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Article

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Age- and Gender-specific Output-employment Relationship across Economic Sectors[1]

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Abstract

This paper supplements a strand of research on sectoral employment responsiveness to changes in sectoral value-added. The methodology is based on the employment version of the first-differenced Okun's equation, which is further developed to (i) complement limited empirical evidence on gender- and age-specific employment elasticity; (ii) analyse differences across economic sectors; and (iii) examine the non-linear impact of output growth on employment. Empirical estimates are based on EU28 data from 2008 to 2020 for four main economic sectors and their subsectors according to the NACE classification. Results show that the services significantly differ from other sectors – the positive growth of value-added increases the sector's employment in all labour force groups, except the youth employment, and the output decrease is not followed by a decline in employment. In all other sectors, we observe the jobless growth phenomenon.

Keywords: *employment intensity, economic sectors, economic growth, youth employment, gender*

JEL Classification: E24, E32, J21, O47

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Introduction

A high employment level is generally assumed to have a beneficial effect on the economy and wealth of society. For decades, the theoretical principle that economic growth increases employment and reduces unemployment has prevailed. The empirical research aimed to determine how strongly the country's unemployment and employment respond to economic growth. In the literature, the reaction of the unemployment rate in percentage points to a 1 per cent rise in output is called Okun's coefficient, as this strand of research originates from seminal Okun's (1962) paper.

After the Great Recession in 2008 – 2009, researchers shifted their focus to more specific issues, such as varying effects of output growth on unemployment and employment by age and gender confirming higher female than men employment intensity (Kapsos, 2005; Anderson and Braunstein, 2013; Anderson, 2016; Majid and Siegmann, 2021), sector-specific effects (Perugini, 2009; Tadjoeddin and Chowdhury, 2012; Hartwig, 2014; Burggraeve et al., 2015; Sassi and Goaied, 2016; El-Hamadi et al., 2017; Thuku et al., 2019; Zaki et al., 2020; Dauda and Ajeigbe, 2021), and the possibility of the non-linear relationship (Oh, 2018) between variables of interest.

The studies on the economic growth-employment nexus at the sectoral level estimate how overall employment responds to sectoral output growth (Ajilore and Yinusa, 2011; Arias-Vazquez et al., 2012; Dahal and Rai, 2019; Ben-Salha and Zmami, 2021) or how sectoral employment is affected by overall economic growth (Sawtelle, 2007; Upender, 2011; Richter and Witkowski, 2014; Ajakaiye et al., 2016; Gelfer, 2020). Research scarcely examines the gender- or age-specific employment elasticity to changes in total output, not mentioning analysis of differences at the sectoral level.

Our research aims to estimate employment elasticity to positive and negative changes in sectoral value-added considering age and gender in 28 EU countries. This research complements limited empirical evidence on gender- and age-specific employment elasticity across economic sectors and examines the non-linear impact of output growth on employment. The nonlinearity of Okun's law is confirmed as regards the economic growth – unemployment relationship, and results show a more robust unemployment reaction to recessions than expansions (Kim and Park, 2019; Novak and Darmo, 2019; Aguiar-Conraria et al., 2020). Regarding output growth – employment nexus, previous research mainly estimates linear relationships, except Burggraeve et al. (2015) and Coşar and Yavuz (2019). However, these studies do not consider age, gender, or sectors. While most studies estimate employment elasticity based on a single-country sample, this study applies the panel estimation technique in EU28. A larger sample (panel of

countries compared to single country time series) increases the efficiency of elasticities estimates and allows us to look at the EU as a single market with free labour movement.

We found that the reaction of employment to negative value-added changes is higher than that to positive ones. We find significant differences in the sectoral output-employment relationship regarding both labour force characteristics and the direction of output change. We did not find a statistically significant relationship between output changes and employment in the agriculture, forestry, and fishing sector. We only confirmed the relationship between youth employment and output growth in the industry sector. We observed the decrease in employment in all labour force groups when the industry sector's output decreased. In the construction sector, we find the different effects of output changes regarding gender and age – output growth has a positive effect on male employment and a negative effect on young female employment, and young females are the only group not affected by the decreasing output. Our results show that the situation in the services is significantly different from other sectors – the growth of value-added increases the sector's employment in all labour force groups, except the youth employment. Decomposing the service sector to subsectors, we find the differences in the output-employment relationship regarding both labour force characteristics and the direction of output change.

The rest of the paper is organised as follows: Section 1 summarises empirical evidence on the output-employment relationship across sectors and discusses age- and gender-specific employment sensitivity to economic growth, Section 2 presents the applied methodology: the model, estimation strategy, and data, Section 3 discusses the main results and the last section concludes the paper.

1. Literature Review

1.1. Output-employment Relationship across Sectors: Empirical Evidence

The studies on employment elasticity to output at the sectoral level focus on various aspects. Part of the literature analyses how sectoral employment responds to overall economic growth (Sawtelle, 2007; Upender, 2011; Richter and Witkowski, 2014; Ajakaiye et al., 2016; Gelfer, 2020). Other researchers, by contrast, seek to assess the elasticity of overall employment to sectoral output growth (Ajilore and Yinusa, 2011; Arias-Vazquez et al., 2012; Dahal and Rai, 2019; Ben-Salha and Zmami, 2021). Part of the literature compares sectoral employment intensities to total GDP growth and sectoral value-added (Kapsos, 2005; Perugini, 2009; Ghazali and Mouelhi, 2018; Aigheyisi and Edore, 2021).

This paper contributes to the strand of the research on sectoral employment responsiveness to changes in sectoral output. The most common conclusion in that strand of literature is that the service sector's growth has the highest job creation potential. In contrast, the agriculture sector has the lowest ability to generate employment. That is confirmed by empirical studies using data from Italy (Perugini, 2009), Switzerland (Hartwig, 2014), Belgium (Burggraeve et al., 2015), Tunisia (Sassi and Goaied, 2016), Kenya (Thuku et al., 2019), and Nigeria (Dauda and Ajeigbe, 2021).

However, some studies have identified other sectors apart from services/agriculture as having the highest/lowest employment elasticity. In contrast, Tadjoeddin and Chowdhury's (2012) estimates of sectoral employment elasticities to sectoral output show that agriculture was the most employment-intensive among eight sectors of Indonesia from 2000 to 2006, while elasticity for services was the lowest. El-Hamadi et al.'s (2017) estimations show that the construction sector has the highest employment elasticity in Morocco. Zaki et al. (2020) find manufacturing as the most crucial sector that generates employment in Egypt.

While a large part of the literature aimed at investigating employment elasticities by sector in a single country, only a few papers referred to the group of countries. Guisan and Exposito's (2017) results show the lowest employment elasticity for industry estimated with a pool of Germany, Spain, France, Italy, and the United Kingdom. Kapsos (2005) estimated global employment elasticities in agriculture, industry, and services sectors for 139 countries from 1991 to 2003. In terms of total GDP growth and growth in the sector's value-added, the services sector is the most employment-intensive. At the same time, employment elasticities for the industry are lower than corresponding figures for agriculture.

In contrast with the global estimates, in Japan, South Asia, and the Middle East, the agriculture sector has the highest employment elasticity to value-added growth. In the 12 Commonwealth of Independent States and Sub-Saharan Africa, employment intensity of value-added growth has been lowest in the services sector. In line with Kapsos (2005), Furceri et al. (2012) confirm that these three sectors (agriculture, industry, and services) have varying employment intensities in different regions. Using panel data from 167 countries, the authors found more employment-intensive growth in the services sector than in agriculture in 3 out of 9 regions, namely, Western Europe, Latin America and the Caribbean, and Australia and New Zealand. It is worth noting that the elasticity of employment in these sectors may be the same, as point estimates are quite similar, and the authors do not provide confidence intervals. Comparison among income level groups reveals that the point estimate for each economic sector is about two times larger for high-income countries than for upper-middle and lower-middle-

income economies. However, in the same income group, all sectors equally contribute to employment growth, except for low-income economies, where the agriculture sector is the most employment-intensive.

1.2. Age- and Gender-specific Employment Sensitivity to Economic Growth

The research on age- and gender-specific employment intensities of growth in general and across different economic sectors are relatively scarce. Previous research on gender-specific output-employment elasticities confirms higher female employment sensitivity to economic growth (Kapsos, 2005; Anderson and Braunstein, 2013; Anderson, 2016; Majid and Siegmann, 2021) and usually higher female output-employment elasticities in the service sector. The findings of Anderson and Braunstein (2013) in 145 countries show higher employment elasticities for females in services. Anderson's (2016) estimations in a panel of 80 countries over the period from 1990 to 2012, including women/men employment in the services and manufacturing sectors as a share of women/men in total employment, confirm higher female employment intensity of growth in the service sector. Higher shares in service and industrial sector employment have a positive impact on the employment intensity of growth for both genders. Surprisingly, the point estimate for the industry was consistently higher than for services. Majid and Siegmann (2021) identified higher volatility of female employment over 1984 – 2017 in Pakistan's agriculture, industry, and services sectors. The research also showed that the output-employment elasticity of both groups is higher in the industry than in agriculture. Females' employment response to service sector growth was more elastic. That may be explained by higher female concentration in labour-intensive sectors.

Some authors also state that males and females vary in occupations (Blau et al., 2013; Cortes and Pan, 2017; Petrongolo and Ronchi, 2020) and levels of educational attainment (He et al., 2011; Pekkarinen, 2012; Bertocchi and Bozzano, 2020; Baten et al., 2021; Evans et al., 2021) which also could be a reason for the higher volatility of female employment. Additionally, Guisinger (2020) states that female labour is more complementary to capital than male which influences the higher elasticity of female employment. This can be explained by shifting requirements from physical toward intellectual work and increased demand for office work, where females usually have a comparative advantage due to their higher educational attainment (Rendall, 2017). The higher opportunities for growth in the service sector to create jobs for females were also confirmed in the research of Ngai and Petrongolo (2017), Rendall (2017) and Petrongolo and Ronchi (2020).

The higher vulnerability of youth unemployment is widely discussed and confirmed in the research on the output-unemployment relationship (Butkus and Seputiene, 2019; Ahn et al., 2019; Dixon et al., 2017). However, there is a lack of studies analysing the age-specific output-employment elasticities, especially across different economic sectors. The impact of economic growth on youth employment was analysed by Kapsos (2005) in the global and regional contexts. The estimations of global output-employment elasticities showed extremely low output-employment elasticities for the youth cohort compared with total employment elasticities. These results indicate low possibilities of economic growth to generate jobs for young people and future generations or so-called jobless growth (Pattanaik and Nayak, 2014; El-Hamadi et al., 2017). The phenomenon of jobless growth was also found by analysing regional youth output-employment elasticities estimated for Western Europe and Japan, indicating an inverse relationship between economic growth and employment from 1999 to 2003 (Kapsos, 2005). Similar results were found by Adegboye et al. (2019), who analysed the changes in youth output-employment elasticities across time. Estimated output-employment elasticities for the youth cohort vary from 0.16 over 1991 – 1999 to 0.38 over 2010 – 2014. Despite the growing potential of economic growth to generate jobs for youth, the employment reaction to economic growth remains lower than estimated for the global sample. The highest output-employment elasticities were found during the period of expansion, indicating possible heterogeneity of output-employment elasticities during the different phases of the business cycle. The research of Adegboye et al. (2019) in the context of 38 Sub-Sacharian countries also determined that the change in the share of the industry and service sector harms youth employment with the higher employment sensitivity to changes of gross value-added in the services sector. The employment output elasticities for both analysed economic sectors are higher for the youth cohort than those estimated for the total employment.

According to Pastore (2018), the higher volatility of youth employment can be related to lower than average human capital of youth. It happens because some young people drop out of school before completing at least compulsory education or lack other key components of human capital after completing upper secondary or higher education, as well as general and specific work experience, which can be acquired through any type of work experience. That creates a gap between the skills and experience young people have and those required in the labour market. Another reason for higher vulnerability is related to labour market flexibility related to the reforms in the labour market that affect new entrants without changing the workers' existing contracts. These reforms allow companies to hire workers on temporary contracts. In turn, temporary contracts are the first

to be terminated during economic crises simply because the easiest way to reduce staff is not to renew temporary contracts after they expire. Companies tend to fire the most recently hired workers first.

The literature analysing the non-linear relationship between unemployment and output confirms a more robust unemployment reaction to recessions than expansions (Kim and Park, 2019; Novak and Darmo, 2019; Aguiar-Conraria et al., 2020). Similar results were found by Coşar and Yavuz (2019), who examined the long-term non-linear relationship between GDP, employment and unemployment rate in Turkey during the period from 1989 to 2018. Estimation results showed asymmetric relationships between labour market variables and GDP within and between the recession and expansion phases. Higher employment and unemployment reaction to GDP changes was confirmed during the recession. Burggraeve et al. (2015) analysed deviations of estimated employment-output elasticities for different recession periods compared to non-recession periods in twelve developed countries. Estimation results differ among recession periods and selected countries indicating the non-linear, heterogeneous relationship between GDP and employment. However, no statistically significant deviations of output-employment elasticities were found comparing all recession periods to non-recession. Asymmetrical behaviour of unemployment and employment is related to labour market regulations, hiring and firing costs, and individual firms' decisions to lay off workers during a recession but not to hire new ones during expansion, expecting to compensate for production capacity by increased labour productivity (Butkus and Seputiene, 2019; Pizzo, 2020).

Previous research by Butkus et al. (2020) showed that unemployment reaction to negative and positive output changes could differ across age and gender, indicating a higher unemployment reaction to negative output change for youth and males. However, we can't find similar studies made in the field of employment version of Okun's law. The literature analysing the employment reaction to negative and positive output changes across different economic sectors is also limited. Research by Foster-McGregor et al. (2012) and Sahin et al. (2015) shows that a downturn leads to significant job losses in sectors with a considerably higher concentration of male employment, such as construction and manufacturing. Verdugo and Allègre (2020) also found that male workers were affected more during the crisis in Europe over the period 2000 – 2013 because of increasing female participation in the labour market during the Great Recession. Controversially, during the Covid-19 crisis, females experienced more considerable employment losses than males (Alon et al., 2020). The most significant impact of the Covid-19 crisis on employment was in high-contact service sectors such as restaurants, hospitality, and travel. These are the sectors in which females make up

a large proportion of the workforce, and this group has lost employment sharply during the COVID crisis.

It is worth noting that employment reaction to economic fluctuations depends on economic structure, demographic characteristics, and the business cycle. However, there is a lack of studies analysing output-employment elasticities taking all aspects that could moderate employment sensitivity to economic growth together.

2. Model and the Data

The original study by Okun (1962) researched the relationship between changes in total output growth and changes in the unemployment rate. The results showed that an additional 1% of GNP leads to a 0.3 percentage point lower unemployment rate. Further studies based on Okun's model extended the research of the output-unemployment relationship not only to determine the age- and gender-specific Okun's coefficients but also to evaluate the output-employment relationship. We use the output-employment relationship version of Okun's Law and generate estimates of the strength of this relationship using the differenced version of Okun's equation for a panel of countries. The initial version of our model can be described as follows:

$$\Delta \ln\left(E_{i,t}\right) = \alpha + \beta \Delta \ln\left(Y_{i,t}\right) + \theta_t + \varepsilon_{i,t} \tag{1}$$

where $\Delta\ln(E_{i,t})$ is the log difference of the number of employed persons between period t and t-1 in country i. $\Delta\ln(Y_{i,t})$ is the log difference of the output between t and t-1 in country i. The parameter β measures the elasticity of the number of employed persons with respect to output. α shows the employment change when the real output does not vary. θ_t represents unobserved time-varying effects, which are modelled using time dummies, and $\varepsilon_{i,t}$ is the idiosyncratic error. Since all variables enter the model in their first-differences any observed and unobserved country-fixed factors are 'differenced away'.

We extend the model by assuming that the responsiveness of the number of employed persons to output fluctuations is not the same for the whole economy. It could depend on sector-specific factors. We aim to analyse how uneven growth in different economic sectors is associated with changes in the sectors' employment change by estimating a modified version of Okun's Law:

$$\Delta \ln\left(E_{s,i,t}\right) = \alpha + \beta_s \Delta \ln\left(Y_{s,i,t}\right) + \theta_t + \varepsilon_{s,i,t} \tag{2}$$

where s represents four aggregated economic sectors: agriculture, industry, construction and services, $Y_{s,\,i,t}$ is the gross value-added in constant 2010 prices in

sector *s*. Agriculture sector includes agriculture, forestry and fishing (A class in the classification of economic activities in the European Union, NACE), industry sector aggregates mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply, water supply, sewerage, waste management and remediation activities (B-E in NACE). The construction sector represents only one class (F in NACE) of economic activities due to its specifics. The service sector aggregates all remaining classes of economic activities (G-U in NACE): wholesale and retail trade, repair of motor vehicles and motorcycles, transportation and storage, accommodation and food service activities, information and communication, financial and insurance activities, real estate activities, professional, scientific and technical activities, administrative and support service activities, public administration and defence, compulsory social security, education, human health and social work activities, arts, entertainment and recreation, other service activities, activities of households as employers; undifferentiated goods- and services-producing activities of households for own use, activities of extra-territorial organisations and bodies.

In our study, we use not only the output but also the employment of the four aggregated sectors. As we aim to analyse the responsiveness to output fluctuations not only in the case of the total labour force but also in different groups of the labour force, we assess the impact on the total (ET), male (EM), female (EF), youth (EY), young male (EYM) and young female employment (EYF). We assume that the output-employment relationship can be sector-, gender- and age-specific.

We also extend this model assuming that the responsiveness of the employment to value-added fluctuations is not the same over periods of its growth and decline. As it was noted above, literature analysing the non-linear relationship between unemployment and output confirms a more robust unemployment reaction to negative than to positive growth (Kim and Park, 2019; Novak and Darmo, 2019; Aguiar-Conraria et al., 2020). There are studies evaluating the non-linear relationship between employment and output, but their results are mixed. For example, Coşar and Yavuz (2019) confirmed asymmetric relationships between employment and GDP within and between recession and expansion phases, but Burggraeve et al.'s (2015) research does not confirm any statistically significant deviations of output-employment elasticity over recession compared to non-recession periods taking all crisis episodes together. It is worth noting that in these studies, the employment reaction to economic fluctuations was assessed at the aggregated country level without considering the structure of the economy and the demographic characteristics of the labour force. Our research makes it possible to assess the relationships between employment and value-added in

different sectors during its growth and decline phases and to identify differences in this relationship across different labour force groups. In our study, following Bartolucci et al. (2018), we include a dummy variable determining the direction of value-added change and allow the sectoral β to vary between value-added growth and decline phases:

$$\Delta \ln\left(E_{s,i,t}\right) = \alpha + \beta_s \Delta \ln\left(Y_{s,i,t}\right) + \delta_s \Delta \ln\left(Y_{s,i,t}\right) \Delta D^r_{s,i,t} + \rho_s D^r_{s,i,t} + \theta_t + \varepsilon_{i,t} \qquad (3)$$

where $D^r_{s,i,t}$ is a binary dummy equal to 1 when value-added in sector s is decreasing, i.e. $\Delta \ln Y_{s,i,t} < 0$, and 0 otherwise. β_s represents the responsiveness of the employment to positive output growth in sector s, δ_s is the difference between the effects during the value-added decrease and growth periods. Thus, $\beta_s + \delta_s$ represents the responsiveness of the employment to output decrease in sector s.

Previous research (Furceri et al., 2012; Richter and Witkowski 2014) at aggregated country level highlights that we might expect endogeneity in Okun's equation because causality between the dependent variable (employment) and the regressor (output) may run in both directions. Some criticism may be addressed to our decision to use the OLS model since our estimates may be affected by endogeneity. The main assumption of Okun's Law is that, in the short term, output supply is primarily driven by demand. The idea of this paper is to apply the assumptions of the original Okun's law to the employment version of Okun's law, including the first differences as one of the primary methods. Hence, although the assumption of the exogeneity of the regressors may not be strictly satisfied for OLS estimates, the estimates remain valid to predict changes in employment given changes in output. Since our interest is to get an idea of the differences in elasticities across sectors for different employment groups by gender and age, the OLS approach, as a "rule of thumb" for the simplest Okun relationship, is used throughout this paper.

After testing the standard assumptions (serial correlation was tested using the Wooldridge autocorrelation test, heteroscedasticity was tested applying the Preusch-Pagan test, and cross-sectional dependency was analysed with the Pesaran CD test), we applied Newey-West standard errors to reduce the probability that detected heteroscedasticity and serial correlation could lead to inefficient estimates with biased regular standard errors and misleading results.

Since the statistical classification of economic activities in the EU has changed from NACE Rev. 1.1 to NACE Rev. 2, the detailed employment statistics by sex, age, and economic activity (NACE Rev. 2 classification) are provided only from 2008 and onwards. To avoid data inconsistencies between the two classifications, we use the panel data of EU-28 countries between 2008 and 2020. The data is collected from Eurostat. Table 1 shows summary statistics of variables.

T a b l e 1

Summary Statistics of the Variables

			Mean	Std. Dev.	Min.	Max.
Δ Employment, %						
Sector	**Gender**	**Age**				
Agriculture (A)	Total	15 – 64	–2.04	8.57	–31.89	53.93
	Males		–1.52	9.09	–35.00	55.88
	Females		–1.97	16.32	–66.67	150.00
	Total	15 – 24	–0.31	16.75	–49.40	100.00
	Males		0.07	16.33	–40.00	85.72
	Females		3.50	40.73	–83.33	250.00
Industry (B – E)	Total	15 – 64	–0.80	4.93	–24.24	39.00
	Males		–0.66	5.22	–23.76	44.16
	Females		–0.87	6.39	–25.80	34.62
	Total	15 – 24	–3.44	14.46	–45.83	80.00
	Males		–3.11	14.93	–43.97	68.89
	Females		–3.70	20.65	–66.67	75.00
Construction (F)	Total	15 – 64	–1.35	8.15	–42.48	34.23
	Males		–1.38	8.28	–42.58	39.80
	Females		0.61	18.89	–58.33	160.00
	Total	15 – 24	–4.67	19.48	–61.54	91.67
	Males		–4.64	20.16	–65.09	88.89
	Females		10.77	80.63	–80.00	600.00
Services (G – U)	Total	15 – 64	0.88	2.29	–8.17	11.59
	Males		0.85	2.60	–7.89	11.03
	Females		0.95	2.50	–8.48	12.13
	Total	15 – 24	–1.31	11.38	–34.55	98.49
	Males		–0.80	14.68	–46.90	112.87
	Females		–1.33	12.62	–42.42	139.47
Δ Gross value-added, %						
Agriculture			1.04	10.19	–31.07	40.84
Industry			0.87	7.70	–20.46	80.30
Construction			–0.57	9.71	–45.64	29.04
Services			1.15	5.30	–68.01	21.40

Source: Authors' calculation based on data from the Eurostat.

3. Estimation Results

Estimations of Eq. (3) are presented in Table 2.

In line with the literature on sectoral employment intensities to sectoral value-added (see Section 1), we find that value-added changes in the agriculture, forestry and fishing sector do not affect employment in this sector. These results can be explained by the appliance of more capital-intensive production techniques in agriculture (Sassi and Goaied, 2016) or a minimal share of the agricultural sector in total value-added and employment. The same is true regardless of employment by gender and age and direction of change in value-added, with two exceptions – it seems that declining value-added in agriculture, forestry, and fishing sector increases female and young male employment. This could be related to

"added worker effect" when inactive females newly enter the labour market in response to their husbands' job loss (Butkus et al., 2020) or the "substitution hypothesis", which means that men are replaced with women because times of crisis bring pressure for cost reduction, and female labor is usually cheaper (Barba and Iraizoz, 2020). A similar conclusion can be made about youth. Young people without education and work experience are usually less paid, so they have a comparative advantage in sectors that do not require special skills during the recession.

T a b l e 2

Estimated Employment Elasticities across Sectors, Gender, and Age

Employment / Sector		Total	Male	Female	Total youth	Male youth	Female youth
β, i.e. effect during the period of positive output (value-added) growth in a sector							
Agriculture		–0.041 (0.100)	–0.028 (0.106)	–0.160 (0.174)	–0.206 (0.209)	–0.184 (0.210)	–0.140 (0.498)
Industry		0.040 (0.057)	0.046 (0.062)	0.055 (0.079)	0.431** (0.180)	0.335* (0.193)	0.352 (0.295)
Construction		0.392*** (0.105)	0.395*** (0.107)	0.370 (0.279)	–0.115 (0.289)	0.129 (0.301)	–2.810*** (1.013)
Services		0.197*** (0.057)	0.175*** (0.067)	0.235*** (0.063)	0.394 (0.284)	0.092 (0.393)	0.579* (0.317)
δ, i.e. difference of the effect comparing the periods of negative and positive output (value-added) change in a sector							
Agriculture		–0.107 (0.139)	–0.115 (0.146)	–0.175 (0.241)	–0.135 (0.317)	–0.403 (0.316)	0.535 (0.751)
Industry		0.264*** (0.100)	0.227** (0.109)	0.321** (0.139)	0.383 (0.318)	0.500 (0.339)	0.747 (0.526)
Construction		0.179 (0.120)	0.206* (0.122)	–0.076 (0.317)	1.037*** (0.328)	0.848** (0.342)	3.335*** (1.120)
Services		–0.175*** (0.059)	–0.158** (0.070)	–0.206*** (0.066)	–0.347 (0.296)	–0.106 (0.410)	–0.491 (0.331)
β + δ, i.e. effect during the period of negative output (value-added) change in a sector							
Agriculture		–0.148 (0.096)	–0.143 (0.102)	–0.335** (0.167)	–0.341 (0.244)	–0.587** (0.241)	0.395 (0.572)
Industry		0.304*** (0.082)	0.273*** (0.090)	0.376*** (0.114)	0.814*** (0.261)	0.835*** (0.277)	1.099** (0.433)
Construction		0.571*** (0.055)	0.601*** (0.056)	0.294** (0.147)	0.922*** (0.152)	0.976*** (0.158)	0.525 (0.474)
Services		0.022 (0.017)	0.017 (0.020)	0.028 (0.019)	0.047 (0.087)	–0.014 (0.120)	0.088 (0.097)
Agriculture	*n* Adj. R^2	334 0	334 0	334 0.03	297 0.01	281 0.03	280 –0.01
Industry	*n* Adj. R^2	333 0.34	333 0.29	333 0.25	331 0.28	326 0.25	324 0.14
Construction	*n* Adj. R^2	334 0.46	334 0.46	334 0.08	334 0.27	334 0.26	303 0.04
Services	*n* Adj. R^2	334 0.30	334 0.25	334 0.26	334 0.18	334 0.17	334 0.10

Note: Heteroscedasticity and serial correlation robust standard errors are presented in parentheses.
*, **, *** indicate significance at the 10, 5 and 1 per cent levels, respectively

Source: Authors' calculation.

Analysis of the industry sector revealed that this sector's value-added growth is not statistically significantly related to the sector's employment growth regardless of gender. We find that the growth of the industry sector's value-added statistically significantly increases only the employment of youth. Our results are similar to Kapsos (2005) and Guisan and Exposito (2017), who also confirmed lower possibilities of value-added growth in the industry sector to create job opportunities than services. The reaction of employment to a negative change in value-added is quite different – in all analyzed cases, employment decreases statistically significantly. The biggest effect again is for youth – Okun's coefficient ranges from 0.84 for young males to 1.10 for young females compared to 0.27 and 0.38 for total males and females, respectively. The reaction is weaker for males than for females, regardless of age. The higher responsiveness of youth employment to negative output changes is mostly related to lower redundancy costs due to working on temporary contracts (European Commission, 2013). Decomposing the industry sector further (the detailed estimates across subsectors are available on the request from the corresponding author), we find that value-added change in its subsectors has a very different effect on employment. Our results suggest that in subsectors such as Mining and quarrying; Electricity, gas, steam, and air conditioning supply; and Water supply, sewerage, waste management, and remediation activities, value-added change is not affecting employment statistically significantly. We observe a different picture in the Manufacturing sector as this sector tends to be more labour-intensive than other non-manufacturing sectors and more sensitive to business cycles (Foster-McGregor et al., 2012). Value-added growth in the Manufacturing sector is positively linked with youth, especially males, employment growth, while employment of other groups is not affected. This can be explained by the higher share of males' employment (68%) in the manufacturing sector compared with women (32%). Contrary, declining value-added in this sector is statistically significantly related to employment decline regardless of gender or age, with an effect for youth (especially for young females) being almost three times bigger than for total employment. This is evidence of jobless growth in the manufacturing sector, suggesting that employment decline during a recession is not followed by its growth during the expansion period. Sectors such as agriculture, manufacturing, and construction are usually preferred by youth, especially males, because it requires low educational attainment and physical work and usually does not require special skills or work experience.

According to Foster-McGregor et al. (2012) and Sahin et al. (2015) construction sector is a more labour-intensive sector that creates new jobs for low-skilled and less educated labour force in many advanced and less developed countries.

Our results show that expansion of the value-added in the construction sector is positively related to increasing male employment, while employment of females or young males is not affected. The higher responsiveness of males' employment to the growth of value-added in the construction sector is related to the higher share of males' employment concentration (91%) in this sector than females' (9%). We also find that growth in the construction sector negatively affects young female employment in this sector. This could be explained by the innate advantage of men to do the physical work which is required in the construction sector. The decline in GDP during the recession was concentrated in the manufacturing and construction sectors (Foster-McGregor et al., 2012), which is why during the output contraction in the construction sector, a statistically significant decline is observed in all employment groups, with only exception – young females. The effect on male employment is two times bigger than on females in the construction sector and males in the manufacturing sector. The construction and manufacturing sectors tend to be more sensitive to business cycles and the higher male output-employment elasticities than females can be mostly explained by the higher share of male employment in these sectors (Kim and Park, 2019).

Our results suggest that only the output expansion in the service sector can generate robust employment opportunities, especially for females, since just in the service sector, we find a positive and statistically significant link between value-added growth and female employment. Still, we do not find a significant effect on youth employment regardless of gender. Value-added growth in the service sector has a twice smaller effect on total and male employment in this sector than the same growth in the construction sector on total and male employment in it. What is more interesting is that a value-added decrease is not followed by a decline in employment, regardless of age and gender. That is additional evidence that the service sector provides robust employment opportunities. Our results are in line with the research of Anderson and Braunstein (2013), Anderson (2016), Majid and Siegmann (2021), who found the service sector as the most job-intensive for females.

Further decomposing the service sector (the detailed estimates across subsectors are available on the request from the corresponding author), we find that during the expansion phase, the greatest employment opportunities for males are in the subsector of real estate activities and for females in Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use; and Professional, scientific and technical activities. The latter is also related to a significant employment decrease when output declines. The subsector of Administrative and support service activities during the phase of value-added growth has employment opportunities for both males and females. Expansion

of the education sector is negatively related to employment, especially for females and youth. The only subsector that, by shrinking, significantly reduces employment is the Wholesale and retail trade, repair of motor vehicles and motorcycles. We find that output-employment elasticities, and thus the effect is almost three times bigger for youth but remains quite the same for males and females. During the value-added decrease periods, Accommodation and food service activities are related just to female employment decline regardless of age and Public administration and defence; compulsory social security to male employment decline.

The literature on sector-specific output-employment elasticity provides conflicting results on which sector's growth has higher job creation potential. Papers applying panel data analysis (Kapsos, 2005; Furceri et al., 2012; Guisan and Exposito, 2017) find varying elasticity across geographic regions and countries' income level groups. In addition to this, our results suggest another possible explanation, that sectors' value-added fluctuations have varying impacts on age- and gender-specific employment over the expansion and recession phases.

Conclusions

Our research provides several contributions to the limited literature on employment sensitivity to sectoral output growth. Unlike most of the studies that assess how total employment responds to sector output growth or how sector employment is affected by overall economic growth, we evaluate the sector's employment response to changes in the sector's value-added. The second contribution is related to examining the non-linear impact analysis of the sectoral economic growth on the sector's employment, distinguishing periods of growth and decline of value-added. The third contribution is related to a larger sample of the study. While most studies are based on a single-country sample, this study applies panel data from 28 EU countries.

Our results suggest that the growth of gross value added in the agricultural sector is jobless, i. e. more associated with the implementation of technological innovations, i.e., productivity growth, than with job creation. Digitized agricultural technologies allow the automation of repetitive standardized and even non-standardized tasks, meaning that part of the labor force is replaced by machinery or artificial intelligence, prompting the agricultural workforce's continuing decline. Although technological change decreases the demand for a labor force inthe agricultural sector, many tasks still require a skilled and educated labor force, especially those related to sustainable and green agriculture development. It means that technological progress in agriculture will increase the demand for a highly skilled labor force. Although we do not find significant differences in

the effect across gender, the gender gap in agricultural employment remains the problem. The industry sector is more capital-intensive compared to construction and services, so the growth of value added is weakly related to job creation with the one exception of youth (15 – 24), who are less educated, usually prefer to work according to the fixed-term contracts and is the lower paid workforce.

Results suggest that there is horizontal sex segregation in the EU, which refers to the tendency for men and women to be employed in different occupations and denotes the tendency for certain economic sectors to be dominated by employees of a certain gender. We find that gross value-added growth in construction is associated with the employment growth of men and vice versa in the case of the service sector. This inequality is related to the different labor participation of both genders in these sectors influenced by physical differences and the gender wage gap, as women's gross hourly earnings are still lower than men, and they tend to work in lower-paid sectors such as services. The technological progress in all sectors and the automation of tasks should decrease gender inequality based on objective gender differences, but additional action should be taken to increase the labor participation rate of women and to decrease inequality based on subjective discrimination associated with maternity, wage, etc.

However, we should draw attention, that employment elasticity, which measures the relationship between employment and output, has several limitations, according to various studies. Kapsos (2005) points to a danger of omitted variable bias as the model only considers output growth and ignores other factors that could impact employment or economic performance. The relationship between output and employment is two-way, but employment elasticity disregards that higher levels of employment generate higher output, as stated by Islam and Nazara (2000). Moreover, the employment elasticity may vary between economic expansions and contractions, which was considered in this study. However, elasticities may also vary during the same phase of the business cycle, i.e., employment reaction to positive (negative) output change is not constant, and this is potentially an emerging strand of the research. Furthermore, sectoral employment elasticities do not account for the indirect effects of output changes on employment in other sectors, which may be addressed in further research.

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