Lodz Economics Working Papers

The Workforce's Age Structure and Wages—Do Age and the Type of Occupation Matter?

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8/2018

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The workforce's age structure and wages—Do age and the type of occupation matter?

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Abstract

This study aims to analyse the relationship between a workforce's age structure and wages. Specifically, we aim to discover whether a relationship exists between the ageing workforce as observed in a majority of European countries and average wages. Economic theory posits that to some extent, the sign of this relationship may depend on the occupational group. We suppose that in those occupational groups that require constant investment in human capital, skills and experience increase with age, and therefore, wages should increase. Consequently, in groups in which formal qualifications are not as important as physical strength, productivity decreases with age, also causing a decrease in wages.

We confirm this hypothesis by using the Structure of Earnings Survey, which is collected every four years for European Union (EU) countries. We analyse the mean hourly wages across 9 major occupational groups in 27 EU economies for the period 2002–2014. Our primary variable of interest is the share of employed workers aged 50 years or older (hereafter, '50+') in a given occupational group. We also control for other available variables that may be important in the evolution of wages: the educational level, share of female workers, share of part-time workers, and the level of competition between employers.

The results confirm a significant relationship between the share of elderly workers and the average wages. The sign of this relationship is negative; thus, a high share of employed workers aged 50+ results in lower average wages. However, this relationship differed across occupational groups and over time.

JEL codes: J24, J31, J14.

Keywords: workforce ageing, age structure, wages, occupational groups.

Acknowledgements:

The project is financed by the National Science Centre, Poland, grant No: UMO-2017/25/B/HS4/02916. The authors would like to thank Dr Paweł Strawiński from the University of Warsaw as well as participants of the ESPAnet 2018 Conference for their valuable comments and suggestions.

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1. Introduction

A profound demographic shift has led to radical changes in populations' age structure in most developed economies. Although sizeable literature exists on population ageing and its impact on various economic variables, the change in the labour force's age distribution still seems to be overlooked. Therefore, this paper aims to analyse the relations between the workforce's age structure and wages. Specifically, aim to discover whether a relationship exists between the ageing workforce as observed in a majority of European countries and average wages.

Economic theory posits that two effects can be anticipated. First, the cohort effect—connected with a higher share of older workers relative to their younger colleagues—may push wages downwards (Sapozhnikov and Triest, 2007). Second, the composition effect indicates that the sign of the relationship between age structure and wages may depend on the occupational group. According to Mincer's (1974) models, skills and experience increase with age in the occupational groups that require constant investment in human capital, and therefore, wages should increase. Consequently, productivity decreases with age in those groups in which formal qualifications are not as important as physical strength, which also causes a decrease in wages.

We use the Structure of Earnings Survey, which is collected every four years for European Union (EU) countries, to analyse the relationship between the workforce's age structure and its wages. Subsequently, we analyse the mean hourly wages across major occupational groups[3] in EU economies for the period 2002 to 2014. Our primary variable of interest is the share of workers aged 50 years or older (hereafter, '50+') employed in a given major occupational group. We also control for other available variables that may be important in the evolution of wages: the educational level and the share of female workers, part-time workers, and those employed in larger companies.

We contribute to literature on ageing and its influence on the labour market as this is the first paper, to the best of the authors' knowledge, that directly analyses the relationship between workforce ageing and wage levels across occupational groups. Further, workforce ageing and its impact on wage structure have important implications for public policy.

The remainder of this paper is structured as follows: Section 2 presents the main findings from literature on workforce ageing and wages. Section 3 describes the workforce ageing process in EU countries. Section 4 describes the data and empirical model. Section 5 presents the results, and Section 6 concludes.

[3] This paper follows the classification from the International Standard Classification of Occupations (ISCO-08), available at: http://www.ilo.org/public/english/bureau/stat/isco/.

2. Workforce ageing and wages—Previous research and theoretical background

Numerous studies have researched the impact of changes in the labour force's age distribution on wages. However, to the best of the authors' knowledge, population ageing's impact on wages in particular occupational groups remains under-researched.

Current literature on wages and age primarily asserts that workers with different labour market experience are imperfect substitutes in production (Sapozhnikov and Triest, 2007). Workers acquire human capital and gain experience through on-the-job training and learning-by-doing. The supply of labour with a given experience increases with an ageing population, and thus, workers' wages in that group will tend to decrease relative to those with different experience levels, as Sapozhnikov and Triest (2007) state. Therefore, cohort effects may lead to lower average wages as the labour force's average age increases. Maestas et al. (2016) parallel this theory and claim that an increase in the fraction of the population aged 60 years and older drives down average wages.

Aside from cohort effects, literature examines workers' wages as they depend on individual productivity. Economic theory posits that wages should reflect labour productivity, at least to some extent. Therefore, a popular approach to assess the relationship between age and wages involves comparing age-productivity and age-wage profiles. However, it is difficult to assess the extent to which workers' productivity declines with age. Productivity, and especially that of individuals, is difficult to measure; further, assessing a point at which it begins to decline remains problematic. Although many empirical studies suggest that productivity declines with age, no agreement exists as to at which point the age effect occurs. Moreover, some studies find no clear decrease in productivity as employees age (Aubert and Crépon, 2003; Hellerstein et al., 1999). Most empirical research confirms that workers' productivity peaks from ages 30 to 45, and begins to visibly decline around the age of 50 years (e.g. Cataldi et al., 2011; Göbel and Zwick, 2009; Skirbekk, 2008). Therefore, an individual worker's age-wage profile typically peaks around the ages of 40 to 50 years.

Hellerstein and Neumark's (1995) comparison of age-productivity and age-wage profiles reveals an upward-sloping age-wage profile that mirrors the upward-sloping age-productivity profile. According to economic theory, a decrease in earnings with age may result from three main reasons. First, this can be attributed to workers' declining productivity. Feyrer (2008) favours this approach, and notes that typical estimates of the return to experience from Mincer's wage regressions imply a 60% difference between the productivity of 20- and 50-year-old workers. Second, firms invest less in older workers, as they often regard them as less profitable. Third, the possibility exists that older workers will receive lower wages if they constitute a higher share of the labour supply and consequently experience higher job competition as they have less bargaining power than younger groups. The potential decrease in productivity also varies among different groups of employees, depending on the sectors they work in, their tasks, and their role as human capital.

Analysing individuals' panel data may lead to different conclusions. Myck (2007) used data from Germany and Great Britain to prove that earnings at the individual level do not necessarily decline with age. This outcome is consistent with theories that involve incentive contracts, which indicate that wage growth is also possible in the absence of human capital growth. Lazear (1981) revealed that older workers may receive higher wages to address the problem of moral hazards and imperfect information. Further, several studies indicate that non-cognitive or social skills are as important as cognitive skills, and are associated with higher wage premiums (Heckman and Rubinstein, 2001;

Postlewaite and Silverman, 2006). In line with this theory, Mahlberg et al. (2013) examine an Austrian panel's dataset to find no proof regarding older employees' overpayment. However, they find a negative relationship between the proportion of young employees and wages, as well as labour productivity, which is more prevalent in the industry and construction sectors. In another example, a case study of German car manufacturers found evidence that more experienced—and hence, older—workers were more productive than younger ones (Börsch-Supan et al., 2008).

Dostie (2011) finds that both wage and productivity profiles are concave, but productivity diminishes faster than wages for workers aged 55 years and older. Cardoso et al. (2011) present contradictory results, in that productivity increases until age 50 to 54, but wages peak around age 40 to 44. These differences in the shape of both profiles serve as motivation for this paper. Further, it is possible that the pace at which a worker's productivity declines has some impact on his or her wages.

Some studies are restricted to particular sectors, which is similar to our approach to some extent. Mahlberg et al. (2008) analysed data on the manufacturing and mining industry to discover that older workers' decreasing productivity occurs relative to plant-specific decreased productivity, as these workers are more often employed in firms with older technologies. After controlling firms' fixed effects, a positive relationship is revealed between productivity and firms' ratio of elderly employees. Göbel and Zwick (2011) also analysed sector differences in age and productivity profiles by using representative, linked employer-employee panel data. However, they found no significant differences in the age-productivity profiles between the manufacturing and related service sectors. Although it has been established that physical performance is crucial for employees in the manufacturing sector, but declines with age (Ilmakunnas et al., 1999; Hageland and Klette, 1999; Hellerstein et al., 1999), varying results exist for mental performance (Bazen and Charni, 2015; Ng and Feldman, 2008; Sturman, 2003). For example, Van Ours (2009) analysed blue-collar workers' productivity using a professional runner as an example, as well as white-collar workers by taking the number of publications in economic journals as a measure of productivity. He proved that blue-collar workers' productivity decreases significantly after the age of 40. However, he did not confirm a similar dependence for white-collar workers, even for those aged 50+. This dependent relationship between age and productivity in different sectors was also analysed by Van Ours and Stoeldraijer (2010), Daveri and Maliranta (2007), and Lallemand and Rycx (2009).

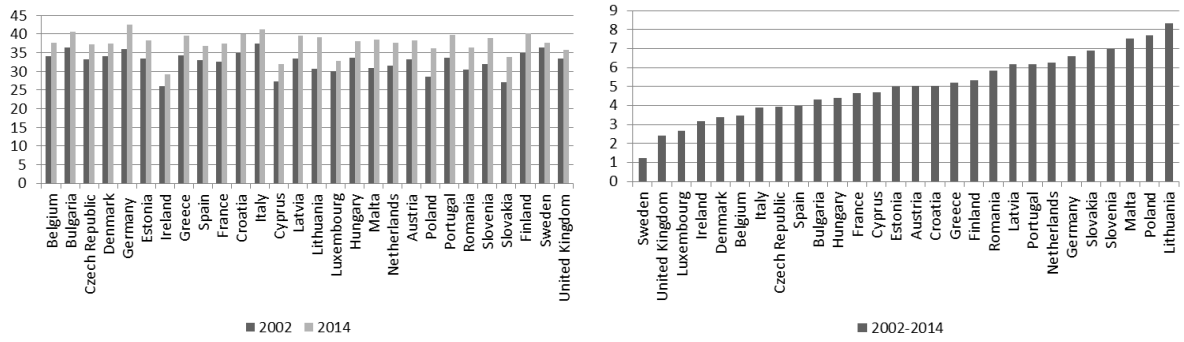
This prior literature suggests that the dependencies between age and productivity may vary between occupational groups. Therefore, it would be useful to define whether the particular sectors include occupations with increasing or decreasing productivity potential. On the one hand, as skills and experience increase in occupational groups that require constant investment in terms of their human capital, salaries should also increase. On the other hand, productivity—and hence, wages—decline with age in groups in which formal qualifications are not as important as physical strength. Veen (2008) distinguishes between occupations that have an increasing productivity with age, such as lawyers, professors, managers, medical doctors or engineers; occupations that are age-neutral, such as bank or commercial clerks, or electronic engineers; and occupations that have a declining productivity with age, such as brick layers, tilers or basic administrators. To the best of the authors' knowledge, no studies have analysed an ageing workforce's impact on wages across occupational groups.

3. The European Union's workforce-age distribution

Most developed economies currently experience population ageing. Changes in the populations' age structure create many challenges for policymakers, relative not only to maintaining pension systems' sustainability or financing long-term care, but also to the labour market. Two factors primarily cause this demographic shift: First, fertility rates in most European countries are declining to below the replacement rate, which is set at 2.1 children per woman. Further, women are postponing the decision to have a first baby, which results in increases in the mothers' mean age at birth. Second, prolonged longevity has contributed to an ageing population. According to Eurostat, life expectancy in the EU increased by 2.9 years over the last 15 years, from 77.7 in 2000 to 80.6 years in 2015. Life expectancy at birth is also increasing due to many factors, including decreases in infant mortality rates, increasing standards of living, improved lifestyles and better education, and advantageous healthcare.

The number of people aged 50+ in European Union countries (the EU-28) increased by 19% between 2002 and 2014[4]. The share of people aged 50+ in the total population increased from 34% in 2002 to 38% in 2014. However, the demographic situation significantly differs among countries. In 2014, the oldest countries in terms of their ratio of the population aged 50+ to the total population were Germany and Italy, with the share of the 50+ population exceeding 40% (see Figure 1). Ireland remains the youngest country in the EU, with a share of 50+ population ratio still less than 30%; however, its demographic situation is different due to high immigration in the 2000s and these immigrants' relatively high fertility rates.

Figure 1. Percentage population share of people aged 50 years or older in EU countries (left, 2002 and 2014) and its changes (right, from 2002–2014)



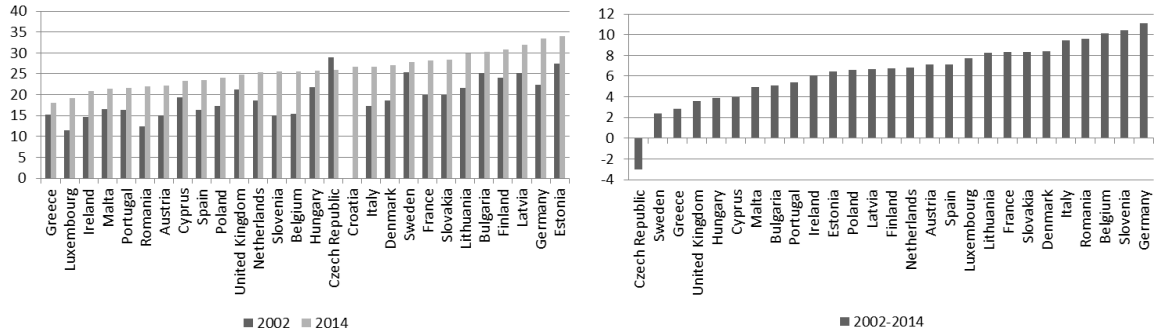
Source: Eurostat.

One consequence of population ageing involves changes in the structure of the workforce. Further, changes in the population age structure lead to a decrease in the labour supply in the European Union. Official statistics from the Eurostat database indicate that the labour force in EU member countries is expected to decrease by nearly 12% between 2020 and 2060. While the labour force is shrinking, its age structure is also changing, as middle-aged and elderly people constitute a growing

[4] As the data used in the empirical part of this paper refers to the period of 2002–2014, we decided to use the same period here for comparison.

proportion. This shift in the workforce composition from relatively young to older workers is also known as 'workforce ageing'. Consequently, the share of workers aged 50+ in the labour force has substantially increased in more recent years, especially in countries such as Germany, Belgium and Italy, and also in Slovenia and Romania (see Figure 2).

Figure 2. Percentage share of the workforce aged 50 years or older in EU countries (left, 2002 and 2014) and its changes (right, 2002–2014)



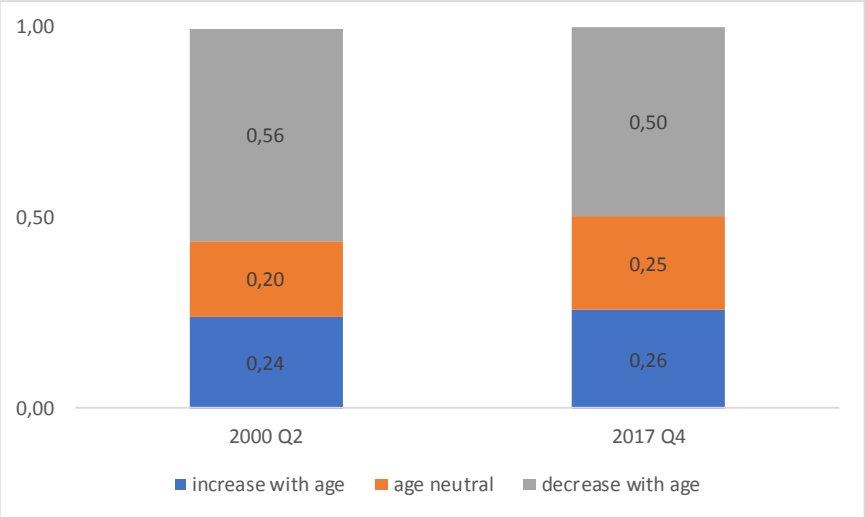
Source: Eurostat data and the authors' calculations.

Although more people aged 50+ are active in the labour market, they seem to be concentrated in specific occupational groups. If workforce ageing's impact on wages differs between sectors, its aggregate impact will depend on the economy's industrial structure. Figure 3 presents a decomposition of occupations that employ workers aged 50+ in the EU. We divided these into three categories following work by Venn (2008): the 'increases with age' category includes managers and professionals, or the first and second major occupational groups, respectively;[5] the 'age-neutral' category, which includes clerical support and services and sales workers, or the fourth and fifth major occupational groups, respectively; and the 'decreases with age' category, which includes technicians and associate professionals, skilled agricultural and fishery workers, craft and related trade workers, plant and machine operators and assemblers, and elementary and armed forces occupations (major occupational groups: third, sixth, seventh, eighth, ninth, and none).

Regarding the EU as a whole, the data reveals a workforce concentration in occupations in which productivity decreases with age, as half of the workers in this age group were employed in those occupational groups in 2017. While this percentage has decreased since 2000, the same percentage of older workers has remained in occupations in which productivity should increase with age, or approximately 25%. Further, 25% of older workers are employed in purported 'age-neutral' occupations, and this percentage has increased since 2000.

[5] According to the ISCO-08, nine major occupational groups exist, as follows: 1) Managers, 2) Professionals, 3) Technicians and associate professionals, 4) Clerical support workers, 5) Service and sales workers, 6) Skilled agricultural and fishery workers, 7) Craft and related trade workers, 8) Plant and machine operators and assemblers, and 9) Elementary occupations. The armed forces group (0) is typically treated as separate and not included in economic analyses.

Figure 3. Employment structure for workers aged 50 years and older in one-digit occupational groups according to changes in productivity with workers' age (%)



Source: Eurostat data and the authors' calculations.

A deeper observation of the changes that have occurred over recent years in the EU reveals an increase in the share of workers aged 50+ across all major occupational groups (see Figure 4), although the magnitude of such changes differs among the sample. The greatest changes were apparent in the craft worker, plant and machine operator and assembler, and elementary occupational groups; however, managers were also among the oldest occupational groups. The process of workforce ageing also significantly differs between EU countries. For example, the share of elderly workers among managers (the first major occupational group) differed in 2014, from 21% in Ireland to 51% in Italy (see Figure A1 in the Appendix). Differences are also observed with skilled manual and elementary workers: the share of workers aged 50+ employed in elementary occupations varied in 2014, from 17% in Romania to 47% in Estonia.

Figure 4. Share of workers aged 50 years or older employed in a given occupational group across the EU in 2002 and 2014 (%)

Source: Eurostat data and the authors' calculations.

4. Data and empirical approach

We analyse the relationship between the workforce's age structure and wages by using the Structure of Earnings Survey, which is published by Eurostat every four years for all European Union countries. As the available dataset encompasses the period 2002 to 2014, our survey includes four rounds.

To consider the possible differences in the relationship between the share of workers aged 50+ and wages by occupation, we analyse data for the major occupational groups according to the International Standard Classification of Occupations (ISCO-08). Data on the eight major occupational groups are analysed for each country, although skilled agricultural, forestry and fishery workers were excluded from the analysis due to missing data for many countries. Regarding the analysed countries, Croatia was excluded from the sample due to missing data for many variables. Therefore, we analyse a set of eight occupational groups for 27 EU countries in four time periods, which provides 864 observations for each variable.

The dependent variable is the mean hourly wages[6] across the eight major occupational groups in 27 EU economies over the analysed period. Wages concern the business economy, or economic sections B-N). Purchasing power standard data are used to enable a comparison across countries and years.

The primary variable of interest is the share of employed workers aged 50+. We also control for other socio-economic variables that can impact wage levels. However, their set is limited by data availability and includes the share of workers with a tertiary education; the share of female or part-time workers; and the share of workers employed in larger firms, or firms that have 1,000 or more employees. We also include year dummies to control for other factors that could affect changes to average wages over time.

According to economic theory and the available empirical evidence, we anticipate a positive relationship between the share of tertiary-educated workers and the share of those employed in larger firms and the average wage level, and negative effects between the share of female workers and part-time workers and average wages.

Table 1 presents the descriptive statistics of the variables used in the model.

[6] Hourly gross earnings are defined as the gross earnings in the reference month divided by the number of hours paid during the same period. The number of hours paid includes all normal and overtime hours worked and remunerated by the employer during the reference month. Hours not worked but nevertheless paid—such as annual leave, public holidays, paid sick leave, paid vocational training, or paid special leave—are counted as 'paid hours'. (Source: Eurostat).

Table 1. Descriptive statistics of the model's variables

	Obs.	Mean	Std. Dev.	Min	Max
Ln(wages)	861	2.284	0.655	0.166	3.784
Share50+	853	0.235	0.073	0.057	0.508
Tertiary	818	0.287	0.286	0.003	0.990
Female	860	0.385	0.188	0.016	0.815
Parttime	830	0.132	0.141	0.001	0.757
Bigfirm	829	0.279	0.137	0.015	0.817

Source: Eurostat data and the authors' calculations.

An extended Mincer equation was used to estimate the relationship between logarithmic wages and the above variables. The analytical form of the estimated equation is as follows:

$$\ln(wage_{i,j,t}) = \beta_0 + \beta_1 share50_{i,j,t} + \beta_2 tertiary_{i,j,t} + \beta_3 female_{i,j,t} + \beta_4 parttime_{i,j,t} + \beta_5 bigfirm_{i,j,t} + \beta_6 year_t + \varepsilon_{i,j,t}$$

where:

$wage_{i,j,t}$ – the average hourly gross wages in major occupational group *i* in country *j* at time *t* (PPS),

$share50_{i,j,t}$ – the share of workers aged 50 or older in major occupational group *i* in country *j* at time *t*,

$tertiary_{i,j,t}$ – the share of tertiary-educated workers in major occupational group *i* in country *j* at time *t*,

$female_{i,j,t}$ – the share of female workers in major occupational group *i* in country *j* at time *t*,

$parttime_{i,t}$ – the share of part-time workers in major occupational group *i* in country *j* at time *t*,

$bigfirm_{,j,t}$ – the share of workers employed in larger firms in major occupational group *i* in country *j* at time *t*,

$year_t$ – the time variable, and

$\varepsilon_{i,j,t}$ - the error term.

We begin by estimating the parameters from the above Equation (1) for the entire pooled sample of workers in the eight major occupational groups, then derive the average value of wage elasticity relative to each of the explanatory variables. Specifically, we aim to understand the relationship between the proportion of workers aged 50+ and wage levels. As the relationship between the proportion of workers aged 50+ and wages can vary depending on the type of occupation, we allow the parameter β_1 to vary across major occupational groups (at a one-digit occupational level). This allows an investigation of occupations in which the proportion of workers aged 50+ affects the average wage level. In the next step, we then check the stability of our parameter of interest regarding time and between groups of countries.

The parameters from Equation (1) were estimated using an ordinary least squares (OLS) method with robust standard errors, fixed- (FE) and random-effect (RE) estimators, and a feasible generalised-least squares method allowing for a heteroskedastic error structure (GLS)[7].

5. Results

In the first step, we estimated the parameters of Equation (1) for the entire sample of workers, as presented in Table 2. The results demonstrate an insignificant relationship between average wages and the proportion of workers aged 50+ in a given occupational group among the entire sample,[8] which may be due to the sample's strong heterogeneity.

As anticipated, average wages increase with the share of tertiary-educated workers, and are negatively affected by the share of employed women. However, an unexpected effect occurred for part-time workers. The higher the share of part-time workers for a given occupational group, the higher the average wages. This issue may seem controversial, although it may be due to countries with a relatively high share of part-time workers (Germany, Denmark, the Netherlands), as these also have the highest share of workers employed in part-time jobs. The share of part-time workers can also positively correlate with the share of females across occupational groups. However, the correlation coefficient between these two variables in the entire sample is not very high (0.37). Finally, the higher the share of workers employed in larger firms—or those with 1,000 or more employees—the higher the average wages.

Table 2. Estimated parameters of Equation (1) for the entire sample of workers: All occupational groups across 27 countries; from 2002–2014

	OLS	FE	RE	GLS
share50	-0.151	-0.663**	-0.611**	-0.078
	(0.286)	(0.228)	(0.216)	(0.109)
tertiary	1.022***	0.000	0.711***	0.977***
	(0.062)	(0.143)	(0.090)	(0.023)
female	-1.856***	-1.063***	-1.351***	-1.808***
	(0.085)	(0.151)	(0.122)	(0.031)
parttime	1.094***	-0.012	0.319*	1.131***
	(0.128)	(0.149)	(0.133)	(0.052)
bigfirm	1.244***	-0.046	0.240*	1.224***
	(0.137)	(0.098)	(0.097)	(0.046)
year	0.015***	0.031***	0.024***	0.012***
	(0.004)	(0.002)	(0.002)	(0.001)
constant	-27.304***	-58.935***	-46.155***	-21.871***
	(8.055)	(3.943)	(3.627)	(2.681)
R-squared	0.526	0.351		
Hausman			378.08	
(Prob > chi^2)			(0.0000)	
Wald chi^2			692.6294	6,304.465
N	761	761	761	761

[7] As our panel is wide (27 countries x 8 occupational groups) but short (only 4 observations over time), we do not control for a panel-specific autocorrelation structure as the number of estimated parameters then sharply increases.

[8] We consider GLS estimates to be more reliable.

* p < 0.05, ** p < 0.01, *** p<0.001.

Ordinary least squares (OLS), fixed-effects (FE), random effects (RE), and feasible generalized least squares with heteroskedastic error structure (GLS) are used.

Source: The authors' calculations.

We use the second step to check whether differences exist in the relationship between wages and the share of workers aged 50+ between groups, and we allow the parameter of interest to vary across the eight major occupational groups.

The results (see Table 3) indicate that the relationship between age structure and wages is significant across all occupational groups[9]. In most of the groups with a negative parameter, a higher share of employed workers aged 50+ is accompanied by lower average wages. Only in two groups is the relationship both positive and significant: managers, as the first occupational group, and clerical support workers, as the fourth group. Regarding the latter group, its positive relationship may be explained by the fact that a majority of clerical workers are employed in the public sector, with wages increasing with age due to a seniority wage scheme.

The strongest negative relationship between the share of workers aged 50+ and wages are observed in those occupational groups in which physical rather than mental qualifications are required, such as manual and elementary workers, ie. seventh, eighth, and ninth major groups; and among service and sales workers (fifth group. Older workers' wages in those groups are lower due to their lower productivity as well as the higher competition among them for existing jobs.

According to economic theory, we could anticipate a relationship between a share of older, more experienced workers and wages to be positive for jobs that require constantly improving human capital, such as professionals in the second group. This major occupational group is incredibly heterogeneous; on the one hand, this group includes medical doctors, lawyers, and academics, whose wages increase with both age and work experience. On the other hand, the group includes IT workers and new technology engineers, among others. Rapid technological progress over the last several years has required higher or more relevant qualifications for young or medium-aged workers in these occupations than for elderly workers. This would explain the estimated parameter's negative sign, as the sharing of these modern occupations among professionals has significantly increased.

[9] Here, and in further analyses, we refer to the GLS estimates as the most reliable.

Table 3. Estimated parameters of Equation (1) allowing the parameter by share of workers aged 50+ to vary by workers' major occupational groups in 27 countries, from 2002–2014

	OLS	FE	RE	GLS
share50_group1	0.491*	-0.708	0.746**	0.698***
	(0.230)	(0.518)	(0.289)	(0.110)
share50_group2	-0.848*	-0.439	-0.137	-0.816***
	(0.343)	(0.610)	(0.450)	(0.184)
share50_group3	-0.403	-1.653***	-0.650	-0.390**
	(0.327)	(0.459)	(0.342)	(0.132)
share50_group4	1.102*	-1.688***	-0.621	0.964***
	(0.439)	(0.480)	(0.356)	(0.177)
share50_group5	-1.410*	0.573	-1.140**	-1.313***
	(0.620)	(0.477)	(0.408)	(0.262)
share50_group7	-3.079***	0.134	-1.617***	-2.881***
	(0.355)	(0.474)	(0.362)	(0.172)
share50_group8	-2.359***	-0.636	-1.442***	-2.302***
	(0.337)	(0.374)	(0.311)	(0.157)
share50_group9	-1.827***	-0.629	-1.663***	-1.699***
	(0.318)	(0.527)	(0.323)	(0.154)
tertiary	0.548***	0.110	0.386***	0.543***
	(0.113)	(0.154)	(0.117)	(0.047)
female	-2.793***	-1.037***	-1.507***	-2.633***
	(0.172)	(0.156)	(0.130)	(0.068)
parttime	1.463***	-0.071	0.574***	1.392***
	(0.144)	(0.149)	(0.134)	(0.066)
bigfirm	0.822***	-0.094	0.296**	0.843***
	(0.124)	(0.099)	(0.099)	(0.054)
year	0.023***	0.030***	0.028***	0.021***
	(0.003)	(0.002)	(0.002)	(0.001)
constant	-43.297***	-57.883***	-52.479***	-39.104***
	(6.861)	(4.053)	(4.008)	(2.955)
R-squared	0.677	0.369		
Wald chi^2			778.4775	7,293.089
N	761	761	761	761

* p < 0.05, ** p < 0.01, *** p < 0.001

Source: The authors' calculations.

The stability of the parameter of interest in time is analysed to check the results' robustness. Table 4 presents the results of the exercise performed separately for each of the four periods. Although the relationship between the share of workers aged 50+ and average wages was strong and negative in the first period; it weakened and turned positive in the year 2014. This may be interpreted as a reflection of changes in the workforce's educational and occupational structure. The share of employees aged 50+ grows in those occupational groups in which productivity increases with age (Veen, 2008) and is also reflected by wages to some extent. The other model parameters are rather stable, while only the relationship between the share of female workers and average wages has weakened.

Table 4. Estimated parameters of Equation (1) separately for each analysed period of time, across all occupational groups and all 27 countries

	2002	2006	2010	2014
share50+	-0.534***	-0.371***	-0.269*	0.714***
	(0.112)	(0.088)	(0.110)	(0.086)
tertiary	1.054***	0.953***	0.902***	1.154***
	(0.013)	(0.012)	(0.015)	(0.019)
female	-2.229***	-1.881***	-1.785***	-1.524***
	(0.031)	(0.015)	(0.028)	(0.017)
parttime	1.864***	1.202***	0.662***	0.821***
	(0.040)	(0.038)	(0.028)	(0.021)
bigfirm	1.124***	1.288***	1.369***	1.155***
	(0.047)	(0.010)	(0.045)	(0.031)
constant	2.349***	2.303***	2.396***	2.020***
	(0.022)	(0.020)	(0.029)	(0.024)
Wald chi^2	31,705.21	34,739.71	9,629.518	96,826.75
N	174	186	197	204

* p < 0.05, ** p < 0.01, *** p < 0.001

The GLS estimates with a heteroskedastic error structure are applied here. Source: The authors' calculations.

Another additional feature that serves as a robustness check involves not only performing separate regressions for each time period, but allowing the parameter by the share of workers 50+ to vary across occupational groups (see Table 5). A negative relationship was observed at the beginning of the analysed period between the share of workers aged 50+ and average wages in all but the fourth occupational group. In subsequent years, this becomes positive for the first and third occupational groups, while the results from the second major occupational group became insignificant at the end of the analysed period. However, this may be explained by a more detailed analysis of the jobs performed in this group, which calls for further research as this paper remains at the major occupational group level. Regarding groups in which physical qualifications are needed, we can observe that the strong, negative relationship has significantly weakened. Another noteworthy issue involves the weakening of the relationship between the share of women and the average wages over time, which indicates that the wage differences between men and women may have partially decreased.

Table 5. Estimated parameters of Equation (1) separately for each analysed period of time with varying parameter by share of workers aged 50+ across occupational groups

	2002	2006	2010	2014
share50_group1	-0.478***	0.350***	0.580***	1.355***
	(0.099)	(0.096)	(0.080)	(0.099)
share50_group2	-1.420***	-1.682***	-0.612***	0.016
	(0.090)	(0.196)	(0.120)	(0.178)
share50_group3	-0.626***	-0.613***	-0.484***	0.299**
	(0.114)	(0.131)	(0.095)	(0.109)
share50_group4	2.713***	1.159***	0.958***	0.983***
	(0.233)	(0.171)	(0.130)	(0.081)
share50_group5	-1.548***	-1.388***	-1.151***	-1.006***
	(0.187)	(0.316)	(0.156)	(0.162)
share50_group7	-4.958***	-3.024***	-3.165***	-1.798***
	(0.142)	(0.150)	(0.110)	(0.080)
share50_group8	-3.312***	-1.950***	-2.567***	-1.389***
	(0.120)	(0.144)	(0.127)	(0.083)
share50_group9	-2.393***	-1.554***	-1.696***	-1.226***
	(0.191)	(0.142)	(0.105)	(0.097)
tertiary	0.628***	0.780***	0.382***	0.525***
	(0.039)	(0.051)	(0.023)	(0.042)
female	-3.794***	-2.629***	-2.813***	-2.207***
	(0.057)	(0.048)	(0.042)	(0.039)
parttime	2.374***	1.479***	0.940***	1.221***
	(0.061)	(0.072)	(0.048)	(0.047)
bigfirm	0.415***	0.943***	0.970***	0.860***
	(0.053)	(0.054)	(0.044)	(0.037)
constant	3.393***	2.863***	3.212***	2.800***
	(0.035)	(0.033)	(0.027)	(0.023)
R-squared				
Wald chi^2	31,565.68	18,132.49	53,762.97	44,457.67
N	174	186	197	204

* p < 0.05, ** p < 0.01, *** p < 0.001

The GLS estimates with a heteroskedastic error structure are applied here. Source: The authors' estimates.

6. Conclusions

This paper aimed to analyse the relationship between the workforce's age structure and average wages. Specifically, we aimed to discover whether a relationship exists between what can be observed in a majority of European countries' workforce ageing and average wage levels. An analysis was performed on the levels of major occupational groups across EU countries in the period 2002–2014.

The results indicate that the relationship between share of workers aged 50+ and the average wages in a given occupational group is insignificant for the entire sample due to the sample's incredibly strong heterogeneity. Further, the relationship between age structure and wages is diversified across occupational groups as well as over time.

In the occupational groups in which productivity decreases with age—such as among craft workers, machine and plant operators, and elementary workers—the relationship between the share of workers aged 50+ and average wages was found to be strongly negative and significant. However, it is noteworthy that although the share of workers aged 50+ in these occupational groups has significantly increased in all EU countries over the analysed period, the analysed relationship has weakened.

Clerical support workers are the only major occupational group in which a positive, significant relationship existed during the entire period between workers aged 50+ and average wages. This may be because a majority of clerical workers are employed in the public sector, with wages increasing with age due to a seniority scheme. A positive, significant relationship between workers aged 50+ and wages was also found at the end of the analysed period among managers. We also anticipated a positive relationship among professionals, as most of the workers need constant improvement in human capital, and workers' productivity is assumed to increase with age. However, the average results indicate a negative sign for this relationship, which is ultimately insignificant. This may be explained by the heterogeneity in this major occupational group—on the one hand, the group includes medical doctors, lawyers and academics with wages that increase with age and work experience. On the other hand, it includes IT workers and new technology engineers, among others. Rapid technological progress in recent years may require qualifications for young or medium-aged workers in these occupations to be higher or more relevant for the market than elderly workers' knowledge. Nevertheless, this issue calls for further research.

Calling for policy recommendations, we found that the workforce's ageing as observed in a majority of European Union countries significantly impacted wage levels. However, the sign of this relationship in a given country will depend on the workforce's occupational structure.

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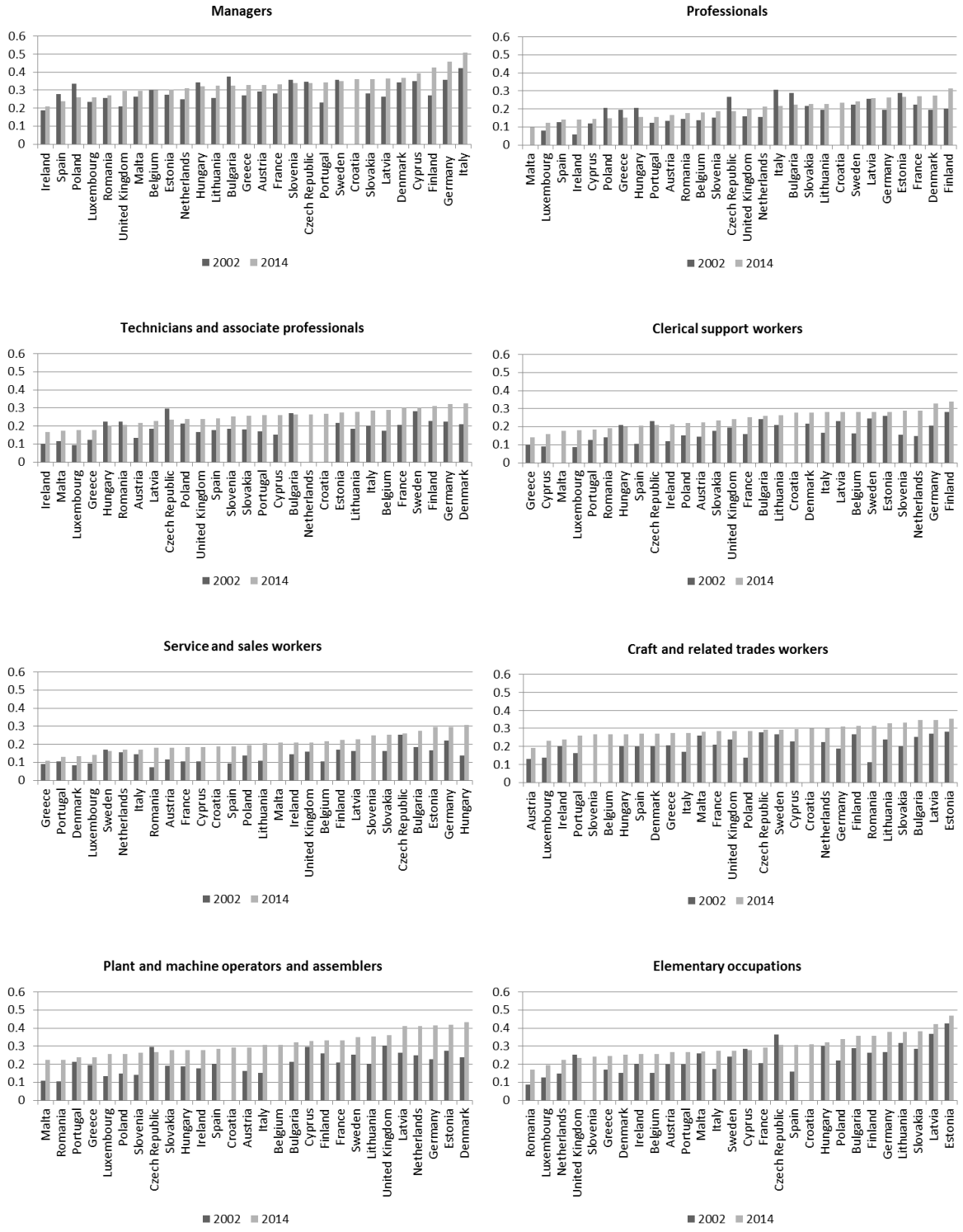
Appendix 1

Figure A1. Share of workers aged 50 or older employed in EU countries' major occupational groups* in 2002 and 2014 (%)



* A sixth occupational group (skilled agricultural and fishery workers) was omitted due to missing data for many countries.

Source: Eurostat data and the authors' calculations.