

COVID-19 IMPACT ON LABOUR MARKET IN EU COUNTRIES – DIFFERENCES IN MEN AND WOMEN EMPLOYMENT RATE TENDENCIES

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Abstract. This paper aims to identify the differences in the employment rate dynamics in economy sections, considering gender, in the European Union countries in 2020, compared to the 2008–2019 period. Two methods were used. The first method compares forecasts from models describing employment changes in the pre-pandemic periods with information concerning the actual employment rate in 2020, using three indices measuring the significance of the observed discrepancies. The second method uses dynamic cluster analysis for the 2008–2020 period, and evaluates the changes in composition of groups that occurred in 2020. The proposed methods were applied separately to the data concerning the employment of females and males (employment rates) in the EU countries, always divided into economy sections and section groups (A, B-E, F, G-I, J, K, L, M and N, O-Q, R). The application of the “Triple 2 Rule” helped to identify the changes in the previous employment trends (“Interventions”). The evaluation of changes in the dynamics of the employment rate in total and in section groups and according to gender in the EU countries in 2020 – compared to the forecasts from the 2013–2019 trends – revealed that the EU labour market responded differently to the COVID-19 pandemic situation.

Keywords: employment rate, Triple 2 Rule, dynamic classification, COVID-19, EU countries, women and men employment rate.

JEL Classification: C38, E24, F16, J16, O52.

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1. Introduction

Fluctuations are an imminent feature of the economy's functioning (Wesley, 1927; Hansen, 1941; Bry & Boschan, 1971; Black, 1987; Gärtner, 1999; Labonte, 2007; Mitchel, 2017; Schumpeter, 2017; Boschof, 2020). Changes apply to the economy's structure and development rate (North, 1997; Sen, 1999; Adams, 2002; Glewwe & Jacoby, 2004; Kapsos, 2005). The labour market, including unemployment and employment, change due to structural changes and business cycles in the economy (Kapsos, 2005; Rodrik, 2007; Nickolas, 2022).

The COVID-19 pandemic, which broke out in the autumn of 2019 in Wuhan and spread all over the world a few months later (Cohen, 2020; Rambaut et al., 2020) caused severe disturbances in all social and economic life areas. The first pandemic year, 2020, saw millions of hospitalised patients (Menachemi et al., 2021), and many lost their lives and health (Our World in Data, 2023). In order to prevent and counteract the spreading of the COVID-19

pandemic and combat the disease it causes, legal solutions were implemented globally. Many of the solutions applied to the labour market, e.g. schools, universities and economy sectors, were closed (e.g. hotels, catering facilities, culture facilities, and selected shopping units). State borders were closed for the traffic of employees and goods, and travel restrictions were introduced. Remote work was introduced on a mass scale, wherever possible (though it was previously hard to imagine).

In addition to short-term consequences, lockdowns and successive restrictions trigger long-term economic consequences (Callegari & Feder, 2022; Carlsson-Szlezak et al., 2020). The pandemic effects concern the labour market (Celbiş et al., 2022), including unemployment increase (Hezam, 2021; Kong & Prinz, 2020; Webster et al., 2022). The changes in the labour market vary for the employee's/unemployed person's gender (Andrew et al., 2020; Alon et al., 2020, 2022; Tertilt et al., 2020; Hughes et al., 2022). They struck entrepreneurs (Hughes et al., 2022), family companies (Kraus et al., 2020), and self-employed ones (Blundell & Machin, 2020; Gavriluță et al., 2022). Moreover, they affected the labour market's policy (Fujita et al., 2020).

Due to restrictions, the pandemic exerted the most significant impact on such sectors as construction (Radzi et al., 2022), industrial production (Stojcic, 2020; Sodhi, 2020; Harris et al., 2020; Cai & Luo, 2020), trade (Rubio-Valdehita et al., 2021), education (Munawar et al., 2021; Xiang et al., 2021), tourism (Gössling et al., 2021; Munawar et al., 2021; Magno & Cassia, 2022; Xiang et al., 2021), catering (Xiang et al., 2021) and accommodation services (Lopes et al., 2021). On the one hand, the transport sector was affected by interrupted supply chains, closed state borders and stopping passenger air traffic (Gössling et al., 2021); on the other hand, a higher demand for courier services was observed (Xiang et al., 2021; Markowska & Marcinkowski, 2022). When the obligation to maintain social distance and isolation was imposed, many art, recreation and entertainment employees lost their jobs or were forced to take some time off work (Mangan, 2020). At the same time, various Internet platforms and applications started to play a significant role in offering creative content (Hall, 2020), while technological and ICT infrastructure supported maintaining social distance.

The coronavirus pandemic stimulated an increase in the demand for some goods, e.g. due to panic shopping, while the demand for other goods decreased (Lobach, 2020; Bentall et al., 2021). The solutions implemented in commerce included self-checkouts to restrict contact, cash payments limited, shop counters additionally protected and merchandise stocks replenished according to schedules (Pak, 2020). The pandemic contributed to the implementation of new ideas. Technological and digital innovations were introduced in tourism (Rao & Krantz, 2020). Tours in augmented and virtual reality make a good example (Chirisa et al., 2020; Kwok & Koh, 2021). In the education sector, technology-based platforms emerged for online education as an alternative to the existing system (Ting et al., 2020). In the health protection system, new technologies played a vital role in flattening the wave of confirmed cases, limiting the patients' inflow to hospitals (Smith et al., 2020), and in the popularisation of online medical consultations and telemedicine on a mass scale (World Health Organization [WHO], 2020). The requirement for remote work triggered the demand for many services, including ICT, courier, financial, real estate and education services.

The pandemic disturbances concerned labour markets in various countries, e.g. Croatia (Stojcic, 2020) and the USA (Atkeson, 2020; Béland et al., 2020a), groups of countries (Kraus

et al., 2020; Strauss et al., 2021; Celbiş et al., 2022; Webster et al., 2022) and regions (Doerr & Gambacorta, 2020).

The evaluation of economic changes which occurred as a result of the pandemic requires various methodological approaches. The applied methods include descriptive and mathematical statistics (Gavriliuță et al., 2022), exploratory machine learning (Celbiş et al., 2022) and various model types, including interconnected equations (Ang & Dong, 2022), dynamic optimum control (Hezam, 2021), for panel data, (Béland et al., 2020a), hierarchic data (Strauss et al., 2021), Keynesian disaggregated model (Lenoël & Young, 2021), and structural equations (Radzi et al., 2022).

This study aims to identify the differences in the dynamics of female and male employment rate changes in the economy sections, in the EU countries, in 2020, compared to 2008–2019. The main research hypothesis of the paper states that COVID 19 impact on employment rate was not the same in all countries, sections of the economy, and not the same for both sexes. The paper's author asks a research question if employing the "Triple 2 rule" proposed by Markowska and Sokołowski (2023) enables evaluating the impact of the COVID-19 pandemic on the employment rate dynamics in the EU countries, in the economy section groups and according to gender. Identification of „interventions" into employment trends, section-wise and sex-wise seems to be the value-added of this paper, together with naming most vulnerable and resilient sections of the economy.

2. Literature review

The COVID-19 pandemic caused disturbances in all areas of human lives, including health, social and economic issues. The crisis caused by the COVID-19 pandemic covered all economic areas. The changes in the labour market concerned the condition of the economy and its sectors, employment in total and in sections, unemployment and businesses' financial situation. Research on the COVID pandemic's impact on the economy, including the labour market, is carried out for almost all countries worldwide. For demonstration purposes, the first ten countries from the research list are quoted here, including Australia (Borland, 2020a, 2020b; Lim et al., 2021; Lloyd & Dixon, 2021; Walkowiak, 2021); Bangladesh (Hossain, 2021); Canada (Beland et al., 2020b; Qian & Fuller, 2020; Lamb et al., 2021); Cameroon (Biwolé, 2021); Denmark (Soested & Videbaek Munkholm, 2020); Estonia (Foresight Centre, 2020); France (Hadjibeyli et al., 2021); Germany (Bauer & Weber, 2021); Guatemala (Diaz-Bonilla et al., 2022); Honduras (Aterido et al., 2021; Bachas et al., 2021); India (Roychowdhury et al., 2022); and Japan (Fukai et al., 2021).

In addition to changes in the labour market in the referenced countries, the researchers analyse the impact of the COVID-19 pandemic in different territorial systems, including but not limited to regions (Markowska & Strahl, 2022), and in smaller territorial systems (OECD, 2020), and also on individual person level (Basuki et al., 2022).

A diversified situation of females and males in the labour market during the crisis caused by the COVID-19 pandemic is an essential motif in the research (Alon et al., 2020, Tertilt et al., 2020; Casale & Posel, 2020; del Boca et al., 2020; Farré et al., 2020; Hupkau & Petrongolo, 2020; Albanesi & Kim, 2021; Graeber et al., 2021; Ham, 2021; Mohapatra, 2021; Nivakoski & Mascherini, 2021; Markowska & Strahl, 2022).

Various research methods are used to evaluate the COVID-19 pandemic's impact on the economic situation. Markowska and Strahl (2022) reviewed the methods used in the research on the economic situation during the pandemic, indicating, e.g. the evaluation of the COVID-19 pandemic's impact on:

1. remedy strategies in the construction industry – structural equations estimated with the Partial Least Squares Method (PLS-SEM) (Radzi et al., 2022);
2. stock exchange – Generalised Autoregressive Conditional Heteroskedasticity GJR-GARCH (1,1) (Golder et al., 2022);
3. employing persons from senior groups in the European labour market – exploratory machine learning (Celbiş et al., 2022);
4. economy – descriptive and mathematical statistics methods (Gavriliuță et al., 2022) and Keynesian disaggregated model (Lenoël & Young, 2021) and evolutionary approach (Callegari & Feder, 2022),
5. unemployment – models of interconnected equations estimated with 3SLS and GMM methods (Ang & Dong, 2022), a new bi-level dynamic optimum control model (BLDOC) (Hezam, 2021), models for panel data (Béland et al., 2020a);
6. changes in the GDP and employment – Bayesian hierarchical models (Strauss et al., 2021).

Other methods used for evaluating the COVID-19 pandemic's development and its impact on various economic functioning areas include:

1. Short-term forecasting method with ARIMA models and Survival Analysis Methods – for evaluating the stock exchange situation in the pandemic (Ahmar & del Val, 2020; Bieszk-Stolorz & Dmytrów, 2021a, 2021b);
2. Dynamic Time Warping Method – for studying the dynamics of the COVID-19 pandemic development in Poland (Landmesser, 2021b) and EU countries (Landmesser, 2021a), and the connections between COVID-19 and energy commodities prices (Dmytrów et al., 2021);
3. Flexibility Using the TOPSIS Method – for evaluating the labour market situation (Galik et al., 2022);
4. Counterfactual before-after comparison – evaluation of the unemployment rate on the development (Svabova et al., 2021);
5. Cluster Analysis – assessment of the COVID-19 pandemic on tourism in European countries (Roman et al., 2022);
6. Multisectoral CGE Model Analysis Coupled with a Micro-Simulation Approach – the impact of the COVID-19 pandemic on the labour market and income inequalities (Zhang et al., 2022);
7. Forecasting – for employment projections in a pandemic environment (Ice et al., 2021).

A brief review of the reference literature reveals that plenty of research was devoted to evaluating the impact of the COVID-19 pandemic on the economy. Extensive literature reviews were dedicated, e.g. to stock markets and financial market reactions to the COVID-19 pandemic (Fianto et al., 2023) and the implications of the COVID-19 pandemic for sustainable development of business and society (Su et al., 2022).

3. Research methods

The literature review reveals that researchers succeed in evaluating the COVID-19 pandemic effects for different aspects of economic functioning. In this paper, two methods were used to identify the differences in the employment rate dynamics in the EU countries, and in the economic sectors, according to gender. The research procedure scheme proposed by Markowska and Sokołowski (2023) is presented below.

The first method (Triple 2 Rule (T2R)):

1. building trend models and autoregression models for the data from the period preceding the expected intervention period,
2. developing forecasts for the expected intervention period,
3. calculating the dynamics index in the intervention period compared to the immediately preceding period (I_1),

$$I_1 = \frac{100 * (y_{2020} - y_{2019})}{y_{2019}}, \quad (1)$$

4. identifying the difference between the forecasts based on the trend and the real value for the intervention period and dividing it by the mean trend model matching error (I_2),

$$I_2 = \frac{y_{2020} - \hat{y}_{2020}^{(1)}}{S_{\varepsilon}^{(1)}}, \quad (2)$$

where

$$\hat{y}_t^{(1)} = \widehat{f(t)} + b_3 \varepsilon_{t-1}; \quad (3)$$

$$\widehat{f(t)} = b_0 + b_1 t + b_2 t^2; \quad (4)$$

$$\varepsilon_{t-1} = y_{t-1} - \widehat{f(t-1)}; \quad (5)$$

$$S_{\varepsilon}^{(1)} = \sqrt{\frac{\sum_{t=1}^n (y_t - \hat{y}_t^{(1)})^2}{n - w}}, \quad (6)$$

5. identifying the difference between the forecast from the autoregression model and the real value for the intervention period and dividing it by the mean error of the autoregression model matching (I_3).

$$I_3 = \frac{y_{2020} - \hat{y}_{2020}^{(2)}}{S_{\varepsilon}^{(2)}}, \quad (7)$$

where:

$$\hat{y}_t^{(2)} = a_0 + a_1 y_{t-1} + a_2 y_{t-2}; \quad (8)$$

$$S_{\varepsilon}^{(2)} = \sqrt{\frac{\sum_{t=1}^n (y_t - \hat{y}_t^{(2)})^2}{n - w}}. \quad (9)$$

The “first two” rule assumes that each of the three indices is considered significant if its absolute value exceeds two. The “second two” rule suggests an intervention if at least two of three indices are substantial. If three indices have the same sign, their geometric mean is

calculated. If not all indices have the same sign, their median is calculated. Finally, the “third two” rule assumes that an intervention shall be considered relevant if the geometric mean or median for the module is greater than two.

The second method assumes using a dynamic cluster analysis (Markowska, 2012) for the data from the entire period (including the expected intervention period) and evaluating potential changes in the composition of groups during the intervention period.

All calculations have been done in STATISTICA 13 software.

4. Data and its initial analysis

In this paper, the spatial scope of the research covers the EU countries. The time frame of the analysis is the 2008–2020 period, meaning twelve years before the pandemic and the first pandemic year. Changes in the female employment rate and male employment rate in the following business sections (grouped as presented by Eurostat (n.d.)¹) are the subject matter of the evaluation in the study. The abbreviated and full names are given, while the letters in brackets stand for the section acronyms:

- agriculture – agriculture, forestry and fishing (A),
- industry – mining and quarrying; manufacturing; electricity, gas, steam and air conditioning generation and supply; water supply; sewerage, waste management and remediation activities (B-E),
- construction – (F),
- trade – wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities (G-I),
- information – information and communication (J),
- finance – financial and insurance activities (K),
- real estate – real estate activities (L),
- science – professional, scientific and technical activities and administrative and support service activities (M-N),
- administration – public administration and defence; compulsory social security; education; human health and social work activities (O-Q),
- entertainment – arts, entertainment and recreation (R).

The employment rates in the studied EU countries were determined in the following way:

- total – as a quotient of the employed and the number of working-age people (18–64 years for men, and 18–59 years for women),
- women – as the quotient of the employed women and the number of working-age women (18–59 years),
- men – as a quotient of employed men and the number of working-age men (18–64 years).

The employment rates in the analysed sections, are the quotients of:

- the number of people employed in the given section and the number of working-age people (18–64 years for males and 18–59 years for females), the total employment rate in the section,

¹ https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfst_r_lfe2en2&lang=en (15.04.2023)

- the number of women employed in the given section and the number of working-age women (18–59 years), women's employment rate in the section,
- the number of men employed in the given section and the number of working-age men (18–64 years), men's employment rate in the section.

The highest total employment rate was reported in 2008 for Denmark, in 2009–2019 and 2020 in the Netherlands, and in 2011–2019 in Sweden. The lowest employment rate, in turn, was reported in 2008 in Malta, in 2009–2010 in Hungary, and the following years of the analysed period – in Greece. Rising extreme levels of the mean and median and a decrease in the extreme value to standard deviation ratio since 2013 were observed in the EU countries analysed as a whole, following the drops and fluctuations in 2009–2012 (crisis); this means reducing the EU's internal diversification for the employment rate in the member states.

The summary below presents a list of countries with the highest and the lowest employment rate in each section and section groups (according to Eurostat (n.d.)² business section presentation):

- section A: the highest in Romania, the lowest in Belgium (2008, 2014, 2018), Luxembourg (2010, 2015, 2016, 2019–2020) and Malta (2009, 2011–2013, 2017);
- sections B-E: the highest in the Czechia, the lowest in Luxembourg;
- section F: the highest in Estonia (2008, 2013–2019) and Cyprus (2009–2012, 2020), the lowest in Malta (2008), Luxembourg (2009), Ireland (2010–2012) and Greece (2013–2020);
- sections G-I: the highest in Cyprus (2008–2011, 2017–2019), Austria (2012–2013), Lithuania (2014), Latvia (2015), Malta (2016), Bulgaria (2020), and the lowest in Luxembourg;
- section J: the highest in Sweden (2008–2009, 2011–2013, 2018–2020), Denmark (2010) and Ireland (2014–2017), the lowest – alternately – in Romania (2008–2011, 2013, 2019) and Greece (2012, 2014–2018, 2020);
- section K: the highest in Luxembourg, the lowest in Romania (2008–2010, 2013–2020) and Lithuania (2011–2012);
- section L: the highest in Sweden (2008–2009) and Latvia (2010–2020), the lowest in Romania (2008–2009) and Greece (2010–2020);
- sections M-N: the highest in Sweden, the lowest in Romania;
- sections O-Q: the highest in Denmark (2008–2011) and Sweden (2012–2020), the lowest in Romania;
- sections R: the highest in Cyprus (2008, 2010–2011), Luxembourg (2009, 2012–2019) and Malta (2020), the lowest in Romania (2008–2014, 2017–2018), Slovakia (2015, 2020) and Poland (2016, 2019).

5. Results and discussion

The method (T2R) was used separately for the male and female employment rate, always divided according to business activity sections. It helped identify significant changes in the employment rates, whereby:

- a decrease is meant as the employment rate level in 2020 significantly lower than suggested by the 2009–2019 trend;

² https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfst_r_lfe2en2&lang=en (15.04.2023)

- an increase is meant as the employment rate level in 2020 is significantly higher than suggested by the 2009–2019 trend.

Hence, it is not about absolute increases or decreases in the employment rates but about their deviations from the previously observed trends.

5.1. Significant changes in the female and male total employment rates

Table 1 summarises the indices (I_1 , I_2 and I_3) and the geometric mean or median for the female and male total employment rates in the EU countries. Employment rates significantly higher in 2020 than suggested by the trends observed in 2009–2019 while maintaining the “Triple 2 rule” are highlighted in blue.

Table 1. Predictions vs actual values in 2020 – total employment rate (women and men)
(source: own calculation)

Country (acronym)	Women				Men			
	I_1	I_2	I_3	Geometric mean or median	I_1	I_2	I_3	Geometric mean or median
European Union	-0.97	-2.82	-4.18	-2.25	-1.36	-3.31	-3.62	-2.54
Belgium (BE)	-1.16	-1.75	-3.80	-1.98	-0.81	-1.81	-0.86	-1.08
Bulgaria (BG)	-2.61	-3.00	-2.15	-2.56	-2.10	-2.77	-1.84	-2.20
Czechia (CZ)	-1.42	-2.68	-2.14	-2.01	-0.68	-2.81	-1.44	-1.40
Denmark (DK)	-0.97	-2.61	-3.40	-2.05	-0.98	-2.34	-2.01	-1.66
Germany (DE)	0.27	-0.21	-0.39	-0.28	-1.91	-1.53	-1.30	-1.56
Estonia (EE)	-1.94	-2.38	-0.83	-1.39	-2.68	-1.75	-0.96	-1.65
Ireland (IE)	-2.94	-3.45	-8.25	-4.37	2.43	-2.81	-3.21	-2.80
Greece (GR)	0.28	-1.25	-0.41	-0.53	-1.82	-1.86	-1.15	-1.57
Spain (ES)	-3.99	-3.71	-3.35	-3.67	-4.02	-3.18	-2.15	-3.02
France (FR)	-0.34	-2.14	-4.35	-1.47	-0.45	-2.58	-0.42	-0.78
Croatia (HR)	0.03	-1.80	0.34	-0.26	-0.45	-2.14	-0.18	-0.55
Italy (IT)	-2.18	-2.71	-3.69	-2.79	-1.07	-1.84	-1.45	-1.42
Cyprus (CY)	-1.12	-1.52	0.42	-0.90	-0.63	-1.46	-1.00	-0.97
Latvia (LV)	-0.62	-2.10	-1.25	-1.17	-1.20	-1.51	-0.80	-1.13
Lithuania (LT)	-1.96	-2.71	-2.12	-2.24	-1.59	-1.96	-0.83	-1.37
Luxembourg (LU)	0.55	-0.70	-0.84	-0.69	-2.29	-0.53	-1.49	-1.22
Hungary (HU)	-0.88	-2.04	-1.47	-1.38	-0.25	-1.99	-0.94	-0.78
Malta (MT)	0.97	-0.96	-0.99	-0.96	-4.57	-4.17	-10.47	5.84
Netherlands (NE)	-0.45	-1.63	-2.45	-1.22	-0.79	-2.63	-1.45	-1.45
Austria (AT)	-1.22	-2.25	-6.51	-2.61	-1.81	-2.85	-2.58	-2.37
Poland (PL)	0.67	-2.00	0.42	-0.83	0.76	-1.59	-0.65	-0.92
Portugal (PT)	-1.13	-2.76	-0.30	-0.98	-2.77	-3.02	-1.23	-2.18
Romania (RO)	-0.97	-2.21	0.57	-1.07	-0.22	-2.09	-0.30	-0.52
Slovenia (SI)	-0.30	-2.29	0.40	-0.65	-1.00	-2.99	-0.16	-0.78
Slovakia (SK)	-1.10	-2.71	-2.88	-2.05	-1.49	-3.20	-1.13	-1.75
Finland (FI)	-1.47	-2.07	-1.11	-1.50	-1.03	-1.85	-1.41	-1.39
Sweden (SE)	-2.68	-4.09	-2.80	-3.13	-2.04	-3.20	-4.37	-3.05

For the female total employment rate, the T2R was fulfilled for ten member states, and the EU evaluated as a whole; fulfilling the rule means that at least two of the I_1 , I_2 and I_3 indices are greater than 2 as regard the module, and the geometric mean or median of the indices is greater than 2 as regards the module. The ten countries mentioned above include Bulgaria, Ireland, Spain, Austria, Sweden, Italy, Denmark, Lithuania, Slovakia, and Czechia. For the male total employment rate, the T2R was fulfilled in seven countries, including Bulgaria, Ireland, Spain, Austria, Sweden, Malta and Portugal. Five countries belong to the “common” group of countries where the T2R occurs for the changes in the female and male total employment rate; they include Bulgaria, Ireland, Spain, Austria and Sweden.

Table 2 summarises the pooled results for the employment rate changes according to gender (in total).

Table 2. Significant changes in the employment rates of women and men in sections of activity (source: own calculation)

Sections	Significant changes in women employment		Significant changes both in women and men employment		Significant changes in men employment	
	↓	↑	↓	↑	↓	↑
Total	CZ, DK, IT, LT, SK		BG, IE, ES, AT, SE		MT, PT	
A	CZ		GR, ES		EE, LT, FI, SE	HR, AT, PL
B-E	EE, HU, SI		CZ, RO		BG, GR, ES, NE	DE, CY
F	ES, RO, LT,	CZ, FR, IT, LV, FI	DE, IE		BG, MT, FI, SE	HR, SI
G-I	SK, SI, LV, MT, PL	LU	NE, AT, PT, BE, BG, CZ, DE, EE, IE, DK, ES, IT, HU, CY, LT, SE, FI			
J	MT, GR, ES, HR	LT, BE, IE, FI, SE, PT, ES		DE, SK		BG, EE, LV, SI
K		DK, SI, IT		DE, LT, IE, MT, SE	BG, IT, HR	BE, FI, FR, PL
L	DK, , CY, LT, SE, PL, PT	SI, IE		DE, HU		LU, NE, FI, SK
M-N	CZ, IT, SK	SI	DE, IE, ES		DK, EE, SI	HU, NE, FI
O-Q	SE	LU			EE, HU	BE, CZ, DE, NE, LT
R	DE, IT, RO		IE, ES, SE		CZ, DK, SK, SI, FI, HR	DE, GR, LV, PT

5.2. Significant changes in the female and male employment rates according to business sections

Table 2 summarises the results for the employment rate changes in business sections and according to gender. The countries where significant changes in the employment rate levels (compared to the 2008–2019 trend) occurred are enumerated. In the first evaluated section (A), significant changes in the employment rate according to gender occurred in the EU countries for the following:

- male employment rate: Lithuania, Finland, Sweden, and Estonia,
- female employment rate: Czechia,
- male and female employment rates: Spain and Greece.

Significant employment rate changes according to gender occurred in this section for the male employment rate in Poland, Croatia, and Austria.

For industry (sections B-E), significant employment rate changes according to gender occurred in the EU countries for the following:

- male employment rate: Bulgaria, Greece, the Netherlands, and Spain,
- female employment rate: Estonia, Hungary, and Slovenia,
- male and female employment rates: Czechia and Romania.

In Germany and Cyprus, significant increases were observed in the male employment rate in the industry.

Significant drops in the employment rate in construction were reported in the EU countries for the following:

- female employment rate: Lithuania, Spain, and Romania,
- male employment rate: Belgium, Malta, Finland, and Sweden,
- male and female employment rates: Ireland and Germany.

Significant increases in the employment rate in construction for the female employment rate were reported for Czechia, France, Italy, Latvia, and Finland, and the male employment rate in Croatia and Slovenia.

The G-I sections (wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities) represent the group that saw significant decreases in the employment rate in the highest number of EU countries:

- female employment rate: Latvia, Malta, Poland, Slovakia, and Slovenia,
- male and female employment rates: Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Spain, Italy, Cyprus, Lithuania, Hungary, the Netherlands, Austria, Portugal, Finland, and Sweden.

Luxembourg was the only EU country where a significant increase in the employment rate (females) was reported in the G-I section group.

In the information and communication section, significant (negative) changes concerned the female employment rates in Greece, Croatia, and Malta. Significant (positive) changes in the female employment rates were observed in Belgium, Ireland, Spain, Lithuania, Portugal, Finland, and Sweden; for the male employment rate, they were reported for Bulgaria, Estonia, Latvia, and Slovenia, while for the female and male employment rate, they included Germany and Slovakia.

If significant changes in the K section occurred in 2020 for the female employment rate, they were positive changes (Denmark, Italy, Slovenia), for the female and male employment rate in Germany, Ireland, Lithuania, Malta, and Sweden, and for male employment rate in Belgium, Poland, France, and Finland. In 2020, the male employment rate went down significantly in three member states (Bulgaria, Croatia, and Italy).

The same holds true for the L section – if significant changes were observed for the employment rate, they were positive – for the male employment rate (Luxembourg, the Netherlands, Slovakia, and Finland), and the female and male employment rate (Germany and Hungary). Significant changes in the female employment rate (positive) were reported for

Ireland and Slovenia, while negative changes in the employment rate in this section covered Denmark, Cyprus, Lithuania, Poland, Portugal, and Sweden.

In the M-N sections, a significant decrease in the female employment rate was observed in three countries (Czechia, Italy, and Slovakia). For the male employment rate, it was also in three countries (Germany, Estonia, and Slovenia) and in three countries for the female and male employment rate (Denmark, Ireland, and Spain). Significant – according to the T2R concept – changes in the employment rate concerned the female employment rate in Slovenia and the male employment rate in Hungary and Finland.

In the O-Q sections, significant changes in the female employment rate were reported for Luxemburg (increase) and Sweden (decrease). A substantial drop in the male employment rate was observed in Hungary, while a significant increase was reported in six countries (Belgium, Czechia, Germany, Estonia, Lithuania, and the Netherlands).

In the last analysed section, i.e. R, a specific situation was observed for the employment rates in Germany: a significant decrease for females and a significant increase for males. As for the employment rate decreases according to gender, for the male employment rate they occurred in Czechia, Denmark, Croatia, Slovenia, Slovakia, and Finland, for the female employment rate – in Italy and Romania, while for the female and male employment rate - in Ireland, Spain, and Sweden. At the same time, significant increases in the male employment rate were reported for three countries (Greece, Latvia, and Portugal).

5.3. Dynamic classification of the EU countries as regards employment rate changes in sections and according to gender

The other method – a dynamic cluster analysis – was applied to the entire period's data (including the expected intervention period) – Figure 1 and Table 3.

Ward's hierarchical clustering method and agglomeration schedule analysis were used to identify the number of groups, while the final division was made using the k-means clustering method. The results helped evaluate the changes that occurred in the groups' composition during the intervention – in the first year of the COVID-19 pandemic, i.e. 2020. A cluster analysis enabled dividing the countries into groups with similar employment rate changes:

Group 1: Belgium, France, Greece, Latvia, Czechia, Italy, Denmark, Cyprus, Bulgaria, Estonia, Romania, Croatia, the Netherlands, Austria, Poland, Slovenia, and Luxemburg,

Group 2: Lithuania and Portugal,

Group 3: Ireland, Spain, Sweden, Hungary, Finland, and Slovakia,

Group 4: Germany.

Table 3. Significantly different means in country groups and sections (source: own calculation)

Country group	B-E	F	G-I		J		L	M-N		O-Q	R
	M	M	W	M	M	W	W	W	M	W	M
1	-0.97	-0.28	-2.49	-2.24	-0.00	0.63	-0.37	-0.20	-1.15	0.25	-0.69
2	-1.77	-1.48	-3.66	-2.93	5.89	-0.71	-8.57	0.61	-1.67	-1.29	2.37
3	-1.09	-2.01	-4.90	-3.71	3.94	0.68	1.23	-2.19	0.11	-1.53	-3.48
4	5.31	-12.44	-4.91	-8.02	6.09	10.16	15.98	-9.42	-7.62	0.06	16.67

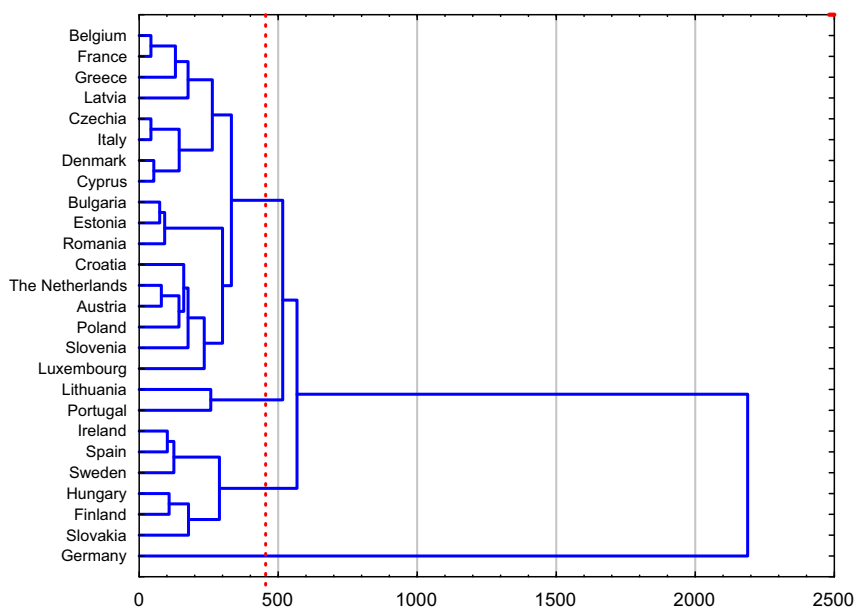


Figure 1. Dendrogram from Ward's method (source: own calculation)

Short characteristics of country groups divided according to significant mean changes in the employment rates in the sections in 2020 are presented below.

Group 4, consisting of only one country (Germany), stands out significantly because of

1. substantial drops in the male employment rate in section F and in the male and female employment rates in section groups G-I and M-N;
2. substantial increases in the male employment rate in sections B-E and R, in the female employment rate in section L, and in both female and male employment rates in sections J, G-I and M-N.

Group 1, with the highest number of countries (17), is characterised by a significant mean decrease in the female and male employment rate in 2020 in the section group, including wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities. The same holds true for Group 2 (as for drops in sections G-I), where the significant mean decrease applied to the female employment rate in the L section, and increases were observed for the mean male employment rates in sections J and R.

A significant mean decrease in the female and male employment rate in the G-I sections is characteristic of Group 3 as well. Moreover, this Group is characterised by a significant mean drop in the male employment rate in sections F and R, and in the female employment rate in the M-N section, and a mean increase in the male employment rate in the J section.

5.4. Insignificant changes in the total employment rate according to gender in the EU countries

The economies of the EU countries, including the labour market, responded to the COVID-19 pandemic in various ways. As described above, besides the economy sections, where in 2020, the significant changes in the employment rate actually meant decreases, in some sections, increases were reported. Moreover, significant positive and negative employment rate changes were non-uniformly distributed in the system analysed according to gender. Nonetheless, in some countries, no significant changes were observed in the total employment rate levels according to gender.

The countries where no significant COVID-19 impact was observed in the total employment rate according to gender are summarised in Figure 2.

These countries are above the determined limits $[-2; +2]$ range]. The countries where no COVID-19 impact was observed on the previous trend in neither female nor male employment rates in the first year of the pandemic included Croatia, Slovenia, Cyprus, Poland, Luxembourg, Belgium, Greece, Germany, Estonia, the Netherlands, Finland, Romania, Hungary, France, and Latvia.

The results concerning diversified trends in the employment rate comply with the results of research, authored by Markowska and Sokołowski (2023), Xiang et al. (2021), Rubio-Valdehita et al. (2021), Munawar et al. (2021), Gössling et al. (2021), Magno and Cassia (2022), and Lopes et al. (2021). It is similar for simultaneous significant employment rate decreases in some sections and increases in others (Gössling et al., 2021; Hall, 2020; Mangan, 2020; Xiang et al., 2021).

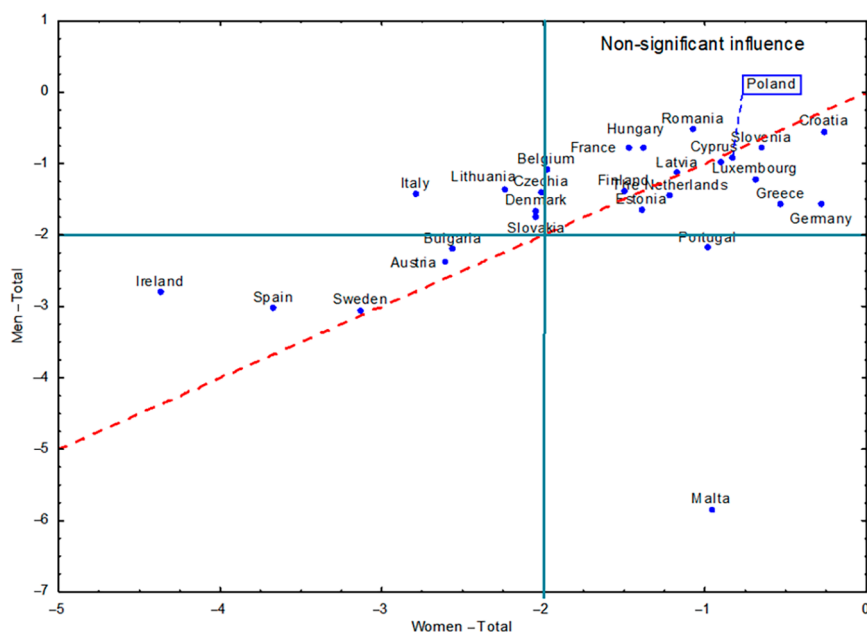


Figure 2. Relation between total employment changes in men and women rate (source: own calculation)

The future research should evaluate the COVID 19 impact on employment rate in 2021, in countries, sections and sex-wise. The next year – 2022 could be considered as the start of lowering the impact of pandemic. But in the same year we had Russian invasion on Ukraine, energy crises and inflation – so the picture would be more complicated. Nevertheless we have to wait for 2022 statistical data to be published. The newly proposed measure of resilience to economic rises (Markowska, 2015) may be used in the further evaluations.

6. Conclusions

This study aimed to evaluate the COVID-19 pandemic's impact on the female and male employment rates in total and in business sections in the EU countries in 2020 and to identify the countries and sections with the most significant impact – according to the T2R – described before. The essential conclusions are as follows:

- there was no single EU country with no employment rate “intervention” observed in 2020, i.e. the first year of the COVID-19 pandemic,
- according to T2R, significant employment rate changes stand for decreases and increases,
- for the total employment rate, a significant drop for females and males was observed in Bulgaria, Ireland, Spain, Austria and Sweden; only for the male employment rate in Portugal and Malta, while only for the female employment rate in Czechia, Denmark, Italy, Lithuania and Sweden.
- in some countries, the changes in the employment rate according to gender occurred in only one section:
 - negative for females in Croatia (J), the Netherlands, Bulgaria, and Austria (G-I), and for males in Romania (B-E),
 - positive in France for females (F) and males (K), and for males in Luxemburg (L),
- the countries where significant changes (decreases) applied to four and more sections include:
 - female employment rate: Czechia and Germany,
 - male employment rate: Bulgaria, Estonia, and Finland,
 - female and male employment rate: Ireland, Spain, and Sweden,
- in Germany, significant increases in the male employment rate were observed in six sections,
- in twenty-two EU countries, a significant decrease in the female employment rate was observed in the G-I sections (including sixteen countries with a significant decrease in the male employment rate) – it is a group of sections most severely affected by the first year of the COVID-19 pandemic,
- in Finland, in section F and in Slovenia in sections M-N, 2020 saw a significant increase in the female employment rate and a decrease in the male employment rate,
- in Germany, in section R, a significant decrease in the female employment rate and an increase in the male employment rate were reported,
- the application of the “Triple 2 rule” helped evaluate the COVID-19 pandemic's impact on the employment rate dynamics in the EU countries, in the economy section groups and according to gender.

The research revealed a diversified situation in the sections. As expected, the most affected sections were the ones where maintaining social distance and lockdowns impaired business operations, i.e. commerce, transport, accommodation and catering services, culture and entertainment (G-I, L, M-N and R). Sections O-Q – especially for the male employment rate – saw an increase in six countries. The most favourable situation for female employment rate changes was observed in finance and insurance (K), where only increases were observed (in eight countries). The German labour market's behaviour was extreme – significant employment rate decreases were reported for some sections, while other saw substantial increases – Figure 3.

Four clusters were obtained in the dynamic classification – they were groups of countries with similar employment rate changes; they consisted of 17, 2, 6 and one country in the last group (Germany), respectively. The classification did not include Malta because of a lack of reliable data on female employment.

Valid further research directions should focus, e.g. on the attempt to identify the causes of the observed differences using substantial analysis, applying T2R for the data in the second pandemic year or comparing the research results for the first and second year of the COVID-19 pandemic.

The frequency of Eurostat's publishing data on employment at the country and section levels, and according to gender (on an annual basis nowadays), is a constraint for more detailed analysis. More frequent publications could enable evaluating, e.g. seasonality in the employment rate changes.

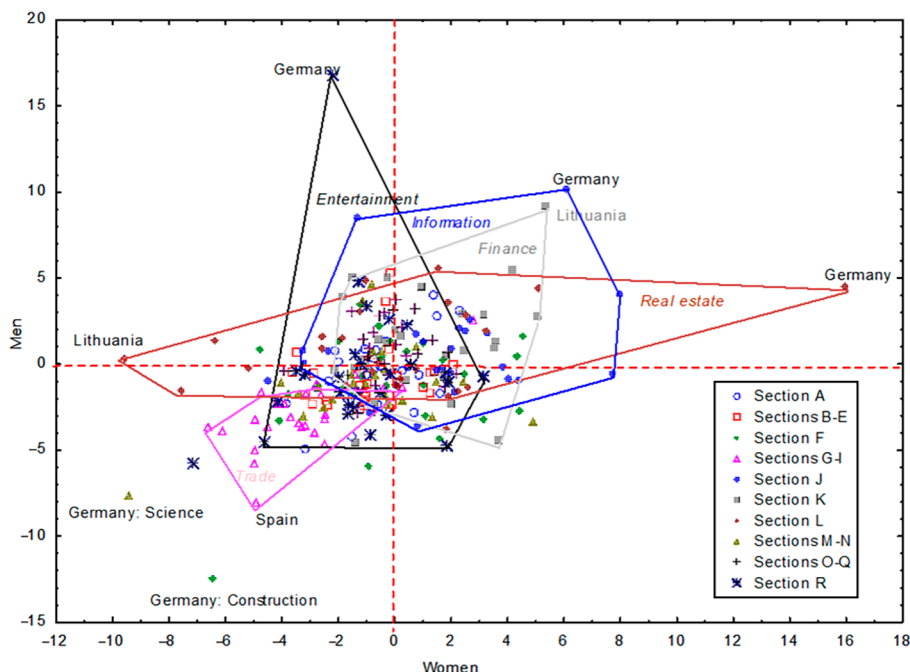


Figure 3. Variability of section-specific employment changes in selected countries (source: own elaboration)

The limitations of the study were as follows: 1. Lack of data for individual sections of the economy, so we had to use groups of sections as defined by EUROSTAT; 2. It was not possible to study COVID-19 impact in subsections and branches, while some restrictions were imposed on these lower levels (closing hotels and restaurants, restrictions in transport, closing borders); 3. Difficulties in late effects identification; 4. The lack of comparable data on legal regulations connected with lockdowns and on financial support provided in different countries were also important limitations in the study.

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Author contributions

Conceptualization: M.M.; data curation: M.M.; formal analysis: M.M., D.S.; funding acquisition: D.S.; review of the literature: M.M.; methodology: M.M.; validation: D.S.; visualization: M.M.; writing – original draft: M.M.; writing – review & editing: M.M., D.S.

Disclosure statement

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