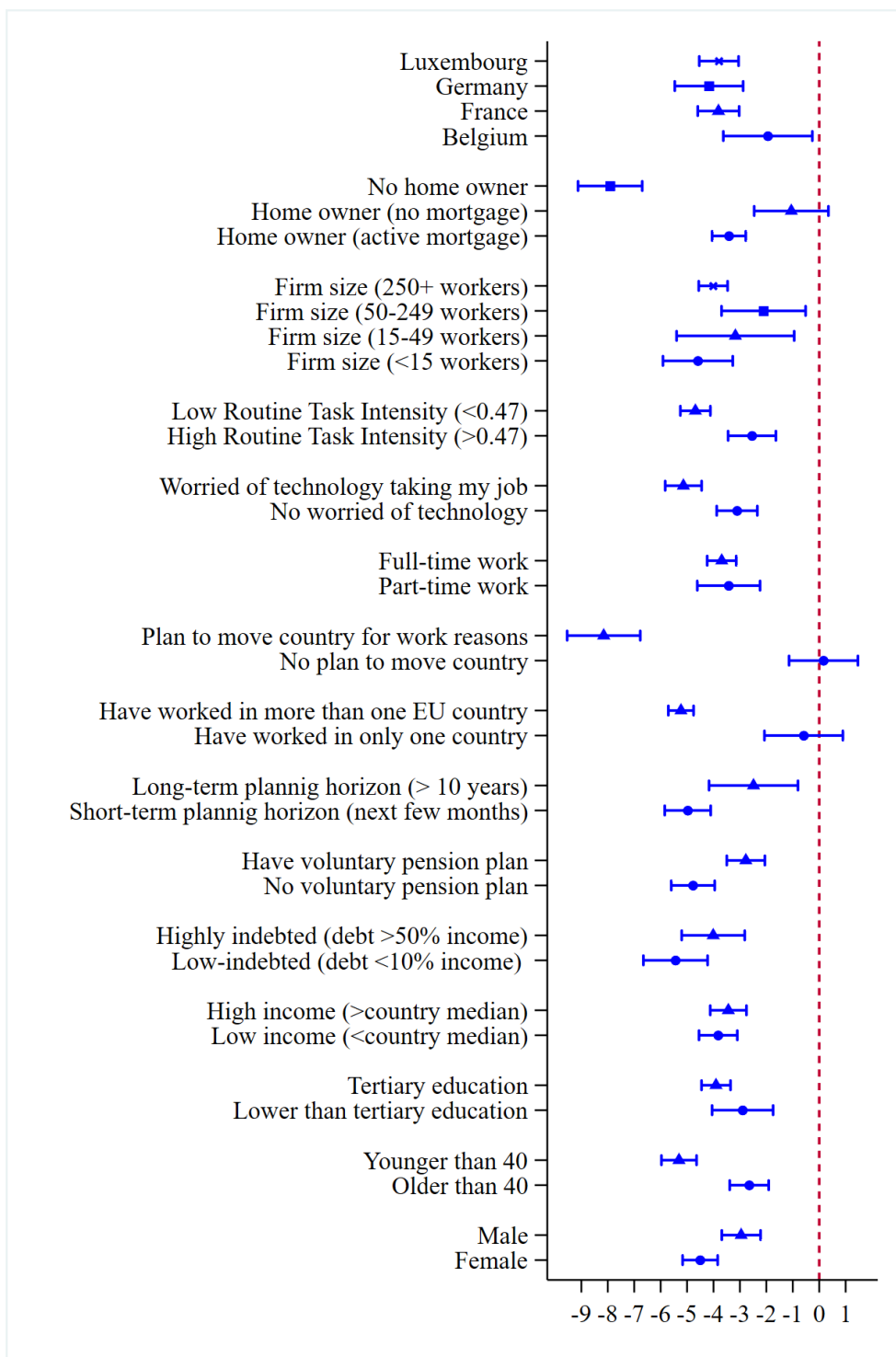
Then, we estimate MRS for different sub-groups of participants in order to capture different responses of individuals and assess whether the effect of our pension plan treatments is still statistically significant. Figure 16 shows these results. Importantly, people who are - on average - more mobile are significantly more likely to have a higher MRS, e.g. they tolerate a larger difference in management costs to be indifferent between portability and non-portability. This is the case for non-home owners versus home owners, for people who plan to work in another country in the future versus people who have no such plans, for people who have worked in more than one EU country versus people who have only worked in one, and people younger than 40 versus people older than 40. We find any statistical difference depending on country of residence. Smaller significant differences were also found between women (higher MRS) and men, between those do not have a voluntary pension plan (higher MRS) and those people that do have one.

**Table 4.** Linear estimates for pension plan choice

	(1)	(2)	(3)
Portable	0.213*** (0.029)	0.216*** (0.030)	0.220*** (0.035)
Loss rate differential	-0.059*** (0.004)	-0.057*** (0.004)	-0.060*** (0.005)
Male		0.017 (0.015)	
Age		-0.002 (0.001)	
Tertiary education		0.030* (0.016)	
Income		0.000 (0.000)	
Luxembourg		-0.026 (0.019)	
Belgium		-0.030 (0.029)	
Germany		-0.013 (0.031)	
Constant	0.363*** (0.016)	0.410*** (0.048)	0.360*** (0.019)
Estimated MRS	-3.642*** (0.303)	-3.751*** (0.314)	-3.687*** (0.333)
Individual fixed effects	No	No	Yes
R2	0.061	0.059	0.189
Observations	4,528	4,244	4,528

*Note:* Robust standard errors are in parenthesis. \* $p < 0.1$ , \*\* $p < 0.05$ , and \*\*\* $p < 0.01$  indicate significance levels. The reference value for country is France.

**Figure 16.** Estimated marginal rate of substitution between portability and rate of loss in pension funds



*Note:* The Figure 16 shows the point estimates of the loss the individual is willing to accept to obtain a pension plan with portability across EU countries. The estimates come from separate regressions for various groups of individuals, and include 90% confidence intervals.

## 6. Summary and concluding remarks

The pan-European personal pension product (PEPP), introduced by the European Union, aims to provide a flexible and portable supplementary pension option for individuals across EU member states. Effective since March 2022, the PEPP allows workers in part-time, temporary, or self-employment roles to contribute to a personal pension account that remains portable even if they move to a different EU country. This report assesses the extent to which the key benefit of this type of pension product - namely, its portability across the EU - is regarded as a valuable feature by individuals. The analysis comprises two parts. The first investigates the determinants of voluntary pension plans, highlighting in particular the impact of mobility and technological change. The second proposes one of the first examinations of individuals' willingness to participate in a portable pension plan and aim to provide detailed insights into individuals' attitudes towards a pension plan like the PEPP. The assessments draw upon data from various well-regarded European surveys as well as a new survey on workers and cross-border workers in Luxembourg, conducted in April 2024 by LISER. The reports provides several insightful results.

First, we show that mobility within EU27 has increased markedly over time, both when we take a cohort and a cross-sectional perspective. This suggests that an increasing share of the workforce in each EU country will be mobile worker in the future. Building on data from the SHARELIFE module we show that (in the past) a large share of mobile people spent five years or more in another country. Hence, the issue of pensions is sizeable for the group of mobile workers.

In addition, the analysis of EU-SILC data shows a negative relationship between contributing to voluntary pension plans and being born in another EU country. Higher routine task intensity generally reduces the likelihood of contributing to these plans, as such occupations are typically lower-paying, leading to negative income effects. However, in a few countries, higher RTI correlates with a higher probability of contributing. The demand for voluntary private pension plans varies based on the proportion of foreign-born EU individuals and the development of voluntary pension systems within a country. Luxembourg, Belgium, Germany, and Austria have the highest shares of voluntary pension contributions, with Luxembourg being particularly notable. Conversely, countries like Poland, Slovakia, Malta, and Lithuania, with negligible shares of foreign EU-born individuals, are expected to have lower demand. This study highlights the significant influence of both the country of birth and RTI on voluntary pension plans.

Furthermore, the analysis of the WeLaR pension survey elucidates the complex relationship between technological change, employees' perceptions of job security, and their engagement in voluntary pension plans. Key findings indicate that employees who perceive their tasks as vulnerable to technological replacement are more likely to invest in voluntary pension plans. However, general concerns about job displacement by technology do not significantly influence such decisions. Gender differences are pronounced, with women more likely to view technological changes as threats to job security, thereby prioritising voluntary pension

plan(s), in contrast to men. Furthermore, age-related differences indicate that older employees are more inclined to secure their financial future through pensions due to concerns about technological change, while younger workers focus on career adaptability.

The discrete choice experiment included in the WeLaR survey revealed that individuals are willing to accept an average additional loss of 3.6% in their pension funds for portability across the EU. The reduction in the final pension balance is attributable to a higher management fee included in portable pension plans. The trade-off between higher management fees and portability was consistently significant across various models and control variables. Sub-groups more likely to be mobile in the future such as non-homeowners, those planning to work abroad, individuals with multi-country work experience, and younger participants showed a higher tolerance for increased management fees in exchange for portability. Smaller yet significant differences in the willingness to pay for portability were observed across gender, contingent on gender and the existence of a voluntary pension plan.

Overall, this report highlights the increasing importance of mobility and technological change in shaping pension plan engagement across the EU. It emphasizes the critical need for flexible and portable pension options, like the PEPP, to accommodate the growing mobile workforce. The findings highlight significant demographic and occupational variations in the willingness to invest in voluntary pensions, with younger workers, women, and those in routine-intensive jobs demonstrating distinct preferences and concerns. The introduction of products like the PEPP represents a crucial step towards addressing these needs, ensuring better pension security and financial planning for the diverse and dynamic EU labour market.

## Appendices

### Appendix 1: Share of individuals who are paying contributions to the voluntary pension plans in total population, local-born population and foreign, EU-born population by countries

		Not paying voluntary pension contributions, %	Paying voluntary pension contributions, %	Difference in proportion of local-born and EU-born individuals who contribute to voluntary pensions
<b>Total</b>	Local-born	78.1	21.9	
	EU-born	83.6	16.4	
	Total	78.4	21.6	
<b>Austria</b>	Local-born	57.0	43.0	0.165***
	EU-born	72.7	27.3	
	Total	58.9	41.1	
<b>Belgium</b>	Local-born	36.0	64.0	0.335***
	EU-born	70.0	30.3	
	Total	38.9	61.1	
<b>Cyprus</b>	Local-born	98.6	1.4	0.006
	EU-born	99.6	0.4	
	Total	99.0	1.3	
<b>Czechia</b>	Local-born	40.0	59.7	0.134***
	EU-born	52.8	47.3	
	Total	40.7	59.3	
<b>Germany</b>	Local-born	48.9	51.1	0.264***
	EU-born	77.0	23.0	
	Total	51.5	48.5	
<b>Denmark</b>	Local-born	82.3	17.7	0.088***
	EU-born	92.2	7.8	
	Total	83.0	17.3	
<b>Estonia</b>	Local-born	80.0	19.7	
	Total	80.3	19.7	
<b>Greece</b>	Local-born	98.0	2.0	-0.004
	EU-born	98.0	2.0	
	Total	98.0	2.0	
<b>Spain</b>	Local-born	87.0	12.6	0.054***
	EU-born	92.7	7.3	
	Total	87.7	12.3	
<b>Finland</b>	Local-born	89.1	10.9	0.054**
	EU-born	93.0	7.2	
	Total	89.2	10.8	
<b>France</b>	Local-born	88.0	12.0	0.034**
	EU-born	90.1	9.9	
	Total	88.0	12.0	

		Not paying voluntary pension contributions, %	Paying voluntary pension contributions, %	Difference in proportion of local-born and EU-born individuals who contribute to voluntary pensions
<b>Croatia</b>	Local-born	96.0	3.8	-0.014
	EU-born	95.5	4.5	
	Total	96.2	3.8	
<b>Ireland</b>	Local-born	83.3	16.7	0.107***
	EU-born	92.0	7.6	
	Total	84.3	15.7	
<b>Italy</b>	Local-born	94.8	5.2	0.035***
	EU-born	98.0	2.0	
	Total	95.0	5.1	
<b>Lithuania</b>	Local-born	65.0	35.0	0.015
	EU-born	70.6	29.4	
	Total	65.5	34.5	
<b>Luxembourg</b>	Local-born	70.6	29.4	0.019
	EU-born	74.3	25.7	
	Total	72.6	27.4	
<b>Latvia</b>	Local-born	86.2	13.8	
	Total	86.2	13.8	
<b>Malta</b>	Local-born	74.7	25.3	0.097*
	EU-born	89.6	10.4	
	Total	74.9	25.1	
<b>Netherlands</b>	Local-born	88.6	11.4	0.049**
	EU-born	93.3	6.7	
	Total	88.8	11.3	
<b>Poland</b>	Local-born	95.4	4.6	0.046
	EU-born	100.0	100	
	Total	95.4	4.6	
<b>Portugal</b>	Local-born	91.9	8.1	-0.029**
	EU-born	91.0	9.0	
	Total	91.8	8.2	
<b>Sweden</b>	Local-born	98.6	1.5	-0.004
	EU-born	99.2	0.8	
	Total	98.6	1.4	
<b>Slovenia</b>	Local-born	77.7	22.3	
	Total	77.7	22.3	
<b>Slovakia</b>	Local-born	76.7	23.3	0.045
	EU-born	77.8	22.2	
	Total	76.7	23.3	

*Note:* z-test for difference in proportions is used without survey weights, therefore the last column for the difference in proportions is based on non-weighted data. Weighted data are used for proportions in the first two columns. The difference in proportions presented in the last column differ slightly then the number that would be obtained by subtracting second row (EU-born) from the first row (Local-born) for contributing to the pensions. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

*Source:* Authors' calculation based on EU-SILC data

## Appendix 2: Description of variables of WeLaR Survey on voluntary pension plan

Individual characteristics	
Age 50+	Employees aged 50 and more
Nationality	Citizenship
Residence	Country of residence
Single	Being equal to 1 if single/never married or consensual union on a legal basis, or widowed or divorced, 0 if married
Size of household	People (including the respondent) living in the household
Education	The highest level of education completed
High-skilled occupations *	Legislators, senior officials and managers, Professionals, Technicians and associate professionals
Middle-skilled occupations (ref. high-skilled occupations)	Clerks, Service workers and shop and market sales workers, Skilled agricultural and fishery workers, Craft and related trades workers, Plant and machine operators and assemblers
Low-skilled occupations	Elementary occupations
Financial situation, risk aversion and savings management	
Self-perceived longevity	Self-perceived chance to live to be 75 or more
Self-perceived risk taking	Self-perceived description of the amount of financial risk when saving or making investments. Being equal to 1 if take substantial financial risks expecting to earn substantial returns, 2 if take above average financial risks expecting to earn above average returns, 3 if take average financial risks expecting to earn average returns, and 4 if not willing to take any financial risk
Expected time horizon for savings	Self-perceived most important periods in planning saving and spending: 1 if next few months, 2 if next year, 3 if next few years, 4 if next 5-10 years, and 5 if longer than 10 years
Intention to move to another country for work	Equal to 1 if plan to move to another country in the future for work, 0 otherwise
Intention to move to another country for retirement	Equal to 1 if plan to move to another country in the future for retirement, 0 otherwise
Income	Monthly net household income: (1) 0 - 1,250 euros; (2) 1,250 - 2,000 euros ; (3) 2,000 - 4,000 euros; (4) 4,000 - 6,000 euros; (5) 6,000 - 8,000 euros ; (6) 8,000 - 12,500 euros ; (7) Greater than 12,500 euros
Not own house/apartment	Do not own house or apartment
Owning paid house/apartment	Own house or apartment and no more mortgage to pay
Owning house/apartment not yet sold	Own house or apartment and still have mortgage to pay
Pension plans	
Voluntary pension plan(s)	Equal to 1 if being entitled to voluntary pension plan(s), 0 otherwise
Private occupational pension	Equal to 1 if being entitled to private occupational pension (pension plan proposed by employer), 0 otherwise
Public old age pension	Equal to 1 if being entitled to public old age pension, 0 otherwise
Life insurance plan	Equal to 1 if being entitled to life insurance plan, 0 otherwise
Use of technologies and perceptions of the consequences of technological change	
Sum of digital tools	Sum of all computing devices and computerised machinery the employee use for the main job, ranging from 0 to 19 <ol style="list-style-type: none"> <li>1. Communication tools (meetings, instant messaging, emails), write or edit texts, using Word or similar software; prepare presentations of your work, using PowerPoint.</li> <li>2. Use spreadsheets, for instance using Excel</li> <li>3. Use document management systems to collaborate, as SharePoint, Google Doc, Dropbox</li> </ol>



	<ol style="list-style-type: none"> <li>4. Work with any specialised, sector or occupation-specific software, for example for accounting, legal analysis, inventory control, customer relationship management, etc.</li> <li>5. Work with software and tools related to digital marketing (e.g. Google Analytics, SEO), UX design (e.g. Adobe XD, Sketch), or website management (such as WordPress)</li> <li>6. Design product or manufacturing process with the assistance of a computer (CAD/CAM)</li> <li>7. Manage and merge databases, for example using the more advanced functions of spreadsheets (e.g. macros or complex formulas), Access, Oracle and related query techniques (e.g. SQL)</li> <li>8. Analyse data using, using software like SAS, Matlab, R</li> <li>9. Apply DevOps practices for application and software development, like Jenkins, GitLab</li> <li>10. Write programs or code using a computer language, like C++, Python, Java, Visual Basic</li> <li>11. Write programs using artificial intelligence methods, for example machine-learning or deep-learning algorithms like Scikit-Learn or TensorFlow/Keras</li> <li>12. Use cybersecurity solutions to safeguard and optimise the security, integrity, and management of IT systems and data like Snort, Cisco ASA, Splunk</li> <li>13. Develop or maintain IT systems, hardware or software</li> <li>14. Digital handheld devices, such as monitors or scanners used for stock control and processing orders</li> <li>15. Computer numerically-controlled (CNC) machine tools, for instance lathes or milling machines</li> <li>16. Robots</li> <li>17. Programmable logic operators (PLCs)</li> <li>18. 3D printers</li> <li>19. Other specialised, sector or occupation-specific computerised machinery (e.g. lasers, CT scan, smart whiteboards, etc.)</li> </ol>
Worried of job replaced by STARA	Self-perception of the impact of smart technology, artificial intelligence, robotics and algorithms (STARA) on the future of job: 'worried that my job could be replaced by smart technology, artificial intelligence, robotics and algorithms (STARA)'. Answer in a Likert-scale ranging from 1 (strongly disagree) to 4 (strongly agree)
Worried of tasks replaced by STARA	Self-perception of the impact of STARA on the future of job: 'worried that some of my current tasks could be done by STARA instead'. Answer in a Likert-scale ranging from 1 (strongly disagree) to 4 (strongly agree)
Technological change - doing different or new tasks	Self-perception of the impact of new computer programs or software or new computerised machinery on the main job or tasks. Answer in a Likert-scale ranging from 1 (strongly disagree) to 4 (strongly agree)
Technological change - doing tasks faster	
Technological change - stopped performing certain tasks	
<b>Job characteristics</b>	
Sector	Sector of activities
Firm size	Size of the firm in which the respondent has the main job
Tenure	Number of years working with the main employer
Part-time vs. Fulltime	Working time

*Note:* \* Following the classification of the International Labour Organization (2023)

*Source:* Authors' calculation based on WeLaR survey. STARA: Smart Technology, Artificial intelligence, Robotics and Algorithms.

## Appendix 3: Descriptive statistics of variables of WeLaR Survey

	Mean	Std. dev.	Min	Max
Voluntary pension plan	.47	.49	0	1
Age	43.55	8.06	25	59
Nationality	2.54	1.16	1	5
Residence	3.28	1.05	1	4
Women	.45	.49	0	1
Single	.48	.49	0	1
Household composition	2.83	1.10	1	4
Education	2.25	.80	1	3
Type of tasks	1.49	.64	1	3
Self-perceived longevity	71.08	23.39	0	100
Self-perceived risk aversion	3.04	.88	1	4
Expected time horizon for savings	3.25	1.34	1	5
Firm sector	6.26	2.20	1	9
Firm size	.47	.49	0	1
Parttime	.16	.36	0	1
Tenure	10.56	8.65	0	39
Tenure <sup>2</sup>	186.56	264.52	0	1521
Intention to move to another country for work	.26	.44	0	1
Intention to move to another country for retirement	.56	.49	0	1
Income	5.07	1.19	3	7
Owning house/apartment	1.41	.79	0	2
Public old age pension	.69	.46	0	1
Private occupational pension	.36	.48	0	1
Life insurance plan	.45	.49	0	1
Sum of digital tools	4.10	2.22	0	10
Worried of job replaced by STARA	2.18	1.01	1	4
Worried of tasks replaced by STARA	2.51	1.17	1	4
Technological change - doing different or new tasks	2.66	1.18	1	4
Technological change - doing tasks faster	2.79	1.23	1	4
Technological change - stopped performing certain tasks	2.57	1.13	1	4

Source: Authors' calculation based on WeLaR survey. STARA: Smart Technology, Artificial intelligence, Robotics and Algorithms.

## Appendix 4: Routine Task Intensity

To quantify the Routine Task Intensity (RTI), we used the task content of work, based on the occupational measure provided by Lewandowski *et al.* (2022). Their task content measure is based on the O\*NET and OECD PIAAC database and elaborated on Acemoglu and Autor (2011). Five categories are distinguished.

- Non-routine cognitive analytical tasks covering, for instance, analysing data/information; thinking creatively; interpreting information for others.
- Non-routine interpersonal tasks covering establishing and maintaining personal relationships; guiding, directing and motivating subordinates; coaching/developing others.
- Routine cognitive tasks showing the importance of repeating the same cognitive tasks; the importance of being exact or accurate.
- Routine manual tasks underlining that the pace is determined by the speed of equipment; controlling machines and processes; spending time making repetitive motions.
- Non-routine manual tasks covering, for instance, operating vehicles, mechanised devices or equipment; spending time using hands to handle, control or feel objects, tools or controls; manual dexterity; spatial orientation.

We measure the relative routine task intensity using the following formula proposed by Lewandowski *et al.* (2022):

$$rti\_all = \ln\left(\frac{r_{cog} + r_{manual}}{2}\right) - \ln\left(\frac{nr_{analytical} + nr_{personal} + nr_{manual}}{3}\right)$$

where  $r_{cog}$ ,  $nr_{analytical}$ ,  $nr_{personal}$  and  $r_{manual}$ ,  $nr_{manual}$  are the levels of routine cognitive, non-routine cognitive analytical and non-routine cognitive interpersonal tasks, routine manual, non-routine manual tasks, respectively.

The measure we use in the analysis is  $rti\_all\_std$  a standardised measure by applying a z-score  $z$  equal to  $(x-\mu)/\sigma$ , where  $x$  is the raw value,  $\mu$  is the population mean and  $\sigma$  is the population standard deviation. The standardised RTI ( $rti\_all\_std$ ) indicates the number of standard deviations from the population mean score. By construction, the mean of the standardised RTI in the population studied is 0 and its standard deviation is 1.

To analyse the links between RTI and job quality, we matched this data to the individual EWCTS data at the occupation level ISCO-08 2-digit and 18 countries.

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WeLaR is Horizon Europe research project examining the impact of digitalisation, globalisation, climate change and demographic shifts on labour markets and welfare states in Europe. It aims to improve the understanding of the individual and combined effects of these trends and to develop policy proposals fostering economic growth that is distributed fairly across society and generates opportunities for all.

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