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ORIGINAL ARTICLE

Gender and Age Wage–Productivity Gaps in Intangible and Non-Intangible Work Occupations

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Abstract

The paper focuses on gender- and age-related wage–productivity gaps in intangible and non-intangible work occupations using the 2017 Slovenian linked employer–employee microdata for privately owned firms. Comparing employees based on age, gender and occupation, our results show that, in general, there are wage gaps in favour of men, with the exception of individuals aged 50 or older who belong to the intangible capital group, where the wages of men and women are almost equal. There are also significant wage gaps in favour of older workers, with the exception of women in non-intangible occupations, where those aged 30–49 and those aged 50+ earn almost the same. Comparing the productivity of workers using value added decomposition method and based on age, gender and occupation, in general we find that gender and age gaps are more pronounced. For example, women tend to be more productive than men, with the exception of men under the age of 30 in non-intangible work occupations. Similarly, older workers tend to be less productive than their younger counterparts, with the exception of women aged 30–49 compared to women under 30 in non-intangible work occupations. Moreover, age-related wage productivity gaps are higher for intangible than for non-intangible worker occupations.

Keywords: Ageing, Gender, Wage gap, Productivity gap, Slovenia

JEL classification: J24, J31

Introduction

The ageing of the population and the associated increase in the old-age dependency ratio are forcing governments to undertake various reforms to increase labour force participation, especially among those aged 55–64 and women (Directorate-General for Economic and Financial Affairs, 2021). In line with this trend, there is growing interest among researchers in analysing the impact of the inclusion of older workers and women in the labour market, in particular in what this means for individual and national productivity. It turns out that the variability of productivity of individuals in different age groups is not clear. Some studies show a decline in the productivity of individuals at older ages (e.g., the extensive literature review by Gabriele et al., 2018; Lee et al., 2018; Skirbekk, 2004). However, productivity declines are smaller or non-existent for older workers whose work tasks require experience or verbal skills (Skirbekk, 2008). In addition, ageing may have a positive impact on labour productivity if older workers are employed in industries with a high ICT share of the capital stock (Lee et al., 2020). In addition, robotics technology can mitigate the negative effects of ageing on productivity growth (Park et al., 2021). Thus, efficient resource allocation combined with lifelong learning can help maintain the productivity of older workers (Lee et al., 2022).

Although younger workers tend to be paid below their marginal productivity, while older workers are paid above their marginal productivity (Lazear, 1979), the conclusion that older workers are paid above their productivity is also empirically unsupported in many cases. On the other hand, research shows that women are less productive than men, but they are also paid

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less (e.g., Ilmakunnas & Maliranta, 2005). The question arises, however, to what extent the gender pay gap results from the gender productivity gap and not from other dimensions, such as labour market discrimination (e.g., Castilla, 2008).

Even though the traditional division of labour between men and women persists, over time they have increasingly chosen similar fields of study and occupations (England, 2010). Therefore, gender gaps in various areas such as work and decision making are gradually narrowing. Recent data shows that gender balance in decision making is visibly increasing. In 2017–2018, the area of power contributed 81% to the overall increase in the Gender Equality Index in the EU. It is also evident that in the EU, young men and women, as the most digitally literate generation, benefit equally from their digital skills. However, at older ages, the gender gap is wider, with men being more digitally literate than women (European Institute for Gender Equality [EIGE], 2020).

Although the information and communication technology (ICT) sector and the demand for ICT professionals are growing overall, and the gender gap in fields of study and occupations is narrowing, only 20% of graduates and 18% of employees in ICT-related fields are women in the EU. The gender gap is even more pronounced for scientists and engineers in high-tech sectors in the EU. Technological progress, in particular artificial intelligence, offers a number of opportunities for European society, but at the same time poses some challenges. For example, the lack of gender diversity in the development of artificial intelligence technologies may lead to potentially unfair treatment of women in the future (EIGE, 2020).

For the future, we therefore expect the working population to become older and to have a higher proportion of women. In addition, workers will tend to do less physical and more innovative work. In line with these demographic and economic trends, as well as the fact that previous literature shows that the wage–productivity gap needs to be analysed considering age and gender, plus the type of work performed by individuals, the main objective of this paper is to examine the age and gender differences in wages and productivity for non-intangible and intangible work occupations. Intangible work occupations represent innovative work types, including: research and development (R&D), organizational, and ICT capital work types (as defined in Piekkola, Bloch, Rybalka, & Redek, 2021). The role of intangible capital on individuals' productivity and wages is analysed based on Slovenian linked employer–employee data from 2017.

The role of intangible capital on productivity has been previously measured for the Slovenian transition by Prašnikar (2010), Verbič and Polanec (2014), Piekkola, Bloch, Redek, and Rybalka (2021), and Bavdaž et al. (2021), while wage and productivity differentials, considering age and gender, have been studied by Vodopivec (2014). However, the research has so far not addressed the wage–productivity nexus with respect to age and gender and the intangible capital. The novelty of this paper, besides using more recent data, is to estimate the role of intangible capital on the wage–productivity nexus, considering age and gender. In particular, we seek to answer the following research questions: (i) How large are gender- and age-related wage gaps in intangible and non-intangible work occupations? (ii) How large are the gender- and age-related productivity gaps in intangible and non-intangible work occupations? (iii) How large are the gender- and age-related wage-productivity gaps in intangible and non-intangible work occupations? Our analysis may also be useful for policymakers in other postsocialist countries that face rapid population ageing and are generally characterized, like Slovenia, by relatively small gender gaps in labour income and relatively high dependence on public transfers at older ages, partly due to the relatively low retirement age of the elderly (see, e.g., Sambt et al., 2021).

The paper begins with a comprehensive literature review on age- and gender-specific differences in wages and productivity and their relationships. We then present the methodological framework and the data used, followed by a presentation of the results of the gender and age-related wage and productivity gaps and the gender and age-related wage–productivity gaps. The final chapter makes conclusions.

1 Age–productivity–wage nexus

A person's productivity varies throughout their life for a number of reasons: the length of their work experience, their cognitive and physical abilities, their motivation, the match between worker and task, etc. (Skirbekk, 2008). The assumption that productivity declines with age goes back to the human capital models of Ben-Porath (1967) and Mincer (1958). As people get older, they become more skilled and experienced, so their productivity increases. However, productivity begins to decline after a certain period of prime working age (Mincer, 1958). As discussed in the following, although the initial theoretical work assumes that older workers are less productive, the empirical evidence does not show a clear relationship between productivity and the age of individuals. On the contrary, some empirical studies show that older workers may even be more productive than their younger counterparts.

Changes in the productivity of individuals over their life cycles are examined in detail in Skirbekk (2004). The author reviews a number of empirical studies and concludes that previous studies mainly show a decline in the work performance (i.e., productivity) of individuals at older ages. A decline is particularly evident among individuals over the age of 50. Consistent with human capital models, Skirbekk (2008) shows, based on a review of numerous articles, that productivity increases at the beginning of working life, then stabilizes, and often decreases with age. A decline in productivity at older ages is particularly evident in work tasks where problem-solving, learning, and speed are important. In contrast, productivity declines are smaller or absent for those older workers whose work tasks are related to experience or verbal skills. Similar conclusions are also found in the comprehensive literature review by Mahlberg et al. (2006). However, Mahlberg et al. (2006) additionally claim that the productivity of older workers may be biased upwards, as older workers who choose to stay in the labour market are likely to be more productive than those who leave it.

The negative relationship between productivity and individual age is also evident in some recent empirical studies, for example, Hu (2016) and Gabriele et al. (2018). Based on Chinese data, Hu points out that experience can be a barrier to increasing the productivity of older workers. This is especially true in today's information age, where workers' knowledge and experience are outdated. Moreover, based on Korean firm-level data, Lee et al. (2018) show a negative relationship between the proportion of workers over 50 and value added per worker. As the authors claim, a similar situation has also been shown in most studies based on European data. However, the authors continue to show a positive relationship between the proportion of workers over 50 and value added per worker in large manufacturing firms that are in a high-risk or growing environment.

Moreover, based on the Austrian matched employer–employee panel, Mahlberg et al. (2013a) conclude that firm productivity is not negatively associated with the share of older workers. Next, the authors claim that older workers are not overpaid relative to their productivity. Mahlberg et al. (2013b) show that the relationship between age and productivity varies considerably by region and industry, with the latter being even more important. Similarly, using German data for the period 1986–2006, Gordo and Skirbekk (2013) show that workers in their 50s have adapted well to technological change and have actually made larger gains in cognitively demanding tasks than younger workers in their 30s. A meta-analysis of 418 empirical studies examining the consistency of common stereotypes about older workers (i.e., their lower motivation, lower willingness to participate in training and career development, lower willingness to change, and lower confidence) shows that the only stereotype consistent in past research is that older workers are actually less willing to participate in training and career development (Ng & Feldman, 2012).

On the other hand, Skirbekk (2004) emphasizes that lower productivity contrasts with the empirically observed wage increase at older ages. Therefore, to better understand age differences in labour income, researchers should go beyond age differences in productivity—it is also necessary to consider institutional factors and/or market rigidities. This is consistent with Lazear's (1979) "alternative theory," according to which young workers are paid below their marginal productivity, while older individuals are paid above their marginal productivity. This also explains why the aging population poses a major threat to the overall labour force. Reducing the wages of young workers below their marginal productivity will not be enough to cover the wages of older workers above their marginal productivity. Thus, population aging must lead to a reduction in the wages of the older age group (Lazear, 1990). Similarly, Casanova (2013) empirically demonstrates that there is no downward sloping wage–age profile for older people in the US. She finds that the wage of a typical fully employed male increases slightly after age 50. The downward-sloping age profiles of wages and earnings often found in empirical research are due to an increased share of part-time employment in old age. Furthermore, Ilmakunnas and Maliranta (2005), using Finnish plant-level data, conclude that the wage–productivity gap increases with age, reflecting strong seniority effects. In contrast, using a matched worker–firm panel data set of Dutch manufacturing firms, van Ours and Stoeldraijer (2011) find little evidence of an age-related pay–productivity gap. Similarly, by comparing the age–wage and age–productivity profiles, Cardoso et al. (2011) show that productivity increases up to age 50–54, while wages peak at lower ages—that is, the age of 40–44. They argue that wages rise in line with productivity gains at younger ages, while wage increases lag behind productivity gains at prime working ages. It follows that older workers are worth their pay. In contrast, Cataldi et al. (2011) show that, while older workers are indeed less productive than younger workers, the relative productivities across age groups do not show statistically significant differences between ICT and non-ICT firms, although they show that the upward age–wage profile seems to be somewhat steeper in ICT firms. Regardless of the ICT environment, however, the results show that young workers are paid below, and older workers are paid above their marginal productivity.

2 Gender–productivity–wage nexus

According to human capital models, women have traditionally participated less continuously in the labour market than men because of their family roles, resulting in their lower productivity and lower wages (Becker, 1985; Blau & Kahn, 2007; Mincer & Polachek, 1974). Moreover, women tend to choose less risky and consequently lower-paying occupations (Blau & Kahn, 2007) and also face income discrimination in the labour market (see, e.g., Castilla, 2008).

However, the gender wage gap has narrowed over time (Blau & Kahn, 2007). According to an empirical study by Mandel and Semyonov (2014), this reduction is particularly due to less frequent discrimination in the workplace. Moreover, centralised wage-setting institutions in Europe have worked to reduce the gender wage gap in industry. Considering the occupational gender segregation, this has also helped to reduce the gender wage gap (Kahn, 2014). Over time, men and women have also chosen more similar fields of study and occupations (England, 2010), which has further narrowed the gender pay gap.

Using Finnish plant-level data, Ilmakunnas and Maliranta (2005) show that the share of female workers is negatively related to productivity, although this productivity difference is not fully reflected in pay. However, this result may depend on the methodology used. Moreover, Hellerstein et al. (1999) conclude that the marginal product of women is lower than that of men, but that they are also paid significantly less than men. In contrast to Ilmakunnas and Maliranta, they conclude that the wage gap between men and women is much larger than the productivity gap. They also show that this conclusion holds most strongly for women who are not managers, who work in firms where many women are employed, and in larger firms. Zhang and Dong (2008), using Chinese firm-level data, also reach a similar conclusion. They find that there is a significant negative relationship between wages and the proportion of female employees, but also find that the marginal productivity of female employees is significantly lower than that of male employees. In examining the gender wage–productivity gap between state-owned enterprises and private firms, they also find that the wage gap in state-owned enterprises is smaller than the productivity gap, while the opposite is true for private firms. From this, they conclude that women in the state sector receive wage premiums, while women in the private sector experience wage discrimination.

Using Canadian data, Dostie (2011) finds that productivity, measured by value added, is not significantly different from wages on average. However, when looking at differences by age and gender, Dostie further finds that the productivity of women over the age of 54 continues to rise and exceed their wages, and this difference offsets the decline in productivity for older men with university degrees. However, young men (under 35) earn less than their productivity, while there is little difference between the productivity and wages of young women. In contrast, using data from New Zealand, Sin et al. (2017) show that the relative wage–productivity gap between genders increases with age and tenure, but only after the age of 40. Moreover, they find that the productivity–wage gap is larger for highly skilled workers, when there is less product market competition, and in more competitive markets. In this context, there is much academic literature analysing the gender productivity gap. Much of the research suggests that women's underrepresentation in science actually results from the existing gender productivity gap (for a meta-analytic review, see Astegiano et al., 2019). However, Garnero et al. (2014), using Belgian data from 1999–2006, show that gender and age differences tend to be detrimental to firm productivity in general, but that gender diversity is beneficial in technology- and knowledge-intensive firms because it can foster complementarities and a more enjoyable working environment and hence increases productivity. The opposite has been found for more traditional sectors, in which gender diversity negatively impacts productivity.

3 Methodological framework

The main objective of this paper was to investigate the gender- and age-related wage–productivity gap in intangible and non-intangible work occupations. Specifically, there were five research objectives, namely (i) to examine the gender wage gap controlling for age and type of occupation, (ii) to examine the age-related wage gap controlling for gender and type of occupation, (iii) to examine the gender productivity gap and (iv) to examine the age-related productivity gap controlling for either age or gender and type of occupation, and (v) to examine the wage–productivity gap separately by gender and age controlling for type of occupation.

The methodological framework relied on Dostie (2011) and first defined 12 different groups of workers based on their age (under 30, 30–49, and 50+), gender (men and women), and the type of work performed (non-intangible and intangible work occupations). Intangible work occupations include organizational

Table 1. Individuals (occupations) belonging to different types of intangible capital work occupations.

Organizational capital work	R&D capital work	ICT capital work
Business services and administration managers; Production managers in agriculture, forestry and fisheries; Manufacturing, mining, construction, and distribution managers; Professional services managers; Finance professionals; Administration professionals.	Physical and earth science professionals; Mathematicians, actuaries and statisticians; Life science professionals; Engineering professionals (excluding electrotechnology); Electrotechnology engineers; Architects, planners, surveyors and designers; Medical doctors; Nursing and midwifery professionals; Other health professionals; Physical and engineering science technicians; Life science technicians and related associate professionals; Medical and pharmaceutical technicians; Research and development managers.	Information and communications technology professionals; Information and communications technicians; Information and communications technology service managers.

Source: Authors' own work based on Piekkola, Bloch, Rybalka, and Redek (2021).

capital work, R&D capital work, and ICT capital work as defined by the Globalinto methodology (for more details, see, e.g., Piekkola, Bloch, Rybalka, & Redek, 2021). All other employees were assumed to perform non-intangible capital work. Table 1 provides individuals who fit into one of these three categories of intangible capital work occupations.

Second, we calculated the mean wage (i.e., gross wages excluding employers' social contributions) for each of these groups. Employees who did not work full time were weighted differently—in proportion to their hours worked per week. We then compared the means with respect to 1) gender and 2) age, controlling for different types of work in each case. To analyse the differences, we calculated the absolute and relative differences in mean wages between the different groups of individuals. The relative gender wage gap was calculated as the ratio between the average wage of men and women, separately for different age groups and types of work (Equation 1). The relative gender wage gap was calculated as:

$$\text{Gender wage gap} = \frac{\bar{w}_{\text{m}} - \bar{w}_{\text{f}}}{\bar{w}_{\text{m}}} \cdot 100 \tag{1}$$

where $\bar{w}_{\text{m}}$ is the mean wage for men, and $\bar{w}_{\text{f}}$ is the mean wage for women. Gender wage gaps were therefore reported as percentages and defined as the absolute difference between the mean wages of men and women, relative to the mean wage of men.

Further, the relative age gap was calculated as the ratio between the average wage of the group of older workers (i.e., either 30–49 or 50+) and younger workers (i.e., either workers under 30 or 30–49) (Equation 2). Such a comparison between age groups (older vs. younger workers) sheds light on how wages change over the life cycle of individuals. Finally, we compared the mean differences using the t-test for independent samples. The relative age wage gap was calculated as:

$$\text{Age wage gap} = \frac{\bar{w}_{\text{older}} - \bar{w}_{\text{younger}}}{\bar{w}_{\text{older}}} \cdot 100 \tag{2}$$

where $\bar{w}_{\text{older}}$ is the mean wage of the group of older employees (i.e., either 30–49 or 50+), and $\bar{w}_{\text{younger}}$ is the mean wage of the group of younger workers (i.e., either workers under 30 or 30–49). This means that the age wage gap was calculated once comparing the first (under 30 years old) and the second (30–49 years old) age group and then the second (30–49 years old) and the third (50+ years old).

In this paper, productivity per employee is measured using real total value added of a firm. While the register includes data on wages at the individual level, (real) value added (i.e., productivity) is recorded only at the firm level. To distribute the total value added of the firm among its employees, different methodologies can be used. For example, Dostie (2011) assumes that groups of workers (defined by, for example, age and gender) are perfectly substitutable with the same marginal product that includes the ratio of the number of employees of a specific group over the total number of employees and inserts this in a production function. Following this methodology, it is assumed that workers have the same marginal product across firms (Hellerstein et al., 1999). However, as Skirbekk (2004), for example, shows, the productivity of workers of different ages varies. To consider that and to relax the assumption that groups of workers are perfectly substitutable, we aimed to decompose the value added within a firm to different groups of workers. In order to do so, we followed the methodological framework used in the estimation of the National Transfer Accounts (Population Division, 2013), where some variables (such as private consumption), reported at the household level, are distributed among household members using a regression method without a constant term. Therefore, in this paper, the value added of a firm is distributed among groups of workers in this way. Specifically, we regressed each firm's total value added on the share of workers belonging to a particular group, again controlling for differences in workers' working hours. The beta coefficients (reported in Appendix, Table A1) then served as weights for the distribution of the firm's total value added across its employee groups (i.e., 12 different types of employees) and, finally, employee value added. The weights were calculated as:

$$\text{weight}_i = \frac{\beta_i \cdot x_i}{\sum_i^{12} \beta_i \cdot x_i} \quad (3)$$

where i is each of the groups, and $i \in (1, 12)$, β_i is the estimated regression coefficient of each group, and x_i is the number of employees in each group. Finally, value added for each employee was calculated as:

$$VA_i = TVA_{\text{real}} \cdot \text{weight}_i \quad (4)$$

where VA is the value added per employee in each group, and TVA_{real} is the real total value added.

As with wages, we compared the average value added of the groups using absolute and relative differences. However, due to the equal distribution of value added among the firm's employees belonging to the same group, the productivity differences were not tested with a t-test.

Finally, we calculated the gender wage–productivity gap by dividing the relative gender wage gap and the relative gender productivity gap. In this way, we captured how much of the wage gap resulted from productivity differences rather than from other factors, such as labour market discrimination. Similarly, we calculated the age-related wage–productivity gap, but using the age-related differences in wages and productivity.

In this paper, we use linked employer–employee data (LEED) from 2017, the latest available data point in the analysis period, provided by the Statistical Office of the Republic of Slovenia (SORS). In order to analyse gender- and age-related wage and productivity differentials, we restricted our analysis to privately owned firms for which all required data were available. Ultimately, we obtained a sample size of 516,068 employees, of which about 36% were men aged 30–49, followed by women in the same age group (about 22%). Men aged 50 or older made up 17% of the total sample, and women in the same age group made up 10%. The youngest age group made up the smallest percentage of the total sample. Men under the age of 30 made up 11% of the total sample, while women in the same age group made up 5% of the total sample. The majority of individuals belonged to the non-intangible work occupations (about 84%), while 16% of the total sample belonged to the intangible work occupations (12% men and 4% women) (see Table 2 for details).

Table 2. Number of observations by type of workers.

Type of work	Men	Women	Row total
	Under 30 years old		
Non-intangible	48,476	23,541	72,017
Intangible	8683	2998	11,681
	30–49 years old		
Non-intangible	149,224	98,637	247,861
Intangible	35,700	14,287	49,987
	50+ years old		
Non-intangible	69,347	43,836	113,183
Intangible	15,885	5454	21,339
Total	327,315	188,753	516,068

Source: SORS (2022), own calculations.

4 Gender and age-related wage gap

Table 3 shows the results of absolute and relative gender wage differentials by age and type of work. In general, individuals who performed non-intangible work earned less than individuals who performed intangible work, regardless of age. Table 3 shows mainly significant wage differences in favour of men, ranging from 8% to 32%. The only exception is women aged 50 or more in the intangible work group, where men and women received roughly the same wage on average. Gender gaps were larger for workers in the non-intangible work group, with the largest gender gaps for those aged 50 or older. On the other hand, gender gaps were smaller in intangible occupations and decreased steadily with age.

Table 4 shows the results of absolute and relative age wage differences by gender and type of work. On average, older workers received higher wages, regardless of gender and type of work. The largest relative differences across age groups were between workers under the age of 30 and workers between the ages of 30 and 49. These age differences were particularly pronounced in intangible work occupations,

Table 3. Absolute and relative gender wage gaps, by age and type of work, Slovenia, 2017.

Type of work	Mean wage—men (w_m)	Mean wage—women (w_w)	Absolute difference ($w_m - w_w$)	Relative difference (w_m/w_w)
		Under 30 years old		
Non-intangible	13,236	10,867	2,369	1.22***
Intangible	18,280	16,655	1,625	1.10
		30–49 years old		
Non-intangible	17,686	14,873	2,813	1.19***
Intangible	28,785	26,740	2,045	1.08***
		50+ years old		
Non-intangible	20,174	15,328	4,846	1.32***
Intangible	31,755	32,224	−469	0.99

Notes: Wages in euros per year. *is significant at 10%, **is significant at 5%, and ***is significant at 1%.
Source: SORS (2022), own calculations.

Table 4. Absolute and relative age wage gaps, by gender and type of work, Slovenia, 2017.

Type of work	Mean wage—younger group (w_y)	Mean wage—older group (w_o)	Absolute difference ($w_o - w_y$)	Relative difference (w_o/w_y)
		Men, under 30 vs. 30-49 years old		
Non-intangible	13,236	17,686	4,450	1.34***
Intangible	18,280	28,785	10,505	1.57***
		Men 30–49 vs. 50+ years old		
Non-intangible	17,686	20,174	2,488	1.14***
Intangible	28,785	31,755	2,970	1.10***
		Women, under 30 vs. 30–49 years old		
Non-intangible	10,867	14,873	4,006	1.37***
Intangible	16,655	26,740	10,085	1.61***
		Women 30–49 vs. 50+ years old		
Non-intangible	14,873	15,328	455	1.03
Intangible	26,740	32,224	5,484	1.21***

Notes: Wages in euros per year. *is significant at 10%, **is significant at 5%, and ***is significant at 1%.
Source: SORS (2022), own calculations.

where women aged 30 to 49 received wages that were on average 61% higher than for those under 30. The situation is similar for men, but with somewhat smaller differences between age groups. The wage differences between workers aged 30 to 49 and those aged 50 and over, while still mainly statistically significant, were smaller regardless of gender and work type—accounting for up to 21% in favour of those aged 50 and over. The age difference was smallest for older women in the non-intangible work type.

5 Gender and age-related productivity gap

Our results show that, in general, workers who belonged to intangible work occupations were, on average, more productive than their counterparts who belonged to non-intangible work occupations, regardless of gender and age. The only exception is women aged 50+, for whom productivity was about the same regardless of work type (see Table 5). Our results also show that men were generally less productive than women, with a 10–23% difference in favour of women. The only exception is for workers under 30 in non-intangible occupations, where men's productivity was 12% higher than women's. The gender productivity gap was smaller in intangible work occupations but tended to increase with age. This could be a consequence of positive selection bias, i.e., that only those with higher wages remained in the labour market.

Table 6 shows the absolute and relative age–productivity gaps by gender and type of work. Our results show that older workers were always less productive than their younger counterparts, regardless of the age groups, gender, and type of work. The only exception is women aged 30–49 who belonged to non-intangible work occupations, whose productivity was 18% higher than that of their peers under 30. Although older workers (aged 30–49 or 50+) were generally less productive than their younger counterparts (aged under 30 or 30–49), productivity differences narrowed with age. This is true regardless of gender or work type. Table 6 also shows that age-related productivity differences were always smaller for non-intangible work occupations—when comparing productivity differences between 30–49- and 50+-year-olds, the difference was only 3% for men and 4% for women, always in favour of 30–49-year-olds. On

Table 5. Absolute and relative gender productivity gaps, by age and type of work, Slovenia, 2017.

Type of work	Mean productivity—men (P_m)	Mean productivity—women (P_w)	Absolute difference ($P_m - P_w$)	Relative difference (P_m/P_w)
		Under 30 years old		
Non-intangible	38,504	34,498	4,006	1.12
Intangible	68,217	75,628	−7,411	0.90
		30–49 years old		
Non-intangible	31,465	40,694	−9,229	0.77
Intangible	43,692	49,465	−5,773	0.88
		50+ years old		
Non-intangible	30,677	39,250	−8,573	0.78
Intangible	31,288	38,812	−7,524	0.81

Note: Productivity in euros per year.
Source: SORS (2022), own calculations.

Table 6. Absolute and relative age productivity gaps, by gender and type of work, Slovenia, 2017.

Type of work	Mean productivity—younger group (P_y)	Mean productivity—older group (P_o)	Absolute difference ($P_o - P_y$)	Relative difference (P_o/P_y)
		Men, under 30 vs. 30–49 years old		
Non-intangible	38,504	31,465	−7,039	0.82
Intangible	68,217	43,692	−24,525	0.64
		Men 30–49 vs. 50+ years old		
Non-intangible	31,465	30,677	−788	0.97
Intangible	43,692	31,288	−12,404	0.72
		Women, under 30 vs. 30–49 years old		
Non-intangible	34,498	40,694	6,196	1.18
Intangible	75,628	49,465	−26,163	0.65
		Women 30–49 vs. 50+ years old		
Non-intangible	40,694	39,250	−1,444	0.96
Intangible	49,465	38,812	−10,653	0.78

Note: Productivity in euros per year.
Source: SORS (2022), own calculations.

the other hand, age-related productivity differences were higher for intangible work occupations, especially when comparing younger age groups (30–49 vs. under 30), where the productivity of older workers was 36% and 35% lower than that of younger workers (men and women, respectively).

6 Gender- and age-related wage–productivity gap

Table 7 shows the gender wage–productivity gap, calculated by dividing the relative gender wage gap and the relative gender productivity gap, separately by age and type of work. Such an indicator was intended to show how much of the gender wage gap can be explained by the gender productivity gap. Our results show that while women were generally paid less than men, they were generally more productive than men, leading to the gender wage–productivity gap, which was always in favour of men. This is true even for non-intangible workers under the age of 30, where men were actually more productive than women, but the wage gap was still larger than the productivity gap, resulting in a positive gender wage–productivity gap in favour of men. Table 7 also shows that the gender wage–productivity gap for non-intangible occupations increased with age, from 1.09 for those under the age of 30 to 1.68 for those aged 50+. Moreover, the gender wage–productivity gap was higher for non-intangible occupations in the 30–49 and 50+ age groups than for intangible occupations, where the gender wage–productivity gap was a constant 1.22 regardless of age.

Table 8 shows the wage–productivity gap by age. Regardless of age, gender, and type of work, the higher wages received by the older group were never offset by their higher relative productivity. In general, the age-related wage–productivity gap even exceeded the age-related wage gap, meaning that older workers earned more than their younger counterparts despite being less productive. However, the

Table 7. Gender wage–productivity gaps, by age and type of work, Slovenia, 2017.

Type of work	Gender wage gap (w_m/w_w)	Gender productivity gap (P_m/P_w)	Gender wage—productivity gap (wage gap/productivity gap)
	Under 30 years old		
Non-intangible	1.22	1.12	1.09
Intangible	1.10	0.90	1.22
	30–49 years old		
Non-intangible	1.19	0.77	1.54
Intangible	1.08	0.88	1.22
	50+ years old		
Non-intangible	1.32	0.78	1.68
Intangible	0.99	0.81	1.22

Source: SORS (2022), own calculations.

Table 8. Age wage–productivity gaps, by gender and type of work, Slovenia, 2017.

Type of work	Age wage gap (w_o/w_y)	Age productivity gap (P_o/P_y)	Age wage–productivity gap (wage gap/productivity gap)
	Men, under 30 vs. 30–49 years old		
Non-intangible	1.34	0.82	1.64
Intangible	1.57	0.64	2.46
	Men 30–49 vs. 50+ years old		
Non-intangible	1.14	0.97	1.17
Intangible	1.10	0.72	1.54
	Women, under 30 vs. 30–49 years old		
Non-intangible	1.37	1.18	1.16
Intangible	1.61	0.65	2.45
	Women 30–49 vs. 50+ years old		
Non-intangible	1.03	0.96	1.07
Intangible	1.21	0.78	1.54

Source: SORS (2022), own calculations.

age-related wage–productivity gap decreased with age, being less pronounced when comparing the age groups 50+ and 30–49 than when comparing age groups 30–49 and under 30. Age-related wage–productivity gaps also tended to be smaller for women then for men. In the case of women, when comparing individuals aged 30–49 and 50+ belonging to non-intangible work occupations, the gap equalled 1.07 only, resulting from relatively low wage and productivity gaps for this group of workers. In contrast, age-related wage–productivity gaps were always relatively high in the case of intangible work occupations (as compared to non-intangible ones); for example, the gap was approximately 2.5 for both genders belonging to the intangible capital group when comparing workers aged below 30 and 30–49. This means that workers aged 30–49 performing intangible work occupations did not only earn much more than their counterparts aged below 30, but they tended to also be much less productive than their younger counterparts.

7 Discussion and conclusion

We found significant wage differentials in favour of men, ranging from 8% to 32%, with the exception of women of 50 or older belonging to the intangible capital group, where men's and women's wages are roughly equal. This result can be explained by a positive selection bias revealed in Mahlberg et al. (2006). Gender differences are larger for non-intangible work occupations than for intangible occupations, and for the latter the differences actually decrease with age. We also found that older workers, regardless of the type of capital and gender, receive higher wages. Similar findings have been made by other authors, such as Skirbekk (2004) and Casanova (2013). The largest relative differences between age groups are between workers up to the age of 30 and workers between the ages of 30 and 49. The age-related wage gap is generally smaller for non-intangible occupations.

Our results also show that women are more productive than men, with the exception of young men (under the age of 30) who are in the non-intangible type of work occupations. The gender productivity gap generally increases with age, leading to a 19% (for intangible occupations) or 22% (for non-intangible occupations) lower productivity for men aged 50+ than for women. Since women in Slovenia tend to retire earlier than men, this may also be the result of a positive selection bias. In a similar vein to Hu (2016), Gabriele et al. (2018), and Lee et al. (2018), our results also show that older workers (aged 30–49 or 50+) tend to be less productive than their younger counterparts (aged under 30 or 30–49), with the sole exception of younger women in the non-intangible group. However, age-related productivity differences narrow with increasing age.

In summary, the gender wage–productivity gaps show that women are paid less than men in most groups, but that they are generally more productive than men, which implies that the gender wage–productivity gaps are actually larger than the gender wage gaps in most cases. The only exception is men under 30 in non-intangible occupations, where the gender wage–productivity gap is still in favour of men, but they tend to be more productive than women. Although these results are subject to the productivity measure used in this study, they are important for policymakers seeking to reduce the gender gap in the labour force. Regardless of age, gender, and type of work, the higher wages received by older groups are never offset by their higher relative productivity. The result is that older workers, although they earn more than their younger counterparts, are generally less productive. This leads to an age-related wage–productivity gap in favour of older workers, regardless of gender or work type. Although the age-related wage–productivity gap declines with age, it is particularly problematic in the current era of population ageing, when firms employ a growing share of older workers. It is important to keep in mind, however, that our work provides a single-year analysis, and therefore the generalizability of the results may be limited. Future research could therefore rely on additional analytical methods based on longer time series.

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Appendix

Table A1. Regression results of value-added decomposition.

Variable (in share)	Coefficient
Men, under 30, non-intangible	524.558***
	(150.854)
Men, 30–49, non-intangible	401.866***
	(62.327)
Men, 50+, non-intangible	381.095***
	(97.689)
Women, under 30, non-intangible	489.376**
	(229.692)
Women, 30–49, non-intangible	561.655***
	(90.783)
Women, 50+, non-intangible	550.322***
	(144.476)
Men, under 30, intangible	824.532**
	(325.191)
Men, 30–49, intangible	500.591***
	(105.764)
Men, 50+, intangible	323.455**
	(142.814)
Women, under 30, intangible	959.749
	(600.242)
Women, 30–49, intangible	550.145***
	(181.828)
Women, 50+, intangible	399.311
	(260.051)
Number of observations	44,923

Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.