Vol. 32, No. 3 (2022) | DOI: 10.37190/ord220305

OPEN ACCESS

Operations Research and Decisions

www.ord.pwr.edu.pl

OPERATIONS RESEARCH AND DECISIONS QUARTERLY

# Occupational composition of an economy and effective retirement age across European countries: an econometric analysis

Filip Chybalski[1]

[1] *Lodz University of Technology*
[*] *Corresponding author: filip.chybalski@p.lodz.pl*

**Abstract**

In this study, panel regression models for 21 European countries and data covering the period between 2008 and 2014 were used to demonstrate that the distribution of working population across different occupational groups explains cross-country differences in terms of the average effective retirement age. Thus, while the great majority of previous studies verified the causal trade-off investigated on the basis of single-country micro data with reference to one economy, this study takes perspective of cross-country diversity in terms of the investigated relationship. The confirmed link holds even when controlling inter alia for health status, education, unemployment, old-dependency ratio, interest rate, GDP per capita, or the share of salaries and wages in GDP. An important practical implication for the policy-makers is that decisions limited only to the increase in the universal pensionable age cannot be effective, since the occupational composition of an economy is very relevant.

**Keywords:** *retirement age, occupation, human resources, policy decisions, regression, simulation*

## 1. Introduction

Although there is a wide range of means that can be employed to respond to population ageing, the main attention is paid to delaying retirement [20]. In line with this, scholars search for determinants of retirement decisions. Macro- and micro-factors of agents' choices about when to exit the labour market were investigated many times (for a review, see [2, 4, 9, 12, 38, 42]). The drivers of retirement typically studied include more institutional ones, referring to the pension system design, through factors determined on an employer's level, to those decided at the individual or household level. However, the great majority of scholars employed a single-country approach. It is very difficult to find studies in which the factors behind cross-country variation in the effective (i.e., actual) retirement age were studied. Thus, although much is known about the determinants that differentiate effective retirement age across individuals or households in a given country, we know little about why the effective retirement age varies

Received 9 December 2021, accepted 14 September 2022, published online 22 November 2022
ISSN 2391-6060 (Online)/

from country to country. Obviously, pensionable (statutory retirement) age was proven to be a natural driver of effective retirement age at a country level [4, 30, 42]. Therefore, one can suspect it to be an important determinant of cross-country variation in terms of the average age at which people actually retire. Moreover, some other factors that determine retirement decisions at the household level can be suspected to determine the differences observed between countries in terms of the effective retirement age. These are *inter alia* factors reflecting: population health status [14, 15, 22, 26, 34, 43], level of education or financial knowledge [1, 6, 8, 9, 27, 28, 29, 45], a form of employment [24, 36, 41], unemployment [7, 11, 13, 31], returns on financial markets [11, 21, 32], or generosity of a pension system [2, 12, 16, 17, 38, 48].

However, the question of which factors are behind data such as the average effective retirement age according to the OECD[1] that present the cross-country variation in the age at which people actually retire (withdraw from the labour force, according to the OECD definition) on average, still remains unexplored. In this regard, a study by Sauré and Zoabi [39] set a very important and alluring direction of further research, as they formulated and verified the hypothesis that what explains cross-country differences in terms of effective retirement age to a great extent is the occupational composition of an economy. As Eurostat data report, European countries vary widely in terms of this composition (see Table A1 in Appendix A), which – together with a potentially varying pensionable age across occupations – can have a noticeable impact on cross-country variation in terms of the effective retirement age. This paper aims to verify a similar hypothesis as formulated by Sauré and Zoabi, though using a different methodological approach and different data, i.e., regression models for a macro-panel of 21 European countries between 2008 and 2014. The empirical analysis allowed for

1. the verification of the nexus between occupational distribution of an economy and an average effective retirement age,
2. the evaluation of the impact a given occupational group has on cross-country differences in terms of the average, effective age of retirement.

A different set of control variables from Sauré and Zoabi was used. Additionally, the simplification of using the variation in retirement ages across different occupations in a given country (Sauré and Zoabi used US data) as a proxy for such variation in the European countries under study was avoided. The investigation was conducted separately for both genders, which allowed to complement the conclusions formulated by Sauré and Zoabi who only used data for men. The results confirmed that the occupational distribution of an economy explains very well the cross-country variation in average effective retirement age, however, with some differences between men and women.

The study contributes to the debate on retirement drivers in that it tackles a rarely addressed problem of the impact of the distribution of population in terms of profession on the economic activity of people at near-retirement age (usually those aged $55-64$), observed at the cross-country macro-level. New light is shed on the parametric pension reforms, as the effect of increasing the universal pensionable age on the effective retirement age can be significantly reduced by the inertia of the occupational distribution of an economy. People of different professions can retire at different ages, which is caused by various factors determined at the institutional, employer's as well as individual or household's level. Since distributions across occupations in many countries were taken into account in this study, the results obtained are more resistant to some country-specific factors affecting retirement than microdata research based on household surveys. This is reinforced through the methodology employed, which was regression for panel data with individual country effects.

The article is organised as follows: first, it reviews the literature on the nexus between occupation and retirement addressing cross-country comparisons in this respect as well; then, the research strategy and the empirical analysis based on panel regression models are presented; finally, the last section includes a discussion of the results as well as final conclusions and policy recommendations.

[1] https://www.oecd.org/els/emp/average-effective-age-of-retirement.htm, (retrieved on January 8, 2019)

## 2. Literature review

In this paper, the main focus is on the occupational distribution of an economy as a factor that differentiates the average effective retirement age across countries. There are some studies that addressed the impact of occupation on retirement, though mainly from a single-country perspective and based on micro (households' survey) data. For review, Blekesaune and Solem [5] studied the effect working conditions have on individual retirement in 270 occupations. They used microdata (mainly from 1990) for Norwegian employees aged $60-67$ and found that occupations that are more demanding in physical terms support earlier retirement. The same impact on retirement was also observed in the case of low-autonomy jobs, which means that the lower one's ability to decide about the sequence or pace of one's work, the earlier one retires. Another finding was that more stressful jobs delay retirement. The authors explained this with the fact that, typically, more stressful jobs are simultaneously more attractive. However, one could expect that such jobs are often characterised by a higher level of professionality and engagement of human capital, resulting in higher salaries; that can be actually why such occupations are more attractive. McFall et al. [33] also used microdata and investigated the trade-off between occupation and retirement in the US between 1992 and 2012. They found (p. 30) that

> *... more blue-collar jobs have the largest decreases in percentage of older workers in occupation, relative to older workers in all occupations. The range of occupations found in the largest increases reflects mostly white-collar jobs but also includes occupations such as taxi drivers and farm operators.*

These results confirmed that agents with less physically demanding and more creative occupations or who work more for pleasure than for money retire later (the 'labour-of-love' types, e.g., the clergy or writers). This refers mainly to white-collar workers and less to taxi drivers or farm operators, in whose case the explanation for later retirement is likely different. For example, in the case of taxi drivers, McFall et al. [33] suspected flexible hours or the need for social engagement to be the factors. They also found that if the occupation is statistically significantly correlated to expectations of working longer or the actual timing of retirement, such a relationship is negative. Therefore, one can expect that first of all de-stimulating factors matter, not stimulating ones. The study by McFall et al. [33] confirmed a previous investigation conducted by Chirikos and Nestel [10] on microdata for the US population, in which physical job requirements and health conditions were found to be drivers of men's retirement. Similar conclusions were drawn by Filer and Petri [18] who showed a statistically significant trade-off between selected job characteristics – for example, physical demand, stress, or repetitive working conditions – and early retirement age. Vermeer et al. [46] analysed Dutch survey microdata to examine whether demanding occupations should have a lower retirement age. More demanding occupations were defined as those that are more physically cumbersome and less demanding than those in which mental and cognitive skills are more important. The respondents indicated the range between 62 and 66 years as reasonable for the retirement age. However, in the case of more physically demanding jobs, the retirement age should be at the lower end of the range, whereas in the case of professions requiring mental and cognitive skills (which are perceived as less demanding), a retirement age closer to 66 is justified. It is also worth emphasising that the inclusion of job characteristics in a multivariate analysis of retirement drivers may affect any conclusions drawn about the impact of other possible factors [23].

The studies mentioned above were based mainly on microdata (characterizing individuals or households) and referred only to a given country. Although they allowed for inference in causal terms, they did not provide any insight into the possible relationship between given factors determined in the labour market and cross-country variation in retirement timing. This refers to the occupational composition of an economy as well. Therefore, the approach employed by Sauré and Zoabi [39] should be seen as unique, as it integrates micro- and macrodata analyses. They started from the general assumption that an 'economy's composition of occupations matters for its average effective retirement age' (p. 2). Their study was based on two main stages. First, they used microdata (for the period 1990–2010) to analyse the average effective retirement age for men across different occupations in the United States and indicated that the differences observed were caused by some intrinsic characteristics of occupations, including physical or knowledge requirements. Therefore, a country with its working population concentrated in low-retirement-age occupations will have a lower average effective retirement age than a country with a workforce concentrated in high-retirement-age occupations. This is the way in which the distribution of a working population across occupations impacts the average effective retirement age. On the basis of US microdata, Sauré and Zoabi estimated the average effective retirement age for men by occupation for the United States. In the second stage, they used these estimates to predict the average effective retirement age in 38 other countries based on their compositions of occupations in 2000. Thus, their final models were estimated on the basis of one-year, cross-sectional macrodata (i.e. data aggregated to a national level) with the assumption that the differences in effective retirement age across occupations they identified for the United States are a good proxy for analogical differences across occupations in other 38 countries in 2000 ('Conceptually, we try to explain differences across countries using differences across Americans', p. 5). They finally concluded that it is not only social security and pension systems that determine cross-country differences in average effective retirement age; another important factor is the occupational composition of an economy.

The study by Sauré and Zoabi [39] opened up a new field of exploration of retirement age determinants, however from a cross-country perspective. This paper attempts to further develop their research in the following way. Firstly, cross-sectional time series for the period between 2008 and 2014 were used (instead of a one-year cross-section). Secondly, data for both genders (not only for men) were analysed. Thirdly, in contrast to Sauré and Zoabi, this study avoids the assumption according to which the average effective retirement age across different occupations in a given country is approximated by such indicator in other countries since without appropriate verification this assumption can be irrelevant.

## 3. Method and data

The main premise behind the verification of the relationship between the occupational composition of selected economies and the variation in the average effective age of retirement between them is that people of different professions retire at different ages. This is caused by differences in the pensionable (statutory retirement) age across professions and intrinsic differences between them that matter in the context of retirement decisions. Thus, the different distributions of occupations across countries can result in varying average effective retirement ages at the country level. What actually determines an average effective age of retirement at the country level is the average weighted pensionable age (weighted by distribution of occupations) rather than the universal pensionable age. The former accounts for the cross-occupational variety in pensionable age, whereas the latter does not. Average weighted pensionable age $\overline{RA}$ can be expressed by the following formula:

$$\overline{RA} = \sum_{j=1}^{m} OCCUP_j RA_j \tag{1}$$

where $OCCUP_j$ stands for the share of working population in a given ($j$th) group of occupations and $RA_j$ stands for the pensionable age in this group.

To verify whether the occupational composition of an economy explains cross-country differences in terms of the average effective age of retirement, macro panel data (cross-sectional time series) covering 21 countries in the period 2008–2014 were used (21 units observed over 7 periods; $n = 147$ observations). The following countries were included: Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. Panel regression models for average effective age of retirement $AER$ (available in the OECD database) were estimated separately for men and women. The general formula of the model can be presented as follows:

$$AER_{it} = \beta \cdot OCCUP_{it} + \gamma \cdot CONTROLS_{it} + \alpha_i + \varepsilon_{it} \tag{2}$$

where $AER_{it}$ is the average effective retirement age for the $i$th country in the $t$th period, $OCCUP_{it}$ is the vector of independent variables (predictors) reflecting the occupational composition of the economy of the $i$th country in the $t$th period, $CONTROLS_{it}$ is the vector of control variables for the $i$th country in the $t$th period, $\beta$ and $\gamma$ are the vectors of parameters, $\alpha_i$ is the individual effects for $i$th country, and $\varepsilon_{it}$ is the vector of residuals (Tables 1 and 2 include the description of the predictors and controls, respectively).

The average effective age of retirement is actually the average age of all persons withdrawing from the labour force in a given period[2]. To describe the occupational composition of an economy, the indicators which reflect the distribution of the population aged $18$ and over by occupation were used (these indicators are available from the Eurostat database and were constructed on the basis of the International Classification of Occupations [ISCO] by the International Labour Organization; the data is not available for separate age groups, e.g., for the near-retirement age group $55-64$). There are ten occupational composition variables expressed in percentages (separately for men and women), shown in Table 1. For the purpose of estimation, these composition variables were transformed so as to their sum for each gender equalled $100\%$ to reflect the occupational composition for men and for women separately (not in total, as presented by Eurostat where the sum of indicators for men and women equals $100\%$ in total). In the estimation procedure, $OCCUP10$ variable was omitted to avoid the collinearity problem.

**Table 1.** The characteristics of occupational composition variables

| Indicator | Occupation categories included |
|---|---|
| $OCCUP1$ | Legislators, senior officials and managers |
| $OCCUP2$ | Professionals |
| $OCCUP3$ | Technicians and associate professionals |
| $OCCUP4$ | Clerks |
| $OCCUP5$ | Service workers and shop and market sales workers |
| $OCCUP6$ | Skilled agricultural and fishery workers |
| $OCCUP7$ | Craft and related trades workers |
| $OCCUP8$ | Plant and machine operators and assemblers |
| $OCCUP9$ | Elementary occupations |
| $OCCUP10$ | Armed forces |

Source: own elaboration on the basis of Eurostat information

The $\beta$-parameters in the first component of the model (2) for $AER$ accounted for some occupation-specific factors that may affect actual retirement age across various professions and, therefore, the average effective retirement age at the national level. Occupation-specific pensionable age can be one of these factors. This is an alternative approach to the one in which a universal pensionable age is included as a separate variable. However, some other specific information that matter for retirement decisions of individuals of a given profession can also be included in $\beta$-parameters (the impact resulting from, e.g., flexible working hours, other working conditions, labour productivity, or pension schemes dedicated to given professions). Thus, the $\beta$-parameter for a given occupational group reflects the impact this group has on the average effective retirement age at the national level. However, an increase in the value of a given $OCCUP$ variable must be reflected in a decrease in other $OCCUP$ variables, as they characterise the occupational structure (these are compositional data having a constant sum of all variables $OCCUP1$–$OCCUP10$ equal to 1). Therefore, a standard interpretation of the parameters next to the $OCCUP$ variables or their signs is impossible, as an assumption of an increase in a given $OCCUP$ variable by $1$ percentage point by fixed values of the other variables (the *ceteris paribus* assumption) is not

[2] A detailed description of the calculating methodology is available at `http://www.oecd.org/els/emp/39371923.pdf` (retrieved on January 8, 2019).

allowed in this case. Thus, a positive sign of a parameter does not automatically translate into a positive impact of a given $OCCUP$ variable on the average effective retirement age. However, the interpretation of changes in the average effective age of retirement as a result of the change in occupational composition (as a whole) assuming constant values of control variables is possible.

The vector of control variables included factors which, according to previous literature, are significant determinants of the retirement decisions and economic activity of older people, mentioned in the Introduction section. Some of them refer to each gender separately; some are common for both of them. The set of control variables included the generosity of a pension system (aggregate replacement ratio), an objective (healthy life years) and a subjective (self-perceived health) measure of health status, education (the share of population with educational attainment level $5-8$ according to the ISCED classification), the form of employment (the proportion of self-employed), the labour market conditions (unemployment rate), returns on financial markets (interest rate). I also controlled for demographic conditions (old-age dependency ratio), income and the level of development (GDP *per capita*), and some characteristics of the economy which can be correlated to occupational composition (salaries and wages as a percentage of GDP). The premise behind controlling for salaries and wages as a proportion of GDP was that occupational composition of an economy can be expected to be reflected in salaries and wages as remuneration of the labour factor of production. The vector of control variables is characterized in Table 2. The controls referring to the design of pension systems were not included in the estimation due to the fact that in some of the countries studied (especially CEE countries) individuals who retired in the period of analysis did so under different pension systems, i.e., some of them were paying contributions and retired under unfunded DB schemes, whereas others retired under an unfunded or funded DC scheme. Thus, it is impossible to capture this aspect using macrodata (however, as mentioned below, regression models for panel data are more resistant to the omitted variable bias).

The method employed was based on panel regression models estimated for cross-country data. Such an approach has been adopted in the literature to study various socioeconomic relationships [19, 25, 40, 44]. Two types of panel regression models were estimated: with fixed and with random individual effects. Fixed effects (FE estimator) represent some factors that are difficult to measure and, therefore, were not included in the model. However, they reflect some specific drivers of the dependent variable which, in case of the effective retirement age, can represent some legal regulations, path-dependency, or social factors that are hidden by their nature. Fixed effects allow them to be included in the model; however, implicitly rather than explicitly. In the case of random effects (RE estimator), their inclusion in the model was motivated mainly by the desire to increase estimator efficiency. Both the FE and RE estimators reduce the omitted-variable bias (including the aware or unaware omission of some controls) through the inclusion of individual effects, which is their important advantage over cross-sectional regression or time-series regression. The strength of such models is also their lesser sensitivity to country-specific traits (especially as compared with a single-country approach). Intuition suggests that in such a phenomenon as final exit from the labour force reflected by the average effective age of retirement, the FE estimator should be employed first, since one can expect some qualitative and implicit determinants of an economic, social, legal, or even historical nature, which are difficult to measure and to include in the model. However, the RE estimator was also employed in the study and the final evaluation of the models and the choice between these two types was made with the assistance of the Wald test, the Breusch-Pagan test, and the Hausman test [3, 47]. As an alternative, the regression for compositional data could be considered ($OCCUP$ variables are an example of such data as they reflect the percentages/relative proportion of the overall set of observations). However, such an estimation procedure is broadly applicable to time series data [35, 37, 49], not to cross-sections or panel data.

Since the estimated regression models can be used for simulation of the dependent variable values through the incorporation of some changes to selected predictors, they were employed to foreseen how different occupational groups affect the average effective age of retirement (as mentioned before, the standard interpretation of the $\beta$-parameters was not allowed in this case). Simulations were conducted

**Table 2.** Characteristics of control variables

| Indicator | Description | Source of data |
|---|---|---|
| | Variables dedicated for each gender separately | |
| *ARR* | Aggregate replacement ratio – 'the ratio of the median individual gross pensions of 65–74 age category relative to median individual gross earnings of 50–59 age category, excluding other social benefits.'[3] | Eurostat |
| *HEALTH* | Self-perceived health by age 55–64 (subjective measure of health) which expresses subjective assessment by the respondent of his/her health. | Eurostat |
| *HLY* | Healthy life years at age 65 (objective measure of health) – the number of years a person is expected to continue to live in a healthy condition. | Eurostat |
| *EDU* | Population by educational attainment level (5–8, according to ISCED 2011 classification) and age (55–64). | Eurostat |
| *SELF-EMP* | Self-employment by age 55–74 – the proportion of population aged 55–74 working as self-employed. 'A self-employed person is the sole or joint owner of the unincorporated enterprise (one that has not been incorporated, i.e., formed into a legal corporation) in which he/she works, unless they are also in paid employment which is their main activity (in that case, they are considered to be employees)'[4]. | Eurostat |
| *UNEMP* | Unemployment rate in the age group 55–64. It measures the ratio between the number of unemployed persons and the labour force in the age group 55–64 based on International Labour Office (ILO) definition. Unemployed persons in a given age group are those who: ' – are without work during the reference week; – are available to start work within the next two weeks; – and have been actively seeking work in the past four weeks or had already found a job to start within the next three months'[5]. | Eurostat |
| | Variables common for both genders | |
| *ODR* | Old-age dependency ratio – the quotient of population aged 65 years and over and population aged 15–64 years. | Eurostat |
| *IR* | Interest rates – 'rates at which short-term borrowings are effected between financial institutions or the rate at which short-term government paper is issued or traded in the market. Short-term interest rates are generally averages of daily rates, measured as a percentage. Short-term interest rates are based on three-month money market rates where available.'[6] Long-term interest rates were also tested in the models however they turned out not to affect average effective retirement age significantly. | OECD |
| *GDP_PC* | Gross domestic product *per capita* in thousands of PPS (measured in current prices). | Eurostat |
| *S&W* | Salaries and wages as a percentage of GDP. | Eurostat |

Source: own elaboration on the basis of OECD and Eurostat information

separately for men and women. The following predictions were produced:

1. with the use of mean values of all the independent variables, i.e., *OCCUP* and controls (one base scenario for each gender),
2. with the use of changed *OCCUP* variables together with (similarly to the base scenario) mean values of control variables (ninety hypothetical scenarios for each gender).

The means of each variable were calculated for the whole cross-sectional time series (i.e., for all countries in the years 2008–2014, see Table A1 in the Appendix). The changes introduced to *OCCUP* variables were as follows: in each subsequent hypothetical scenario (1–10), the value of a given *OCCUP* variable (starting from *OCCUP1* and ending with *OCCUP9*) was increased by $1, 2, \ldots, 10$ percentage points, whereas other *OCCUP* variables were decreased proportionally to their values so as to keep the sum of all the *OCCUP* variables constant, as they reflected the occupational distribution. This way it was possible to identify occupational groups which positively or negatively impacted on the average effective retirement age.

[3] https://ec.europa.eu/eurostat/web/products-datasets/product?code=tespn070 (accessed June 7, 2020).
[4] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Self-employed (accessed January 8, 2019).
[5] https://ec.europa.eu/eurostat/en/web/products-datasets/-/TIPSUN20 (accessed June 7, 2020).
[6] https://data.oecd.org/interest/short-term-interest-rates.htm#indicator-chart (accessed January 8, 2019).

## 4. Results

The countries under study varied widely in terms of their occupational distribution. This can be seen in the standard deviations and the ranges (the differences between maximum and minimum values) of the $OCCUP$ variables (the statistical characteristics of all the variables used in the analysis are presented in Table A1 in Appendix A). Thus, to examine whether this variation shapes cross-country differences in terms of the average effective age of retirement was justified not only in substantial but also in statistical terms. The results of the estimation of both FE and RE models for the average effective age of retirement for men and women are presented in Table 3. As mentioned before, the $OCCUP10$ variable was removed from the estimation procedure due to collinearity and, as a result, from the simulation experiment. It constituted the smallest occupational group in the ISCO classification (armed forces, which was represented by less than 1% of the working population; see Table A1 in the Appendix) and their necessary omission did not affect the results significantly. The models indicated by the results of the Hausman test as better ones are in bold, and the further interpretation is based on them. However, it is worth emphasising that the differences between FE and RE models were minor (in the case of $OCCUP$ variables, they referred only to the values of the parameters, not to their statistical significance). Thus, for both FE and RE models the conclusions in terms of the nexus between occupational composition and cross-country differences in the average effective age of retirement are similar.

As for the $OCCUP$ variables in the models estimated, eight out of nine were statistically significant ($p < 0.05$) in the case of men ($OCCUP4$ – Clerks being the exception), and all nine were significant in the case of women. All of them had positive parameters which resulted from the construct of the first component of the model for $AER$, that is, a weighted average of occupation-specific factors (including the occupation-specific pensionable age) that influence the average effective retirement age. Thus, as mentioned before, a standard interpretation of the parameters next to the $OCCUP$ variables or their signs is not allowed in this case.

The estimates obtained for the occupational component of the model for $AER$ strongly suggest that the occupational composition of the economy has a relevant impact on the cross-country variation in the average effective retirement age. This nexus held, although some control variables were also statistically significant. In the case of men, $HEALTH$, $SELF\text{-}EMP$, $UNEMP$, $IR$, and $S\&W$ were such variables (providing that $p < 0.10$). In the case of women, these were $HEALTH$, $ODR$, $IR$, $GDP\_PC$, and $S\&W$. As reported, the similarity of the set of control variables that were statistically significant for cross-country differences in terms of the average effective retirement age was quite similar for both genders. The signs of parameters next to the significant control variables were generally consistent with expectations. The only variable that might have raised some doubts in this area was the unemployment rate ($UNEMP$) in the model for men. However, this could have resulted from one of the limitations of this study, which referred to the period under analysis: it includes the global recession that started after 2008 as a consequence of the financial crisis, which could have influenced retirement decisions. Between 2008 and 2014, according to Eurostat data, the unemployment rate in the EU28 in the $55 - 64$ age group increased by 2.0 percentage points (from 5.3% to 7.3%), whereas in the $20 - 64$ age group it was 2.8 percentage points (from 7.0% to 9.8%). Thus, the global recession was less detrimental for the employment of people around retirement than for the employment of younger people[7]. In the same time period, according to OECD data, the average effective age of retirement increased in the EU28 from 62.6 to 62.9 years for men and from 60.9 to 61.8 years for women[8]. This means that during the recession older workers remained economically active for longer despite a worsening labour market situation. The positive impact of such variables as health status ($HEALTH$), the ageing population process (reflected by the old-age dependency ratio – $ODR$), the interest rate ($IR$), or GDP per capita ($GDP\_PC$) was not surprising. In the context of studied nexus, a positive impact of salaries and wages as

[7] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsq_urgan&lang=en (retrieved on April 10, 2022)
[8] https://www.oecd.org/els/emp/Summary_1970%20values.xlsx (retrieved on June 7, 2020)

a percentage of GDP ($S\&W$) on the average effective retirement age captured at the macro-level is worth a more in-depth interpretation. This variable was included in the models as a proxy for the occupational composition of an economy. $S\&W$ can be perceived as an indicator determined by the distribution of population across occupations, since the share of salaries and wages in GDP is expected to be greater due to greater labour productivity. Thus, this control variable could complement the interpretation drawn from the occupational distribution reflected in the variables *OCCUP1*–*OCCUP9*. The positive signs of the parameter next to $S\&W$ in the models for both men and women suggest that in countries in which salaries and wages constitute a greater part of the GDP, people retire later on average.

**Table 3.** Models for average effective age of retirement for males and females

| | *AERm* | | | | *AERf* | | | |
|---|---|---|---|---|---|---|---|---|
| | FE | | RE | | FE | | RE | |
| *const* | −7.386 | | **−6.343** | | **−205.048** | *** | −182.561 | *** |
| *OCCUP1* | 0.506 | *** | **0.523** | *** | **2.433** | *** | 2.334 | *** |
| *OCCUP2* | 0.500 | ** | **0.518** | *** | **2.382** | *** | 2.212 | *** |
| *OCCUP3* | 0.477 | ** | **0.490** | *** | **2.392** | *** | 2.205 | *** |
| *OCCUP4* | 0.187 | | **0.188** | | **2.257** | *** | 2.076 | *** |
| *OCCUP5* | 0.589 | *** | **0.608** | *** | **2.442** | *** | 2.278 | *** |
| *OCCUP6* | 0.555 | ** | **0.533** | ** | **2.331** | *** | 2.218 | *** |
| *OCCUP7* | 0.498 | ** | **0.547** | *** | **2.574** | *** | 2.364 | *** |
| *OCCUP8* | 0.564 | *** | **0.597** | *** | **2.606** | *** | 2.437 | *** |
| *OCCUP9* | 0.442 | ** | **0.453** | ** | **2.447** | *** | 2.285 | *** |
| *ARR* | 0.047 | * | **0.033** | | **0.024** | | 0.039 | ** |
| *HEALTH* | 0.060 | ** | **0.047** | ** | **0.090** | *** | 0.070 | *** |
| *HLY* | −0.010 | | **−0.001** | | **−0.048** | | 0.000 | |
| *EDU* | −0.005 | | **−0.014** | | **−0.032** | | 0.018 | |
| *SELF-EMP* | 0.133 | | **0.208** | *** | **−0.070** | | 0.091 | |
| *UNEMP* | 0.099 | ** | **0.104** | *** | **0.046** | | 0.049 | |
| *ODR* | −0.056 | | **−0.005** | | **0.280** | *** | 0.169 | *** |
| *IR* | 0.086 | * | **0.084** | * | **0.087** | ** | 0.089 | ** |
| *GDP_PC* | 0.090 | | **0.045** | | **0.118** | ** | 0.075 | * |
| $S\&W$ | 0.329 | *** | **0.257** | *** | **0.280** | *** | 0.183 | *** |
| Test statistics: | | | | | | | | |
| Wald F(20, 107) | 15.124 | *** | | | **20.531** | *** | | |
| Breusch-Pagan chi^2 | | | **108.327** | *** | | | 33.207 | *** |
| Hausman chi^2 | | | **11.249** | | | | 65.190 | *** |

$p$-value: * $< 0.1$, ** $< 0.05$, *** $< 0.01$

The simulation using the estimated panel regression models led to the identification of occupational groups that positively or negatively affected average retirement age for either gender across the countries studied (see Figures 1 and 2). The horizontal axis represents the base scenario and the distinguished ten curves reflect ten hypothetical scenarios for different (from 1 to 10 percentage points) increases in each *OCCUP* variable separately (by the fixed sum of all *OCCUP* variables and fixed control variables). The points on the lines placed below the horizontal axis indicate a negative effect of an increase in a given *OCCUP* variable on the average effective retirement age, whereas points placed above the horizontal axis represent a positive effect. For both genders, the most detrimental impact on the average effective retirement age across the countries studied came from clerical professions. This simulation result corresponds well with empirical microdata for the US used by Sauré and Zoabi [39], where some types of clerical professions were characterised by a very low average effective retirement age among men. For instance, in the case of library attendants and assistants, it was 51.1 years; ticket, station, and express agents retired at 53.5 years; and mail carriers at 56.5 years. Similar results were obtained by McFall et al. [33], who reported lower employment probabilities after age 62 or 65 in such occupational groups as librarians, archivists, file clerks, records clerks, or auditing clerks.

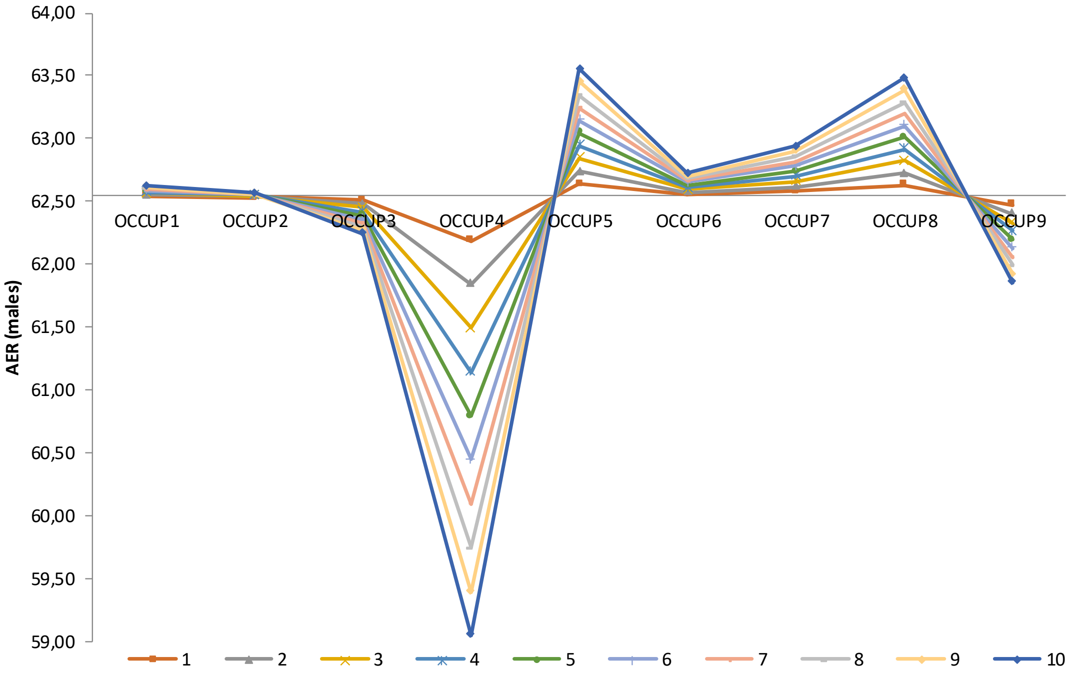


**Figure 1.** The results of simulation for males (10 scenarios)

Other occupations that negatively affected the average effective age of retirement, did so to a much lesser extent than did clerks. In the case of men, these were actually only the share of workers representing elementary occupations (the negative impact from technicians and associate professionals was very weak). When it comes to women, the occupations that negatively affected the average effective retirement age were skilled agricultural and fishery workers (the negative impact of professionals or technicians and associate professionals was very week). What positively affected the average effective retirement age across the studied countries was the greater share of plant and machine operators and assemblers, service workers, or shop and market sales workers and craft and related trades workers. In the case of men, a weak positive effect on retirement age was also reported by the share of skilled agricultural and fishery workers and in the case of women the share of workers representing elementary occupations was such a factor. It is worth emphasising that the interpretation of the simulation results deliver information consistent with the interpretation of the models parameters next to all $OCCUP1$–$OCCUP9$ variables standardized so as their sum equalled 0 (a mean value for the set of these parameters were calculated and subtracted from each parameter in the model for males and for females; the signs of the standardized parameters indicated the impact of a given occupational group on the effective retirement age similar to that obtained from the simulation experiment).

Obviously, this interpretation pertains to the simulation based on the mean values of the variables and did not refer to any particular country. Nevertheless, it provides an overview of the nexus investigated. Accounting for the range between the minimum and maximum values of occupational variables *OCCUP1–OCCUP9* across the selected countries, reaching from about 10 to almost 40 percentage points (see Table A1 in Appendix A), a pure impact of occupational composition on the cross-country variation in the average effective retirement age is definitely noticeable. There is also no doubt that behind each group of occupations there are some factors that alter a pure impact caused by the physical, mental, or psychological characteristics of different jobs. For instance, although the share of workers representing elementary occupations decreases the average effective retirement age of men, in the case of women, it very slightly increases this age. However, a more in-depth look into the occupations included in this

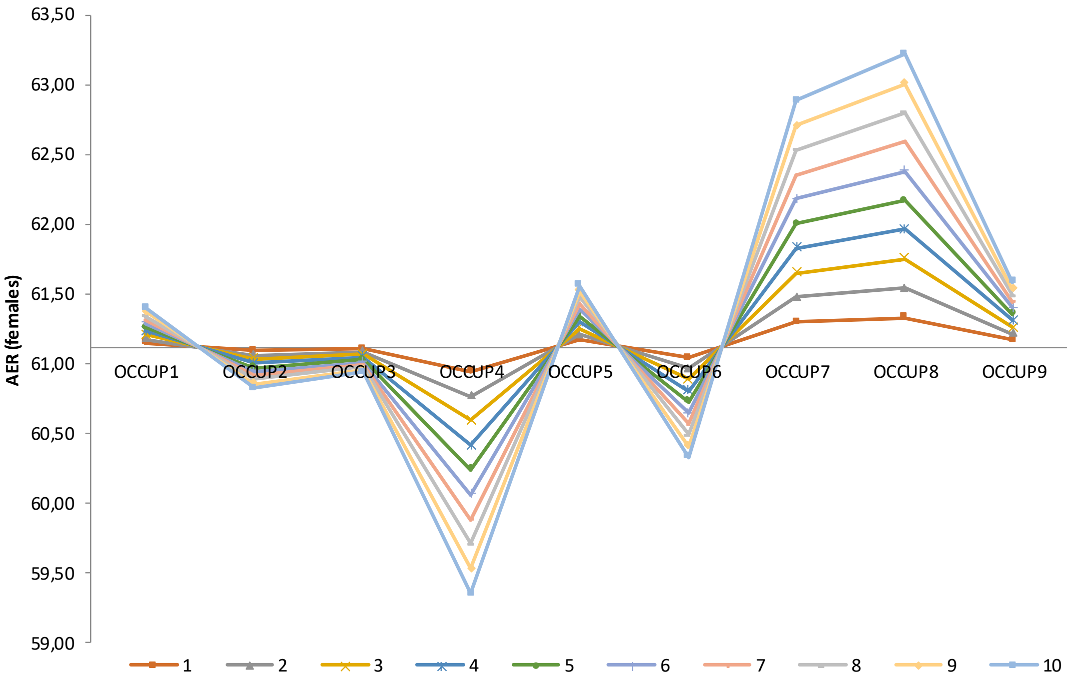


**Figure 2.** The results of simulation for females (10 scenarios)

group allows one to formulate some hypothetical premises which may be behind this. Mining and construction labourers belong to this group; these professions are typically held by men, not women. In the majority of countries, miners are permitted to retire earlier and receive some pension-related privileges. Other professions included in this group are domestic, hotel, and office cleaners and helpers, which are more likely to be held by women. These occupations are usually not well-paid. In the case of earning-related pension schemes (DC or DB), pension benefits paid for such workers are naturally low as well, since they are linked to earnings or contributions. Thus, females representing such occupations may be motivated to work longer in order to receive higher pensions. Simultaneously, such jobs are physically and psychologically less demanding than, for example, mining. More in-depth analyses of the relationships between the professions gathered in a given occupational group and the effective retirement age require information on the microdata level. That is why studies conducted on the basis of micro- and macrodata should be treated as complementary instead of alternative ones.

## 5. Discussion and conclusions

Many studies referred to in the literature review demonstrated on the basis of microdata that occupation affects an individual's decision about retirement. However, studies on the nexus between occupational composition observed on the macro-level and the cross-country variation in the average effective retirement age are quite rare. In fact, the only example of such an investigation is the paper by Sauré and Zoabi [39], which paved a new, interesting path of research exploration. This article tried to further develop this trail and to verify a similar hypothesis that the occupational composition of an economy determines the cross-country variation in the average effective retirement age.

The results obtained support a positive verification of this hypothesis and, therefore, they remain generally consistent with what is proven by the literature to be observed on the micro-level: as microdata studies report, there are some occupation-specific factors that determine an individual's or a household's decision of when to retire. Hence, all occupational groups can be characterized by these factors at a macro-level. An obvious example of such a factor is the pensionable age, which varies across professions. Thus, the explanation of the cross-country differences of effective retirement age based on the universal pensionable age is a simplification. The incorporation of occupational distribution to the model explaining these differences delivered very interesting results in the study by Sauré and Zoabi [39]. This article reinforces these findings, as the empirical approach differed from that of Sauré and Zoabi. Moreover, the analysis pertained to both genders. The simulation experiment showed that there were some differences between males and females in terms of the impact of occupational distribution on cross-country variation in the average effective retirement age. However, there is one common and convincing argument that refers to both genders, that is, what lowers the effective retirement age the most is the percentage of working population engaged in clerical work. The reason behind this can be the retirement privileges dedicated for public administration. On the other end of the spectrum were first of all plant and machine operators and assemblers, who most stimulated the effective retirement age of both genders.

The results suggest a kind of caution in any international comparisons of the effective retirement age that is limited to the using the design of a pension system or the universal pensionable age as the main reason for cross-country variation. Such comparisons should take the differences between countries in terms of occupational composition into account. As the simulation experiment conducted on the basis of estimated models demonstrated, a pure (based on the similar values of control variables for all the countries) effect of occupational variables on the cross-country variation in effective retirement age is noticeable.

The results of the study have some practical implications. Namely, the effective retirement age can be perceived as the boundary between the working generation and the generation of pensioners. In the era of ageing populations caused by increasing life expectancy, an intergenerational balance on both the micro- and macro-scale requires a steadily rising effective retirement age. On the micro-scale, this refers to the reasonable relationship between the working period (the accumulation phase in pension terms) and the retirement period (the decumulation phase in pension terms). On the macro-scale, this refers to the relationship between the working generation and the pensioners' generation. However, considerable research – including the present study – suggests that policy decisions limited only to the increase in the universal pensionable age cannot be effective, since the occupational composition of an economy is very relevant. This means that while stimulating an increase in the effective retirement age, the distribution of the population between different professions should be taken into account. This is an important constraint for creating a short-term, quick-acting retirement age policy, since a change in the occupational composition of an economy is impossible in the short term due to its inertia. Thus, a long-term labour market policy including effective and efficient age management strategies aimed at creating a dynamic distribution of agents between occupations, which requires mobility between different jobs across the life cycle so as to remain economically active for longer, seems to be a future that will come very soon. Otherwise, an ageing population retiring too early will be an enormous economic burden for younger generations, reducing their prospects for the future.

The study has some obvious limitations. The most important one relates to the statistical information that characterises the distribution of population across different occupations, which in the case of the Eurostat database are very general – reduced to ten major groups and total population at working age. Such data is not available for the preretirement age group (e.g., $55 - 64$). On the other hand, using a macro-panel has consequences in the limited number of observations for each indicator (as opposed to a micro-panel, which usually includes thousands of observations). This limits the number of independent variables in the regression models so as to retain a reasonable number of degrees of freedom. Naturally, people may change the occupation over the working-life cycle for which the data used does not account. This is mainly the consequence of the data set employed which is a macro panel. To address the possible changes of occupation by an individual would be possible only in the case of the appropriate micro survey data. Another limitation lies in the inference in terms of causal relationships which is very restricted in case of a cross-sectional time series, especially as compared with time-series analyses. However, an important advantage of regression for panel data is a lower omitted-variable bias through the inclusion of individual effects in the model. As mentioned in the Results section, the period under analysis covering the global financial crisis may have affected the results due to its abnormality (e.g., declining returns on financial markets, decreasing retirement saving, and increasing unemployment). Nevertheless, the data from 2008–2014 used in this study generally confirmed what was observed by Sauré and Zoabi for cross-sectional data from 2000.

### Disclosure statement

No potential conflict of interest was reported by the author.

**Funding:** This study was funded by the National Science Centre, Poland (2016/23/B/HS4/01772)

## References


[1] Agnew, J. R., Bateman, H., and Thorp, S. Financial literacy and retirement planning in Australia. *Numeracy* 6, 2 (2013), 1–25.

[2] Attanasio, O. P., and Brugiavini, A. Social security and households' saving. *The Quarterly Journal of Economics* 118 (2003), 1075–1119.

[3] Baltagi, B. H. *Econometric Analysis of Panel Data*. Wiley, 2013.

[4] Bernal, N., and Vermeulen, F. The impact of an increase in the legal retirement age on the effective retirement age. *De Economist* 162 (2014), 115–145.

[5] Blekesaune, M., and Solem, P. E. Working conditions and early retirement: a prospective study of retirement behavior. *Research on Aging* 27, 1 (2005), 3–30.

[6] Boisclair, D., Lusardi, A., and Michaud, P.-C. Financial literacy and retirement planning in Canada. *Journal of Pension Economics and Finance* 16, 3 (2017), 277–296.

[7] Bould, S. Unemployment as a factor in early retirement decisions. *American Journal of Economics and Sociology* 39, 2 (1980), 123–136.

[8] Brown, M., and Graf, R. Financial literacy and retirement planning in Switzerland. *Numeracy* 6, 2 (2013), 1–23.

[9] Bucher-Koenen, T., and Lusardi, A. Financial literacy and retirement planning in Germany. *Journal of Pension Economics and Finance* 10, 4 (2011), 565–584.

[10] Chirikos, T. N., and Nestel, G. Occupational differences in the ability of men to delay retirement. *The Journal of Human Resources* 26, 1 (1991), 1–26.

[11] Coile, C. C., and Levine, P. B. The market crash and mass layoffs: how the current economic crisis may affect retirement. *The B.E. Journal of Economic Analysis & Policy* 11, 1 (2011), 1–40.

[12] Coronado, J. L. The effects of social security privatization on household saving: evidence from the Chilean experience. *Finance and Economics Discussion Series* 12 (1998), 1–34.

[13] Dahl, S.-A., Nilsen, O. A., and Vaage, K. Work or retirement? Exit routes for Norwegian elderly. *Applied Economics* 32, 14 (2000), 1865–1876.

[14] Disney, R., Emmerson, C., and Wakefield, M. Ill health and retirement in Britain: a panel data-based analysis. *Journal of Health Economics* 25, 4 (2006), 621–649.

[15] Dwyer, D. S., and Mitchell, O. S. Health problems as determinants of retirement: are self-rated measures endogenous? *Journal of Health Economics* 18,2 (1999), 173–193.

[16] Feldstein, M. Social security, induced retirement, and aggregate capital accumulation. *Journal of Political Economy* 82, 5 (1974), 905–926.

[17] Feldstein, M. Social security and saving: new time series evidence. *National Tax Journal* 49, 2 (1996), 151–164.

[18] Filer, R. K., and Petri, P. A. A job-characteristics theory of retirement. *The Review of Economics and Statistics* 70, 1 (1988), 123–128.

[19] Fuinhas, J. A., Marques, A. C., and Couto, A. P. Oil-growth nexus in oil producing countries: macro panel evidence. *International Journal of Energy Economics and Policy* 5, 1 (2015), 148–163.

[20] Ghilarducci, T. The future of retirement in aging societies. *International Review of Applied Economics* 24, 3 (2010), 319–331.

[21] Gustafson, M. T. The market sensitivity of retirement and defined contribution pensions: evidence from the public sector. *Journal of Public Economics* 145, C (2017), 1–13.

[22] Hagan, R., Jones, A. M., and Rice, N. Health and retirement in Europe. *International Journal of Environmental Research and Public Health* 6, 10 (2009), 2676–2695.

[23] Hayward, M. D. The influence of occupational characteristics on men's early retirement. *Social Forces* 64, 4 (1986), 1032–1045.

[24] Hochguertel, S. Self-employment around retirement age. In *Entrepreneurship, Self-Employment and Retirement*. N. Sappleton and F. Lourenço, Eds. Palgrave Macmillan UK, 2015, pp. 209–258.

[25] Hong, J., and Knapp, M. Impact of macro-level socio-economic factors on rising suicide rates in South Korea: panel-data analysis in East Asia. *Journal of Mental Health Policy and Economics* 17 4 (2014), 151–162.

[26] Karpansalo, M., Manninen, P., Kauhanen, J., Lakka, T. A., and Salonen, J. T. Perceived health as a predictor of early retirement. *Scandinavian Journal of Work, Environment & Health* 30, 4 (2004), 287–292.

[27] Klapper, L., and Panos, G. A. Financial literacy and retirement planning: the Russian case. *Journal of Pension Economics and Finance* 10, 4 (2011), 599–618.

[28] Lusardi, A., and Mitchell, O. S. Financial literacy around the world: an overview. *Journal of Pension Economics and Finance* 10, 4 (2011), 497–508.

[29] Lusardi, A., and Mitchell, O. S. How ordinary consumers make complex economic decisions: financial literacy and retirement readiness. *Quarterly Journal of Finance* 7, 3 (2017), 1-31.

[30] Manoli, D. S., and Weber, A. The effects of the early retirement age on retirement decisions. *National Bureau of Economic Research*. Working Paper 22561, Cambridge, MA, 2016.

[31] Marmora, P., and Ritter, M. Unemployment and the retirement decisions of older workers. *Journal of Labor Research* 36, 3 (2015), 274–290.

[32] McFall, B. H. Crash and wait? The impact of the Great Recession on the retirement plans of older Americans. *American Economic Review* 101, 3 (2011), 40–44.

[33] McFall, B. H., Sonnega, A., Willis, R. J., and Hudomiet, P. Occupations and work characteristics: effects on retirement expectations and timing. *Michigan Retirement Research Center*. Working Paper Series 331, Ann Arbor, MI, 2015.

[34] McGarry, K. Health and retirement: do changes in health affect retirement expectations? *The Journal of Human Resources* 39, 3 (2004), 624–648.

[35] Mills, T. C. Forecasting compositional time series. *Quality and Quantity* 44, 4 (2010), 673–690.

[36] Parker, S. C., and Rougier, J. C. The retirement behaviour of the self-employed in Britain. *Applied Economics* 39, 6 (2007), 697–713.

[37] Ravishaiiker, N., Dey, D. K., and Iyengar, M. Compositional time series analysis of mortality proportions. *Communications in Statistics – Theory and Methods* 30, 11 (2001), 2281–2291.

[38] Rossi, N., and Visco, I. National saving and social security in Italy. *Ricerche Economiche* 49, 4 (1995), 329–356.

[39] Sauré, P., and Zoabi, H. Retirement age across countries: the role of occupations. Tech. rep., Swiss National Bank, 2012.

[40] Schmidt-Hebbel, K., and Serven, L. Saving across the world. Puzzles and policies. *World Bank Discussion*. Paper 354, World Bank, Washington DC, 1997.

[41] Schuetze, H. J. Self-employment and retirement in Canada: The labour force dynamics of older workers. *Canadian Public Policy* 41, 1 (2015), 65–85.

[42] Staubli, S., and Zweimüller, J. Does raising the early retirement age increase employment of older workers? *Journal of Public Economics* 108 (2013), 17–32.

[43] Szinovacz, M. E., and Davey, A. Predictors of perceptions of involuntary retirement. *The Gerontologist* 45, 1 (2005), 36–47.

[44] Tas, N., Hepsen, A., and Önder, E. Analyzing macroeconomic indicators of economic growth using panel data. *Journal of Finance and Investment Analysis* 2, 3 (2013), 41–53.

[45] van Rooij, M. C., Lusardi, A., and Alessie, R. J. Financial literacy and retirement planning in the Netherlands. *Journal of Economic Psychology* 32, 4 (2011), 593–608.

[46] Vermeer, N., Mastrogiacomo, M., and Soest, A. V. Demanding occupations and the retirement age. *Labour Economics* 43 (2016), 159–170.

[47] Wooldridge, J. M. *Econometric analysis of cross section and panel data*. The MIT Press, 2010.

[48] Yamada, T. The effects of Japanese social security retirement benefits on personal saving and elderly labor force behavior. *Japan and The World Economy* 2, 4 (1990), 327–363.

[49] Zheng, T., and Chen, R. Dirichlet ARMA models for compositional time series. *Journal of Multivariate Analysis* 158 (2017), 31–46.

# A. Appendix

**Table A1.** Statistical parameters of the variables

| | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|
| Males | | | | |
| *AER* | 62.54 | 2.07 | 57.93 | 68.04 |
| *OCCUP1* | 8.74 | 3.55 | 2.78 | 21.30 |
| *OCCUP2* | 13.12 | 4.42 | 6.13 | 26.46 |
| *OCCUP3* | 13.50 | 4.29 | 4.73 | 21.93 |
| *OCCUP4* | 5.93 | 2.40 | 2.25 | 12.98 |
| *OCCUP5* | 9.21 | 3.47 | 4.02 | 26.85 |
| *OCCUP6* | 4.58 | 3.04 | 0.79 | 14.63 |
| *OCCUP7* | 22.62 | 5.39 | 4.21 | 31.82 |
| *OCCUP8* | 13.19 | 3.48 | 6.53 | 20.90 |
| *OCCUP9* | 8.20 | 3.42 | 1.16 | 17.29 |
| *OCCUP10* | 0.91 | 0.56 | 0.00 | 2.59 |
| *RA* | 63.89 | 2.32 | 57.00 | 67.00 |
| *ARR* | 54.37 | 8.18 | 37.00 | 70.00 |
| *HEALTH* | 55.26 | 15.31 | 25.80 | 77.30 |
| *HLY* | 8.83 | 2.57 | 3.00 | 15.30 |
| *EDU* | 21.95 | 6.96 | 7.40 | 33.70 |
| *SELF-EMP* | 11.08 | 4.46 | 4.09 | 24.30 |
| *UNEMP* | 7.12 | 3.86 | 1.10 | 20.40 |
| Females | | | | |
| *AER* | 61.12 | 2.23 | 55.43 | 66.18 |
| *OCCUP1* | 4.52 | 2.02 | 1.30 | 11.43 |
| *OCCUP2* | 15.58 | 5.32 | 7.25 | 40.12 |
| *OCCUP3* | 15.79 | 6.13 | 4.47 | 43.74 |
| *OCCUP4* | 14.95 | 3.90 | 7.76 | 24.21 |
| *OCCUP5* | 21.50 | 5.62 | 3.99 | 34.07 |
| *OCCUP6* | 4.32 | 4.70 | 0.00 | 20.17 |
| *OCCUP7* | 4.85 | 2.93 | 0.82 | 12.57 |
| *OCCUP8* | 5.04 | 2.88 | 1.25 | 13.86 |
| *OCCUP9* | 13.37 | 4.70 | 2.91 | 26.60 |
| *OCCUP10* | 0.08 | 0.14 | 0.00 | 0.81 |
| *RA* | 62.77 | 2.71 | 55.00 | 67.00 |
| *ARR* | 51.66 | 6.53 | 40.00 | 68.00 |
| *HEALTH* | 52.98 | 15.32 | 19.90 | 74.40 |
| *HLY* | 9.01 | 2.91 | 2.70 | 16.70 |
| *EDU* | 20.26 | 8.57 | 7.00 | 41.70 |
| *SELF-EMP* | 3.99 | 2.36 | 1.57 | 16.29 |
| *UNEMP* | 6.08 | 3.55 | 0.60 | 19.70 |
| Common for males and females | | | | |
| *ODR* | 25.28 | 3.89 | 15.60 | 33.10 |
| *IR* | 1.84 | 1.93 | 0.21 | 8.90 |
| *GDP_PC* | 27.37 | 7.57 | 14.50 | 49.40 |
| *S&W* | 36.69 | 5.23 | 24.80 | 50.40 |