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Sustainability of gender employment and pay gap types regarding female participation in corporate management

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Abstract
The main goal of the study is to investigate the various types of the gender employment gap, the gender pay gap, and female participation in corporate management. These aspects have become even more important in the recent period. The comprehensive analysis of the eleven indicators demonstrates the fields of further examination. The employed panel regression analysis reveals that all the explored types of gender employment gaps along with the gender pay gap are statistically significant according to the certain regression models. All the gender employment gap types aimed at the geographical localisation are statistically significant regarding their impact on the eco-innovations. The second group of the gender employment gap types related to the work type behave in the same way reaching the highest levels of statistical significance. Similarly, the gender pay gap demonstrates statistical significance for its impact on the eco-innovations. Finally, female participation in corporate management achieves the highest statistical significance levels too. These outcomes point to the need for an observation of the particular effects assigned to the statistically significant regression models. Altogether, the two-way effect shows a very low level of statistical significance, while the time effect and the individual effect behave at a considerably higher level. It could be concluded that these effect types represent almost the same applicability. Hence, the position of the individual countries could be investigated in the further examination in order to demonstrate the disparities among the countries. The study outcomes will create a basement for the designers of national and regional environmental and innovation policies as well as for regulatory authorities.

Keywords Eco-innovation · Female · Gender · Employment gap · Pay gap · Regression model

JEL Classification E24 · J16 · J21

1 Introduction

The depletion of non-renewable resources and the increasing degradation of the environment have become global issues in the recent years, whose solution requires construction of effective international ecological systems, national and international policies, and transnational

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collaboration. Eco-innovations represent one of the most effective solution to the environmental issues that need the transformation of ecological and environmental management, modernisation of industrial structures, as well as economic, political, and social support (Pepelyaeva et al., 2021). In the past, the countries governments played the most important role in eco-innovation development, which was related to many historical, political, institutional, and social aspects. In the recent period, the perception of the leading role of the government as the most important factor in eco-innovation has begun to change (Geng et al., 2021). Even though the influence of the government remained significant, whether from the point of view of support, regulatory or stabilization mechanisms, the microeconomic level of the economy increasingly received attention (Elisenda et al., 2018). The influence of the management mechanisms at the business level has proved to be very statistically significant, not only in a relation to the construction of an optimal environment for the implementation of the eco-innovations, but also for their effective development and linking with the other dimensions of the technological development of enterprises. The management systems complexity and the adaptation conditions of the transformation processes in enterprises is increased with technological innovation too. Female population plays an increasingly important role in the business management and in politics that is supported by the creation of the regulations related to the ratio of women in the leadership positions in many countries. According to several studies, female participation in politics has made it possible to increase the political management level and to eliminate the shortcomings of male managerial work (Isidro & Sobral, 2015; Jizi, 2017; Kassinis et al., 2016; Nielsen & Huse, 2010).

Though, there are many research studies scrutinising the determinants of eco-innovation, their noteworthy shortcoming is that they lack the regional and locational factors. This is due to the unavailability of the appropriate data, caused by its lack or unsuitable analysis, thus creating a large research gap. It is essential for the building of optimal strategies and eco-innovation policies at the both national and international levels to systematically investigate the dynamic and asymmetric effects of eco-innovations and investments in green energy on employment, both in the short-term and in the long-term horizons. These consequent facts are the motivation to carry out the research, whose main goal is to investigate the various types of the gender employment gap, the gender pay gap, and female participation in corporate management. Such indicators are able to build up high-quality analytical studies on the one hand and to prepare data sets for further exploration of this field on the other hand.

The study is composed as follows. After the Introduction section, which opens up the discussed topic of the gender employment and pay gaps, the Theoretical Background section is following. It offers the structured view at the literature review of the issues related to the employment gaps and pay gas from a perspective of the gender inequality. Successively, the Data and Methodology sections describe the examined data set and employed methodology in the succeeding analytical section. The comparative scrutinisation with the other studies in the similar field is found in the Discussion section along with the recommendations for the policy-making process, while the final section summarises the obtained findings.

2 Theoretical Background

Green technology innovations represent an important determinant of increasing ecological efficiency. Many research studies declare the regional disparities between the cities in the ecological efficiency level and green technology innovations. There is an appeal for the search for mechanisms of the green technology innovations influence on the convergence of

urban eco-efficiency (Melece, 2016; Shang et al., 2022). The eco-innovations combine the environmental impacts with the socio-economic impacts and thus, construct the basement for creating jobs, increasing competitiveness and ensuring sustainable economic growth (Bacalum et al., 2022). According to Galliano et al. (2023), the type of spatial externalities, such as specialisation and unrelated diversity have the different effects on eco-innovation depending on the enterprise involvement and extent of eco-innovation, as well as depending on the enterprise localisation – whether urban, suburban, or rural location.

Gender inequality is a long-term major social issue of the developed countries that according to Saha et al. (2022) may represent an issue in accomplishment of eco-innovative development. The eco-innovation efforts are not gender inclusive. Gender inequality can also weaken the effects of the structural and institutional environment of innovative development. Many research studies have also investigated the impact of female participation in office and in management on the eco-innovations with the regional disparities found (Shen & Liao, 2023). The inclusion of women in various corporate and administrative boards can also support more diverse corporate management and a higher level of implementation of the principles of social responsibility that also relate to the environmental responsibility of enterprises (Valls et al., 2019). Also, Li et al. (2017) confirm the importance of gender diversity in the effective adaptation of the environmental policies and for improving the management processes of enterprises applying the eco-innovations. Liao et al. (2019) confirm this fact, even though their study focuses on investigating the impact of the share of female directors on the board of directors on increasing the eco-innovation level in enterprises. The findings of the study by Cucari et al. (2018), who confirm that the increasing number of women in the board does not have a positive effect on the improvement of environmental, social, and governance information disclosure. If we focus on the positions of women in promoting and applying the eco-innovations regardless of their function, it is clear that women are more successful in promoting the eco-innovations and in introducing positive expectations that the eco-innovations should bring. This is also due to the fact that women are usually less performance-oriented and more socially effective, which is also confirmed by Fritz and Knippengerg (2017).

Specialisation is positively correlated with the extent of eco-innovation of the suburban enterprises. In the case of the urban enterprises, the spatial externalities possess a smaller impact on enterprises eco-innovation behaviour. In the recent period, the development of innovation models in the peripheral areas has been investigated with a purpose of revealing the reasons, why and how enterprises can innovate even in the absence of the agglomeration effects. It has been demonstrated that the local resources offered by the peripheral areas are significant for eco-innovative development. Hence, it is important to investigate the innovation processes in these peripheral areas more deeply, to understand the dynamics of the use of extra-local as well as local resources for the eco-innovative development of enterprises and locations (Galliano et al., 2019). The institutional and market actors at the regional level play an important role in this process, especially in obtaining resources. The impact of innovations on employment is often discussed, while a differentiated examination of the eco-innovations impact on overall employment is important. The increase in the number of green jobs can be caused by a decrease in the number of the nongreen employees and a smaller increase in the number of green employees. In this context, Ortega-Lapiedra et al. (2019) recommend investigating more in detail the specific human capital that enterprises use to implement the eco-innovation processes and thus, using the specific human capital index. The search for optimal metrics for evaluating the human resources in the eco-innovation processes will enable the improvement of the decision-making processes in a support the development of eco-innovations, as well as for managerial control

of the eco-innovation processes. It is pointed to the fact that the industry type has an impact on the positive relationship between the eco-innovations and employment too, while this relationship is stronger for enterprises operating in the so-called dirty industries (Kunapatarawong and Martínes-Ros, 2016).

Sustainable smart work plays a significant role in employment within the eco-innovations. According to Bucea-Manea-Ţoniş et al. (2021), increased work productivity in the eco-innovation processes of enterprises is ensured, if a flexible and comfortable working environment is created, including the introduction of the special programmes such as work from home. In the enterprises, which have expanded themselves rapidly, the eco-innovations impact on employment is minimal (Caravella & Crespi, 2022). The eco-innovations have an indirect beneficial effect on the environment through urbanisation. According to the study by Ahmad et al. (2021), the eco-innovations will facilitate sustainable urbanisation in the Group of Seven countries. In addition to these aspects, it is also important to investigate the development of employment supported by the eco-innovations in the small and medium-sized enterprises (Cecere & Mazzanti, 2017), which have more limited access to innovative investments, but are more flexible in the terms of the process changes. It is important to explore the potential of green skills development, competences and new jobs in these enterprises as a response to market and political levers. This is caused by the eco-innovations requiring high qualification of personnel and the implementation of the educational processes in enterprises (Horbach, 2014). Zhang et al. (2023) confirm a bidirectional causality between investments in green energy and unemployment, while a unidirectional relationship was confirmed between the environmental technologies and unemployment. On the other hand, also the area of the developing countries performs considerably heterogeneously in the field of gender inequalities here (Klasen, 2018). Economic growth is very possibly influenced by these issues (Klasen & Lamanna, 2009).

The enterprises involvement in the collaboration with external stakeholders is one of the important determinants of the eco-innovations, as many empirical studies have confirmed the existence of the substitution effects between them (Acebo et al., 2021). The heterogeneity of the eco-innovation development factors restricts the unambiguous quantification of synergies between the eco-innovations and employment. Enterprise size, research and development, and export affect the eco-innovations and employment in the same direction (Triguero et al., 2017), but enterprise age has a different effect. Employment grows faster in young enterprises than in old ones that belong to the parent company. Innovations of the ecological products and services are required for creation of green jobs (Cedere & Mazzanti, 2017). Aldieri et al. (2019) also point to the importance of the environmental spillovers based on local innovation at the enterprise level on employment. There is also a potential relation to the earning of employee when creating new green jobs (Juhásová, 2021). The considerable disparities are seen among the top earnings, making the pay gap even more opened (Fortin et al., 2017). There are many various techniques employed in order to investigate the factors behind the gender pay gap as it is a very structured issue and hence, applied methodologies are very invited to analyse this issue (Auspurg et al., 2017). Also, from a perspective of the labour market itself, it is concluded that the gender pay gap is not only about theoretical topic, it performs rather as an intersection of the issues related to this field (Litman et al., 2020). It is not unusual to employ an enhanced technique for the sake of scrutinization such a comprehensive issue as the gap in general is, namely expressing the concerns about the gender pay gap (Toczek er al., 2021). Many research studies up to date declare contradictory claims about the impact of the eco-innovations and growth of green jobs. Even policymakers cannot clearly evaluate an impact of the eco-innovations on the quality and number of green jobs that have already been created or prepare optimal

conditions for new jobs. Sectoral analyses can identify significant process trajectories, which the eco-innovation development in enterprises can support or restrict jobs within. For this reason, it is important to examine the adaptability of enterprises to new technologies, taking into account their financial, economic, and personnel policies. This will create an important platform for investigating the environmental policies for functioning labour markets, allowing the identification of elementary macroeconomic channels. Within them, it is important to monitor changes in labour productivity and employment costs that are often overlooked. As Bowen and Kuralbayeva (2015) states, these aspects need to be examined in a relation to the specific economic structure of the country and the labour market institutions. The structure of the work positions can be possibly impacted by the changes in the gender inequality perception considerably (Blackburn et al., 2018). The geographical aspect is also important and it can play a significant role as there are many different cultural influences (Choi & Greaney, 2022; Ryskaliyev et al., 2019). In addition, it is important to intensify the international efforts aimed at creating statistical standards for evaluating existing green jobs that would create a platform for national and international benchmarking and would enable the quantification of the outputs of the environmental policies in a relation to employment and regional development (Arranz et al., 2019).

The countries' governments should create strategies to deal with the social problems related to the job losses in the sectors that will have green policy and green growth processes implemented. Ge and Zhi (2016) point to the fact that even if databases and systems are created to measure the relationship between the ecological economy and employment, their results may be problematically comparable that will depend on the type of measurement methodology applied. The whole measurement process and quantification of the effects of eco-innovations can be complicated if the type of the policies in a given country is taken into account (Elliott et al., 2021). Knowledge of the regulatory and support mechanisms of the eco-innovations can significantly distort the results about the real impact of the introduced and applied eco-innovations on employment.

3 Data

The data set comes from the online Eurostat database provided by Eurostat – the statistical office of the European Union. The explained variable is the eco-innovation index. There are the eleven independent variables explored in the analytical section. These are the employment gap in city (Eurostat, 2022a), the employment gap in town and suburb (Eurostat, 2022a), the employment gap in rural area (Eurostat, 2022a), the employment gap (Eurostat, 2022a), the employment gap in full-time work (Eurostat, 2022b), the employment gap in part-time work (Eurostat, 2022b), the employment gap in temporary contract (Eurostat, 2022b), the underemployment gap in part-time work (Eurostat, 2022b), the pay gap (Eurostat, 2022c), the female board member (Eurostat, 2022d), and the female executive (Eurostat, 2022d). The eco-innovation index represents performance of the individual countries in the field of innovation policy and digital transformation (European Commission, 2022). All the gaps indicating variables are denominated in percentage points. They demonstrate a subtraction of the appropriate employment levels or the pay level for the female population from the numbers assigned to the male population. The last two variables – the female board member and the female executive – show a share of the female sex in the largest publicly listed enterprises in their boards and among the executive staff. This data comes originally from the Gender Statistics Database of the European Institute for

Gender Equality. The data set covers the period from the year 2013 to the year 2022. The geographical view covers all the current member countries of the European Union. The included countries are the Republic of Austria, the Kingdom of Belgium, the Republic of Bulgaria, the Swiss Confederation, the Republic of Cyprus, the Czech Republic, the Federal Republic of Germany, the Kingdom of Denmark, the Republic of Estonia, the Hellenic Republic, the Kingdom of Spain, the Republic of Finland, the French Republic, the Republic of Croatia, Hungary, Ireland, Iceland, the Italian Republic, the Principality of Liechtenstein, the Republic of Lithuania, the Grand Duchy of Luxembourg, the Republic of Latvia, the Republic of Malta, the Netherlands, the Kingdom of Norway, the Republic of Poland, the Portuguese Republic, Romania, the Kingdom of Sweden, the Republic of Slovenia, and the Slovak Republic.

4 Methodology

The main methodological technique applied in the analytical processing is a regression analysis (Galton, 1989). The data set possesses a form of a panel data. The both possibilities of intercept involvement are employed. There are the four types of the panel regression models with no intercept examined – namely, the fixed effects, the random effects, a between approach, a pooling approach. On the other hand, the intercept involving regression models comprise all the techniques, but the fixed effects. The Durbin–Wu–Hausman test is engaged in order to pick up the appropriate regression analysis effect type (Durbin, 1954; Hausman, 1978; Wu, 1973). All the appropriate regression models are compared, while the fixed effects regression models, naturally not involving a constant value, are compared with the random effects regression models with a constant value. The elementary statistical significance threshold of 5% is applied. The improved levels comprise 1% and 0.1%, while a lowered level sinks to 10%. All the analytical procedures are processed in the R software environment.

The research hypotheses are formulated followingly:

- The research hypothesis 1: there is not a statistically significant relation between the eco-innovation index and the employment gap in city;
- The research hypothesis 2: there is not a statistically significant relation between the eco-innovation index and the employment gap in town and suburb;
- The research hypothesis 3: there is not a statistically significant relation between the eco-innovation index and the employment gap in rural area;
- The research hypothesis 4: there is not a statistically significant relation between the eco-innovation index and the employment gap;
- The research hypothesis 5: there is not a statistically significant relation between the eco-innovation index and the employment gap in full-time work;
- The research hypothesis 6: there is not a statistically significant relation between the eco-innovation index and the employment gap in part-time work;
- The research hypothesis 7: there is not a statistically significant relation between the eco-innovation index and the employment gap in temporary contract;
- The research hypothesis 8: there is not a statistically significant relation between the eco-innovation index and the underemployment gap in part-time work;
- The research hypothesis 9: there is not a statistically significant relation between the eco-innovation index and the pay gap;

- The research hypothesis 10: there is not a statistically significant relation between the eco-innovation index and the female board member;
- The research hypothesis 11: there is not a statistically significant relation between the eco-innovation index and the female executive.

5 Analysis

The analytical section comprises the eleven sections assigned to the particular variables examined. The first of the three sections are related to the gender employment gap types. The second section is aimed at the gender employment gaps related to the types of the work positions. And finally, the third section is devoted to the gender pay gap as well as female participation in business management.

The first examined variable is the employment gap in city visualised below in the succeeding table.

As seen in Table 1, almost all the regression models meet the criteria of statistical significance of the variables. The exceptions are as follows. All the two-way effect regression models are not statistically significant. The no intercept regression model with the random effects aimed at the individual effect fulfils a five-per-cent threshold of statistical significance, while the individual effect in the between regression model with intercept meets the lowest statistical significance level. The constant values are statistically significant in all the cases.

The testing phase of the first variable regression models involving the employment gap in city is shown in the table below.

Table 2 demonstrates a selection of the most suitable regression models for the first variable. The random effects regression models are appropriate only in the case of the constant value including regression model with the individual effect – for the both cases. In the case of the time effect regression model with the constant value compared to the fixed effects regression model, it shows that the fixed effects are appropriate under a ten-per-cent statistical significance threshold.

The following table illustrates a situation of the second explored variable, that is, the employment gap in town and suburb.

The regression models examining the employment gap in town and suburb are shown in Table 3. All the regression model with a sole exception of the between approach for the intercept regression model of time effect meet the highest criteria of statistical significance. The mentioned one is assigned a ten-per-cent statistical significance threshold. The constant values are statistically significant in all the cases.

Table 4 visualises the testing phase of the second variable regression models that comprises the employment gap in town and suburb.

The random effects regression models are appropriate only in the case of the constant value inclusion with the individual or time effect against the fixed effects regression models, while the between approach rejects the individual effect model too.

Followingly, the employment gap in rural area is scrutinised in the below-placed table.

As seen in Table 5, regarding the position of the employment gap in rural area in the regression models, it looks like variously. While the two-way effect regression models demonstrate almost no statistical significance, only the random effects regression model with the constant value fulfils the lowest statistical significance threshold. The individual effect behaves differently. Whereas the random effects regression model without the

Table 1 Estimation of the regression models investigating the employment gap in city

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	−1.2298	0.3123	$1.08.\ 10^{-4}$
			Time	−2.3572	0.4090	$2.34.\ 10^{-8}$
			Two-way	0.0665	0.2072	$7.48.\ 10^{-1}$
		Random	Individual	−0.7320	0.3301	$2.66.\ 10^{-2}$
			Time	2.7155	0.5212	$1.89.\ 10^{-7}$
			Two-way	0.2322	0.2135	$2.77.\ 10^{-1}$
		Between	Individual	8.4895	1.3182	$7.98.\ 10^{-7}$
			Time	11.5334	0.5084	$2.98.\ 10^{-9}$
		Pooling		8.2280	0.4183	$5.48.\ 10^{-54}$
Intercept	Constant	Random	Individual	114.5003	6.9492	$5.39.\ 10^{-61}$
			Time	124.7924	4.1125	$2.94.\ 10^{-202}$
			Two-way	103.6841	7.0213	$2.39.\ 10^{-49}$
		Between	Individual	126.1580	13.6295	$1.49.\ 10^{-9}$
			Time	181.4458	18.7125	$1.07.\ 10^{-5}$
		Pooling		124.7924	4.1125	$1.12.\ 10^{-88}$
	Variable	Random	Individual	−1.2994	0.3044	$1.97.\ 10^{-5}$
			Time	−2.4623	0.4046	$1.16.\ 10^{-9}$
			Two-way	−0.0772	0.2111	$7.14.\ 10^{-1}$
		Between	Individual	−2.6166	1.3594	$6.57.\ 10^{-2}$
			Time	−8.8638	2.1090	$2.98.\ 10^{-3}$
		Pooling		−2.4623	0.4046	$3.99.\ 10^{-9}$

Source: own elaboration by the authors

Table 2 Testing of the regression models investigating the employment gap in city

Examined model			Comparative model		Durbin–Wu–Hausman test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	21.7760	$3.06.\ 10^{-6}$
		Time	No intercept	Time	246.4674	$1.53.\ 10^{-55}$
		Two-way	No intercept	Two-way	10.2475	$1.37.\ 10^{-3}$
	Between	Individual	No intercept	Individual	52.2123	$4.98.\ 10^{-13}$
		Time	No intercept	Time	5883.1487	$0.\ 10^{0}$
	Pooling		No intercept	Individual	1215.4892	$2.62.\ 10^{-266}$
			No intercept	Time	314.2346	$2.61.\ 10^{-70}$
			No intercept	Two-way	494.0819	$1.84.\ 10^{-109}$
	Fixed	Individual	Intercept	Individual	0.9878	$3.20.\ 10^{-1}$
		Time	Intercept	Time	3.0901	$7.88.\ 10^{-2}$
		Two-way	Intercept	Two-way	12.6695	$3.72.\ 10^{-4}$
Intercept	Between	Individual	Intercept	Individual	0.9886	$3.20.\ 10^{-1}$
		Time	Intercept	Time	9.5654	$1.98.\ 10^{-3}$
	Pooling		Intercept	Individual	19.0363	$1.28.\ 10^{-5}$
			Intercept	Two-way	47.7390	$4.87.\ 10^{-12}$

Source: own elaboration by the authors

Table 3 Estimation of the regression models investigating the employment gap in town and suburb

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	−1.6688	0.2737	$4.23.\ 10^{-9}$
			Time	−2.1620	0.3572	$4.97.\ 10^{-9}$
			Two-way	−0.6989	0.1826	$1.67.\ 10^{-4}$
		Random	Individual	−1.1371	0.2938	$1.09.\ 10^{-4}$
			Time	2.9010	0.4413	$4.91.\ 10^{-11}$
			Two-way	−0.5090	0.1918	$7.96.\ 10^{-3}$
		Between	Individual	7.1733	1.0610	$3.56.\ 10^{-7}$
			Time	9.4534	0.3831	$1.41.\ 10^{-9}$
		Pooling		6.9756	0.3380	$2.24.\ 10^{-57}$
Intercept	Constant	Random	Individual	121.4022	7.0098	$3.39.\ 10^{-67}$
			Time	127.2475	4.3261	$3.62.\ 10^{-190}$
			Two-way	111.4488	6.9721	$1.63.\ 10^{-57}$
		Between	Individual	127.9611	14.3628	$3.13.\ 10^{-9}$
			Time	186.4758	24.3176	$5.92.\ 10^{-5}$
		Pooling		127.2475	4.3261	$6.90.\ 10^{-86}$
	variable	Random	Individual	−1.7010	0.2664	$1.70.\ 10^{-10}$
			Time	−2.2413	0.3540	$2.43.\ 10^{-10}$
			Two-way	−0.7809	0.1831	$1.99.\ 10^{-5}$
		Between	Individual	−2.3073	1.1886	$6.36.\ 10^{-2}$
			Time	−7.7162	2.2434	$8.83.\ 10^{-3}$
		Pooling		−2.2413	0.3540	$1.02.\ 10^{-9}$

Source: own elaboration by the authors

Table 4 Testing of the regression models investigating the employment gap in town and suburb

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	24.8036	$6.35.\ 10^{-7}$
		Time	No intercept	Time	381.5865	$5.62.\ 10^{-85}$
		Two-way	No intercept	Two-way	10.5016	$1.19.\ 10^{-3}$
	Between	Individual	No intercept	Individual	66.4441	$3.60.\ 10^{-16}$
		Time	No intercept	Time	894.5448	$1.51.\ 10^{-196}$
	Pooling		No intercept	Individual	2356.7928	$0.\ 10^{0}$
			No intercept	Time	206.1651	$9.43.\ 10^{-47}$
			No intercept	Two-way	723.3419	$2.51.\ 10^{-159}$
	Fixed	Individual	Intercept	Individual	0.2607	$6.10.\ 10^{-1}$
		Time	Intercept	Time	2.7604	$9.66.\ 10^{-2}$
		Two-way	Intercept	Two-way	42.6772	$6.46.\ 10^{-11}$
Intercept	Between	Individual	Intercept	Individual	0.2739	$6.01.\ 10^{-1}$
		Time	Intercept	Time	6.1077	$1.35.\ 10^{-2}$
	Pooling		Intercept	Individual	5.3706	$2.05.\ 10^{-2}$
			Intercept	Two-way	23.2340	$1.43.\ 10^{-6}$

Source: own elaboration by the authors

constant value is not statistically significant, the one with the constant value is. All the other cases show the highest level od statistical significance with an exception of fixed effects regression model with the individual effect, where it reaches a per-cent statistical significance threshold. The constant values are statistically significant too, although the between regression model with the time effect reaches a per-cent statistical significance threshold, while the others the highest one.

The subsequent table shows the testing phase of the third variable regression models demonstrating the employment gap in rural area.

Table 6 reveals that the random effects regression models are acceptable in several cases – the individual effect with the constant value only slightly overcomes the statistical significance threshold against the fixed effects regression model and the same outcome is seen also for the between regression model. The same situation repeats for the time effect in the both cases. The other regression models reject assignment of the random effects.

The altogether variable demonstrating the employment gap overall is shown in the following table.

Pictured by Table 7, it is evident that the altogether employment gap behaves very homogeneously. The only situation, where it does not reach statistical significance threshold is found at the random effects regression model without the constant value of with two-way effect. Although, there is to note that individual effect assigned to the between regression model with the constant value only very slightly meets the criterium

Table 5 Estimation of the regression models investigating the employment gap in rural area

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	−0.7044	0.2528	$5.76.\ 10^{-3}$
			Time	−2.3745	0.3140	$6.92.\ 10^{-13}$
			Two-way	−0.2091	0.1578	$1.86.\ 10^{-1}$
		Random	Individual	−0.2906	0.2650	$2.73.\ 10^{-1}$
			Time	3.1934	0.4041	$2.74.\ 10^{-15}$
			Two-way	−0.0689	0.1645	$6.75.\ 10^{-1}$
		Between	Individual	6.4875	1.0035	$7.50.\ 10^{-7}$
			Time	8.7266	0.2951	$2.83.\ 10^{-10}$
		Pooling		6.3098	0.3178	$1.21.\ 10^{-54}$
Intercept	Constant	Random	Individual	112.5354	6.8046	$1.95.\ 10^{-61}$
			Time	131.3678	4.1677	$4.55.\ 10^{-218}$
			Two-way	106.2592	6.7661	$1.40.\ 10^{-55}$
		Between	Individual	133.9163	13.7187	$5.21.\ 10^{-10}$
			Time	188.3437	41.0267	$1.78.\ 10^{-3}$
		Pooling		131.3678	4.1677	$3.87.\ 10^{-92}$
	Variable	Random	Individual	−0.8111	0.2468	$1.01.\ 10^{-3}$
			Time	−2.4132	0.3132	$1.32.\ 10^{-14}$
			Two-way	−0.2772	0.1580	$7.93.\ 10^{-2}$
		Between	Individual	−2.6299	1.0440	$8.53.\ 10^{-2}$
			Time	−7.2600	3.4862	$7.08.\ 10^{-2}$
		Pooling		−2.4132	0.3132	$2.57.\ 10^{-13}$

Source: own elaboration by the authors

Table 6 Testing of the regression models investigating the employment gap in rural area

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	27.1767	$1.86.\ 10^{-7}$
		Time	No intercept	Time	479.1293	$3.31.\ 10^{-106}$
		Two-way	No intercept	Two-way	9.0940	$2.56.\ 10^{-3}$
	Between	Individual	No intercept	Individual	49.0465	$2.50.\ 10^{-12}$
		Time	No intercept	Time	401.7547	$2.29.\ 10^{-89}$
	Pooling		No intercept	Individual	1416.9732	$4.31.\ 10^{-310}$
			No intercept	Time	155.7853	$9.43.\ 10^{-36}$
			No intercept	Two-way	550.4786	$9.91.\ 10^{-122}$
	Fixed	Individual	Intercept	Individual	3.7395	$5.31.\ 10^{-2}$
		Time	Intercept	Time	3.0026	$8.31.\ 10^{-2}$
		Two-way	Intercept	Two-way	84.4393	$3.96.\ 10^{-20}$
Intercept	Between	Individual	Intercept	Individual	3.2146	$7.30.\ 10^{-2}$
		Time	Intercept	Time	1.9486	$1.63.\ 10^{-1}$
	Pooling		Intercept	Individual	68.9420	$1.01.\ 10^{-16}$
			Intercept	Two-way	62.3615	$2.86.\ 10^{-15}$

Source: own elaboration by the authors

of statistical significance. As usually, all the constant value are statistically significant at the highest level.

The next table summarises the testing phase for the overall employment gap.

As shown in Table 8, the individual effect of the random regression model with the constant value is accepted against the fixed effects and the between regression models. The very little overstep of the p-value is found for time effect random regression model with the constant value. All the other cases show the firstly constructed regression models as appropriate.

The employment gap in full-time work as variable included in the regression models is analysed in the subsequent table.

Table 9 illustrates the situation related to the employment gap in full-time work. All the cases meet the highest statistical significance criteria with the following exceptions. The random effects model with no constant value, but with the two-way effect is not statistically significant. The regression models with the constant value behave followingly. The two-way effect of the random regression model fulfils a per-cent statistical significance threshold and the individual effect of the between regression model meets a ten-per-cent statistical significance threshold only a touch. All the constant values are statistically significant at the highest level.

The succeeding table shows the examination of the employment gap in full-time work.

As illustrated by Table 10, the random effects regression models are allowed only in the case of the individual effect assigned to the fixed effects regression model and to the between regression model without the constant value. The remaining cases do not recommend use of the random effects regression models.

The part-time work alternative of the employment gap scrutinisation is visualised in the subsequent table.

Table 7 Estimation of the regression models investigating the employment gap

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	−1.9450	0.3486	$6.43.\ 10^{-8}$
			Time	−2.4021	0.3740	$6.36.\ 10^{-10}$
			Two-way	−0.5370	0.2344	$2.29.\ 10^{-2}$
		Random	Individual	−1.1441	0.3687	$1.92.\ 10^{-3}$
			Time	3.3478	0.4632	$4.90.\ 10^{-13}$
			Two-way	−0.2527	0.2436	$3.00.\ 10^{-1}$
		Between	Individual	7.4639	1.1206	$4.58.\ 10^{-7}$
			Time	9.9199	0.3770	$7.98.\ 10^{-10}$
		Pooling		7.3178	0.3553	$3.10.\ 10^{-57}$
Intercept	Constant	Random	Individual	123.5329	7.2175	$1.13.\ 10^{-65}$
			Time	128.6676	4.3246	$1.60.\ 10^{-194}$
			Two-way	110.2992	7.1264	$4.93.\ 10^{-54}$
		Between	Individual	129.1063	14.1569	$1.99.\ 10^{-9}$
			Time	214.4412	23.9582	$1.93.\ 10^{-5}$
		Pooling		128.6676	4.3246	$6.58.\ 10^{-87}$
	Variable	Random	Individual	−1.9886	0.3348	$2.85.\ 10^{-9}$
			Time	−2.4859	0.3715	$2.21.\ 10^{-11}$
			Two-way	−0.7069	0.2374	$2.90.\ 10^{-3}$
		Between	Individual	−2.5284	1.2257	$4.97.\ 10^{-2}$
			Time	−10.7935	2.3173	$1.63.\ 10^{-3}$
		Pooling		−2.4859	0.3715	$1.29.\ 10^{-10}$

Source: own elaboration by the authors

Table 8 Testing of the regression models investigating the employment gap

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	44.3557	$2.74.\ 10^{-11}$
		Time	No intercept	Time	442.8134	$2.64.\ 10^{-98}$
		Two-way	No intercept	Two-way	18.5283	$1.67.\ 10^{-5}$
	Between	Individual	No intercept	Individual	66.1748	$4.13.\ 10^{-16}$
		Time	No intercept	Time	596.4175	$1.01.\ 10^{-131}$
	Pooling		No intercept	Individual	7348.6980	$0.\ 10^{0}$
			No intercept	Time	178.4735	$1.04.\ 10^{-40}$
			No intercept	Two-way	856.7582	$2.47.\ 10^{-188}$
	Fixed	Individual	Intercept	Individual	0.2023	$6.53.\ 10^{-1}$
		Time	Intercept	Time	3.8114	$5.09.\ 10^{-2}$
		Two-way	Intercept	Two-way	20.6453	$5.53.\ 10^{-6}$
Intercept	Between	Individual	Intercept	Individual	0.2096	$6.47.\ 10^{-1}$
		Time	Intercept	Time	13.1912	$2.81.\ 10^{-4}$
	Pooling		Intercept	Individual	9.5342	$2.02.\ 10^{-3}$
			Intercept	Two-way	38.7575	$4.80.\ 10^{-10}$

Source: own elaboration by the authors

Table 9 Estimation of the regression models investigating the employment gap in full-time work

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	−1.7692	0.3928	$1.04.\ 10^{-5}$
			Time	−2.0661	0.3823	$1.47.\ 10^{-7}$
			Two-way	−0.5244	0.2508	$3.76.\ 10^{-2}$
		Random	Individual	−0.8248	0.4095	$4.40.\ 10^{-2}$
			Time	4.3941	0.4603	$1.33.\ 10^{-21}$
			Two-way	−0.2043	0.2607	$4.33.\ 10^{-1}$
		Between	Individual	7.6794	1.1560	$4.78.\ 10^{-7}$
			Time	10.3243	0.3453	$2.56.\ 10^{-10}$
		Pooling		7.5516	0.3657	$2.03.\ 10^{-57}$
Intercept	Constant	Random	Individual	120.9360	7.4695	$5.88.\ 10^{-59}$
			Time	124.2142	4.3061	$5.66.\ 10^{-183}$
			Two-way	109.9553	7.3799	$3.33.\ 10^{-50}$
		Between	Individual	124.4464	14.0201	$3.36.\ 10^{-9}$
			Time	268.3726	29.1780	$1.58.\ 10^{-5}$
		Pooling		124.2142	4.3061	$3.68.\ 10^{-84}$
	Variable	Random	Individual	−1.8041	0.3741	$1.42.\ 10^{-6}$
			Time	−2.1338	0.3814	$2.20.\ 10^{-8}$
			Two-way	−0.6995	0.2581	$6.72.\ 10^{-3}$
		Between	Individual	−2.1572	1.2501	$9.68.\ 10^{-2}$
			Time	−16.6345	2.9330	$4.70.\ 10^{-4}$
		Pooling		−2.1338	0.3814	$5.43.\ 10^{-8}$

Source: own elaboration by the authors

Investigation of the employment gap in part-time work is picture in Table 11. The regression models without the constant value do not show statistical significance in the both cases of the two-way effect. Although, the individual effect assigned to the random effects regression model without the constant value fulfils at least a ten-per-cent statistical significance threshold. The same situation repeats for the regression models with the constant value, where the two-way effect of the random effects regression model is not statistically significant. All the other cases meet the highest criteria together with all the constant values.

Followingly, the testing phase of the employment gap in part-time work is shown in the below-placed table.

Table 12 demonstrates the two cases of the random effects regression models with the constant value that are appropriate – namely, the time and two-way effects assigned to the fixed effects regression models. The further regression models are acceptable without use of the random effects.

Table 13 demonstrates the regression models including the employment gap in temporary contract.

The employment gap in temporary contract shows the six occasions, where statistical significance is not occurred. All the two-way effect regression models belong here besides the fixed effects regression model with the individual effect, the between regression model with the constant value and the individual effect, and the random effects regression model

Table 10 Testing of the regression models investigating the employment gap in full-time work

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	66.5609	$3.39.\ 10^{-16}$
		Time	No intercept	Time	635.1882	$3.72.\ 10^{-140}$
		Two-way	No intercept	Two-way	20.1823	$7.04.\ 10^{-6}$
	Between	Individual	No intercept	Individual	61.8906	$3.63.\ 10^{-15}$
		Time	No intercept	Time	379.7818	$1.39.\ 10^{-84}$
	Pooling		No intercept	Individual	2063.4438	$0.\ 10^{0}$
			No intercept	Time	127.6151	$1.36.\ 10^{-29}$
			No intercept	Two-way	915.0106	$5.35.\ 10^{-201}$
	Fixed	Individual	Intercept	Individual	0.0847	$7.71.\ 10^{-1}$
		Time	Intercept	Time	6.5254	$1.06.\ 10^{-2}$
		Two-way	Intercept	Two-way	8.2423	$4.09.\ 10^{-3}$
Intercept	Between	Individual	Intercept	Individual	0.0876	$7.67.\ 10^{-1}$
		Time	Intercept	Time	24.8633	$6.15.\ 10^{-7}$
	Pooling		Intercept	Individual	19.9307	$8.03.\ 10^{-6}$
			Intercept	TWO-way	26.1037	$3.24.\ 10^{-7}$

Source: own elaboration by the authors

Table 11 Estimation of the regression models investigating the employment gap in part-time work

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	2.4478	0.3652	$1.43.\ 10^{-10}$
			Time	−1.4161	0.1419	$4.58.\ 10^{-20}$
			Two-way	0.2713	0.2674	$3.11.\ 10^{-3}$
		Random	Individual	0.6724	0.3657	$6.60.\ 10^{-2}$
			Time	−2.6416	0.1881	$8.75.\ 10^{-45}$
			Two-way	−0.4039	0.2634	$1.25.\ 10^{-1}$
		Between	Individual	−4.5946	0.6168	$6.56.\ 10^{-8}$
			Time	−6.9905	0.2519	$4.98.\ 10^{-10}$
		Pooling		−4.5609	0.1951	$9.31.\ 10^{-67}$
Intercept	Constant	Random	Individual	116.3840	7.6962	$1.15.\ 10^{-51}$
			Time	82.6397	2.8124	$8.74.\ 10^{-190}$
			Two-way	105.5991	7.6101	$8.82.\ 10^{-44}$
		Between	Individual	82.0177	8.7971	$1.29.\ 10^{-9}$
			Time	251.0188	18.0177	$6.82.\ 10^{-7}$
		Pooling		82.6397	2.8124	$8.50.\ 10^{-86}$
	variable	Random	Individual	0.9125	0.3061	$2.87.\ 10^{-3}$
			Time	−1.3882	0.1439	$5.02.\ 10^{-22}$
			Two-way	0.1772	0.2562	$4.89.\ 10^{-1}$
		Between	Individual	−1.4306	0.4512	$3.99.\ 10^{-3}$
			Time	10.0919	1.2273	$3.58.\ 10^{-5}$
		Pooling		−1.3882	0.1439	$4.25.\ 10^{-19}$

Source: own elaboration by the authors

with the individual effect again that meets criteria of only a ten-per-cent statistical threshold. For the first time in the analytical section, the constant value of the between regression model with the time effect is not statistically significant, while the other ones are.

The testing phase of the employment gap in temporary contract is illustrated by the subsequent table.

According to Table 14, the examined regression models are appropriate with the following exceptions – the fixed effects regression model with the two-way effect, which fulfils a ten-per-cent statistical significance threshold, the fixed effects regression model with the individual effect compared to the regression model with the constant value, and finally, the between regression model with the constant value and the individual effect. In the other cases, the examined regression models are suitable. There is to note that the regression model with the time effect type and no constant value is not evaluated because of presence of singularity.

The estimation of the underemployment gap in part-time work is demonstrated in the following table.

As shown by Table 15, only the two occasions do not perform standard statistical significance. Firstly, the fixed effects regression model without the constant value with the two-way effect and secondly, the between regression model with the constant value and the individual effect fulfils a ten-per-cent statistical significance threshold. All the constant values are statistically significant at the highest level.

Successively, the following table involves the testing phase of the regression models with the underemployment gap in part-time work.

Table 16 demonstrates that the fixed effects regression model with the two-way effect compared to the regression model with the constant value is not appropriate along with the fixed effects regression model with the two-way effect compared to the same one with the

Table 12 Testing of the regression models investigating the employment gap in part-time work

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	7945.1426	$0.\ 10^{0}$
		Time	No intercept	Time	98.3408	$3.52.\ 10^{-23}$
		Two-way	No intercept	Two-way	214.3082	$1.58.\ 10^{-48}$
	Between	Individual	No intercept	Individual	112.4572	$2.84.\ 10^{-26}$
		Time	No intercept	Time	673.4987	$1.73.\ 10^{-148}$
	Pooling		No intercept	Individual	286.1127	$3.50.\ 10^{-64}$
			No intercept	Time	1389.5575	$3.90.\ 10^{-304}$
			No intercept	Two-way	551.5550	$5.78.\ 10^{-122}$
	Fixed	Individual	Intercept	Individual	59.4121	$1.28.\ 10^{-14}$
		Time	Intercept	Time	1.3394	$2.47.\ 10^{-1}$
		Two-way	Intercept	Two-way	1.5091	$2.19.\ 10^{-1}$
Intercept	Between	Individual	Intercept	Individual	49.9788	$1.55.\ 10^{-12}$
		Time	Intercept	Time	88.7167	$4.56.\ 10^{-21}$
	Pooling		Intercept	Individual	72.5151	$1.66.\ 10^{-17}$
			Intercept	Two-way	54.5391	$1.52.\ 10^{-13}$

Source: own elaboration by the authors

Table 13 Estimation of the regression models investigating the employment gap in temporary contract

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	−1.0368	0.7167	$1.49.\ 10^{-1}$
			Time	−3.1079	0.9191	$8.32.\ 10^{-4}$
			Two-way	0.0937	0.4353	$8.30.\ 10^{-1}$
		Random	Individual	−1.5507	0.7381	$3.56.\ 10^{-2}$
			Time	−24.0758	1.4957	$2.68.\ 10^{-58}$
			Two-way	−0.1375	0.4556	$7.63.\ 10^{-1}$
		Between	Individual	−25.4295	4.7910	$1.49.\ 10^{-5}$
			Time	−47.1700	0.8155	$6.95.\ 10^{-13}$
		Pooling		−24.0758	1.4957	$2.72.\ 10^{-41}$
Intercept	Constant	Random	Individual	100.4666	6.8619	$1.53.\ 10^{-48}$
			Time	95.9867	2.9093	$1.04.\ 10^{-238}$
			Two-way	102.9716	7.0603	$3.52.\ 10^{-48}$
		Between	Individual	95.4262	9.4875	$2.85.\ 10^{-10}$
			Time	29.9913	28.2358	$3.19.\ 10^{-1}$
		Pooling		95.9867	2.9093	$2.29.\ 10^{-96}$
	Variable	Random	Individual	−1.1619	0.6976	$9.58.\ 10^{-2}$
			Time	−3.2158	0.9183	$4.62.\ 10^{-4}$
			Two-way	−0.0134	0.4356	$9.76.\ 10^{-1}$
		Between	Individual	−3.4728	3.0815	$2.70.\ 10^{-1}$
			Time	−33.4735	12.9201	$3.21.\ 10^{-2}$
		Pooling		−3.2158	0.9183	$5.41.\ 10^{-4}$

Source: own elaboration by the authors

Table 14 Testing of the regression models investigating the employment gap in temporary contract

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	8.5032	$3.55.\ 10^{-3}$
		Time	No intercept	Time	315.7797	$1.20.\ 10^{-70}$
		Two-way	No intercept	Two-way	2.9614	$8.53.\ 10^{-2}$
	Between	Individual	No intercept	Individual	25.4454	$4.55.\ 10^{-7}$
		Time	No intercept	Time	339.2683	$9.21.\ 10^{-76}$
	Pooling		No intercept	Individual	299.8256	$3.60.\ 10^{-67}$
			No intercept	Two-way	282.3641	$2.29.\ 10^{-63}$
	Fixed	Individual	Intercept	Individual	0.5767	$4.48.\ 10^{-1}$
		Time	Intercept	Time	8.4322	$3.69.\ 10^{-3}$
		Two-way	Intercept	Two-way	44.2007	$2.96.\ 10^{-11}$
Intercept	Between	Individual	Intercept	Individual	0.5928	$4.41.\ 10^{-1}$
		Time	Intercept	Time	5.5124	$1.89.\ 10^{-2}$
	Pooling		Intercept	Individual	11.8253	$5.84.\ 10^{-4}$
			Intercept	Two-way	15.6916	$7.46.\ 10^{-5}$

Source: own elaboration by the authors

constant value that meets the criterium of a ten-per-cent statistical significance threshold. In the other cases, the examined regression models are suitable.

The regression models related to the gender pay gap are listed in the successive table.

As visualised by Table 17, no statistical significance is found in the fixed effects regression models with the time and two-way effect types and the random effects regression model with the individual effect type. Regarding the regression models with the constant value, no statistical significance is seen in the random effects regression model with the time effect type, the between regression model with the individual effect type, and the pooling regression model. All the other cases and the constant values are evaluated at the highest level.

The testing phase of the gender pay gap is shown in the subsequent table.

Regarding the gender pay gap as illustrated by Table 18, the random effects regression model is allowed for the both cases of the two-way effects regression model against the fixed effects regression model with the same effect with no constant value and the pooling regression model with the constant value.

The next table lists the regression models related to the female board member.

According to Table 19, statistical significance is missing at all only in the fixed effects regression model with the two-way effect. On the other hand, the random effects regression model without the constant value with the two-way effect is statistically significant at a per-cent threshold and the same situation is valid for the between regression model with the

Table 15 Estimation of the regression models investigating the underemployment gap in part-time work

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	5.8255	0.7720	$9.26.\ 10^{-13}$
			Time	−5.9478	1.0481	$3.74.\ 10^{-8}$
			Two-way	0.6804	0.5939	$2.53.\ 10^{-1}$
		Random	Individual	4.9294	0.8353	$3.61.\ 10^{-9}$
			Time	−9.5278	1.2366	$1.31.\ 10^{-14}$
			Two-way	0.3239	0.1122	$3.90.\ 10^{-3}$
		Between	Individual	−30.4186	4.8530	$1.24.\ 10^{-6}$
			Time	−48.7738	3.4825	$2.04.\ 10^{-7}$
		Pooling		−28.6569	1.5538	$1.52.\ 10^{-49}$
Intercept	Constant	Random	Individual	113.5850	6.7583	$2.18.\ 10^{-63}$
			Time	92.2095	2.9979	$9.51.\ 10^{-208}$
			Two-way	106.4356	1.2512	$0.\ 10^{-0}$
		Between	Individual	89.4799	9.4936	$1.04.\ 10^{-9}$
			Time	148.9584	5.2195	$2.46.\ 10^{-9}$
		Pooling		92.2095	2.9979	$1.39.\ 10^{-89}$
	Variable	Random	Individual	5.2311	0.7690	$1.03.\ 10^{-11}$
			Time	−5.2972	1.0529	$4.88.\ 10^{-7}$
			Two-way	1.6920	0.1080	$2.37.\ 10^{-55}$
		Between	Individual	−6.5897	3.4309	$6.62.\ 10^{-2}$
			Time	22.3237	2.5177	$2.07.\ 10^{-5}$
		Pooling		−5.2972	1.0529	$8.99.\ 10^{-7}$

Source: own elaboration by the authors

Table 16 Testing of the regression models investigating the underemployment gap in part-time work

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	7.8856	$4.98.\ 10^{-3}$
		Time	No intercept	Time	29.7557	$4.90.\ 10^{-8}$
		Two-way	No intercept	Two-way	0.3736	$5.41.\ 10^{-1}$
	Between	Individual	No intercept	Individual	54.6734	$1.42.\ 10^{-13}$
		Time	No intercept	Time	145.3299	$1.82.\ 10^{-33}$
	Pooling		No intercept	Individual	657.1702	$6.16.\ 10^{-145}$
			No intercept	Time	413.4893	$6.38.\ 10^{-92}$
			No Intercept	Two-way	349.7100	$4.90.\ 10^{-78}$
	Fixed	Individual	Intercept	Individual	76.6532	$2.04.\ 10^{-18}$
		Time	Intercept	Time	42.1976	$8.25.\ 10^{-11}$
		Two-way	Intercept	Two-way	3.0003	$8.32.\ 10^{-2}$
Intercept	Between	Individual	Intercept	Individual	12.4988	$4.07.\ 10^{-4}$
		Time	Intercept	Time	145.8605	$1.39.\ 10^{-33}$
	Pooling		Intercept	Individual	214.2792	$1.60.\ 10^{-48}$
			Intercept	Two-way	44.5318	$2.50.\ 10^{-11}$

Source: own elaboration by the authors

Table 17 Estimation of the regression models investigating the gender pay gap

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	−1.6274	0.2770	$1.68.\ 10^{-8}$
			Time	0.6478	0.4143	$1.19.\ 10^{-1}$
			Two-way	0.2567	0.2442	$2.94.\ 10^{-1}$
		Random	Individual	−0.4587	0.3180	$1.49.\ 10^{-1}$
			Time	4.8142	0.3461	$5.40.\ 10^{-44}$
			Two-way	0.8511	0.0463	$1.53.\ 10^{-75}$
		Between	Individual	6.6722	0.6715	$2.42.\ 10^{-10}$
			Time	7.6457	0.3432	$1.74.\ 10^{-8}$
		Pooling		6.5753	0.2358	$3.36.\ 10^{-76}$
Intercept	Constant	Random	Individual	121.4584	7.8584	$6.89.\ 10^{-54}$
			Time	96.1416	5.8930	$7.77.\ 10^{-60}$
			Two-way	102.5556	1.5271	$0.\ 10^{0}$
		Between	individual	91.4971	18.3245	$3.79.\ 10^{-5}$
			Time	169.9683	12.5218	$2.77.\ 10^{-6}$
		Pooling		96.1416	5.8930	$2.26.\ 10^{-40}$
	Variable	Random	Individual	−1.5229	0.2720	$2.16.\ 10^{-8}$
			Time	0.4769	0.4071	$2.41.\ 10^{-1}$
			Two-way	−0.0885	0.0463	$5.57.\ 10^{-2}$
		Between	Individual	0.7410	1.2829	$5.69.\ 10^{-1}$
			Time	−5.0751	0.9398	$1.01.\ 10^{-3}$
		Pooling		0.4769	0.4071	$2.43.\ 10^{-1}$

Source: own elaboration by the authors

constant value and the individual effect. Also, the constant value of this regression model possesses the same statistical significance level. The remaining regression models and the constant values keep the best statistical significance record.

The female board member testing phase is demonstrated in the following table.

There are only the four cases, where the random effects regression model is accepted as pictured by Table 20. Firstly, the fixed effects regression model with the individual effects compared to the regression model with the constant value is accepted only at a ten-per-cent statistical significance threshold. Secondly, the time effect alternative of the previous situation along with the both between regression models with the constant value do not keep statistical significance at all.

Finally, the female executive involving regression models are estimated in the subsequent table.

As demonstrated by Table 21, the are several occasions of no statistical significance. The both two-way effect regression model without the constant value keep such a state along with the between regression model with the constant value with individual effect. The two regression models with the constant value meet the criterium of a ten-per-cent statistical significance threshold – the random effects regression model with the time effect and the pooling regression model. Finally, a per-cent statistical significance threshold is kept by the fixed effects regression model with the time effect and the random effects regression model with the constant value and the two-way effect. All the other cases fulfil the highest statistical significance threshold.

Last of all, the testing phase scrutinising the female executive is offered in the succeeding table.

Illustrated by Table 22, the female executive is the only case of all the observed variables, which all the examined regression models are appropriate in the form of the original

Table 18 Testing of the regression models investigating the gender pay gap

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	55.9577	$7.40.\ 10^{-14}$
		Time	No intercept	Time	334.4419	$1.04.\ 10^{-74}$
		Two-way	No intercept	Two-way	6.1472	$1.32.\ 10^{-2}$
	Between	Individual	No intercept	Individual	145.3709	$1.78.\ 10^{-33}$
		Time	No intercept	Time	4080.4715	$0.\ 10^{0}$
	Pooling		No intercept	Individual	1085.8672	$3.90.\ 10^{-238}$
			No intercept	Time	48.3325	$3.60.\ 10^{-12}$
			No intercept	Two-way	613.1150	$2.35.\ 10^{-135}$
	Fixed	Individual	Intercept	Individual	3.9482	$4.69.\ 10^{-2}$
		Time	Intercept	Time	4.9199	$2.65.\ 10^{-2}$
		Two-way	Intercept	Two-way	2.0741	$1.50.\ 10^{-1}$
Intercept	Between	Individual	Intercept	Individual	3.2604	$7.10.\ 10^{-2}$
		Time	Intercept	Time	42.9632	$5.58.\ 10^{-11}$
	Pooling		Intercept	Individual	43.5878	$4.05.\ 10^{-11}$
			Intercept	Two-way	1.9545	$1.62.\ 10^{-1}$

Source: own elaboration by the authors

Table 19 Estimation of the regression models investigating the female board member

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	0.9731	0.0842	$6.93.\ 10^{-25}$
			Time	1.7481	0.2003	$3.25.\ 10^{-16}$
			Two-way	0.0604	0.0901	$5.04.\ 10^{-1}$
		Random	Individual	1.2047	0.0961	$4.87.\ 10^{-36}$
			Time	3.4301	0.1543	$1.89.\ 10^{-109}$
			Two-way	0.3446	0.1060	$1.14.\ 10^{-3}$
		Between	Individual	4.3243	0.3031	$8.25.\ 10^{-14}$
			Time	4.6114	0.1583	$3.22.\ 10^{-10}$
		Pooling		4.1741	0.1027	$8.20.\ 10^{-117}$
Intercept	Constant	Random	Individual	81.2752	6.1725	$1.35.\ 10^{-39}$
			Time	64.4376	4.4389	$9.50.\ 10^{-48}$
			Two-way	85.5231	7.6459	$4.80.\ 10^{-29}$
		Between	Individual	58.5677	15.8508	$1.08.\ 10^{-3}$
			Time	63.2714	2.3916	$4.48.\ 10^{-9}$
		Pooling		64.4376	4.4389	$1.26.\ 10^{-35}$
	Variable	Random	Individual	0.9894	0.0838	$3.45.\ 10^{-32}$
			Time	1.7563	0.1835	$1.06.\ 10^{-21}$
			Two-way	0.7960	0.0865	$3.45.\ 10^{-20}$
		Between	Individual	2.0236	0.6704	$5.78.\ 10^{-3}$
			Time	1.8094	0.1074	$1.56.\ 10^{-7}$
		Pooling		1.7563	0.1835	$7.40.\ 10^{-19}$

Source: own elaboration by the authors

Table 20 Testing of the regression models investigating the female board member

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	24.9880	$5.77.\ 10^{-7}$
		Time	No intercept	Time	173.5079	$1.27.\ 10^{-39}$
		Two-way	No intercept	Two-way	26.0340	$3.35.\ 10^{-7}$
	Between	Individual	No intercept	Individual	117.8063	$1.91.\ 10^{-27}$
		Time	No intercept	Time	1133.5359	$1.70.\ 10^{-248}$
	Pooling		No intercept	Individual	6710.1144	$0.\ 10^{0}$
			No intercept	Time	41.7385	$1.04.\ 10^{-10}$
			No intercept	Two-way	21,784.8869	$0.\ 10^{0}$
	Fixed	Individual	Intercept	Individual	3.6348	$5.66.\ 10^{-2}$
		time	Intercept	Time	0.0103	$9.19.\ 10^{-1}$
		Two-way	Intercept	Two-way	842.3636	$3.32.\ 10^{-185}$
Intercept	Between	Individual	Intercept	Individual	2.4170	$1.20.\ 10^{-1}$
		Time	Intercept	Time	0.1274	$7.21.\ 10^{-1}$
	Pooling		Intercept	Individual	22.0631	$2.64.\ 10^{-6}$
			Intercept	Two-way	35.2078	$2.96.\ 10^{-9}$

Source: own elaboration by the authors

Table 21 Estimation of the regression models investigating the female executive

Model	Dimension	Effects	Effect type	Regression coefficient	Standard error	p-value
No intercept	Variable	Fixed	Individual	1.0542	0.1117	$3.38.\ 10^{-18}$
			Time	−1.0938	0.3342	$1.20.\ 10^{-3}$
			Two-way	−0.0515	0.1066	$6.29.\ 10^{-1}$
		Random	Individual	1.2051	0.1196	$7.30.\ 10^{-24}$
			Time	3.8068	0.2747	$1.16.\ 10^{-43}$
			Two-way	0.1136	0.1164	$3.29.\ 10^{-1}$
		Between	Individual	5.3998	0.5777	$8.49.\ 10^{-10}$
			Time	6.0433	0.2128	$4.06.\ 10^{-10}$
		Pooling		5.1762	0.1860	$3.77.\ 10^{-81}$
Intercept	Constant	Random	Individual	85.6926	6.9813	$1.24.\ 10^{-34}$
			Time	111.8856	5.6240	$4.57.\ 10^{-88}$
			Two-way	97.8952	7.8342	$7.85.\ 10^{-36}$
		Between	Individual	126.3929	21.2221	$3.23.\ 10^{-6}$
			Time	64.3548	4.2123	$3.34.\ 10^{-7}$
		Pooling		111.8856	5.6240	$1.04.\ 10^{-54}$
	Variable	Random	Individual	1.0332	0.1119	$2.61.\ 10^{-20}$
			Time	−0.5304	0.3103	$8.74.\ 10^{-2}$
			Two-way	0.3048	0.1106	$5.86.\ 10^{-3}$
		Between	Individual	−1.3964	1.2024	$2.56.\ 10^{-1}$
			Time	2.3070	0.2480	$1.45.\ 10^{-5}$
		Pooling		−0.5304	0.3103	$8.86.\ 10^{-2}$

Source: own elaboration by the authors

alternatives to. This is a unique outcome as no random effects are required in order to analyse the female executive variable.

6 Discussion

The main goal of the study is to investigate the relations between the eco-innovation index and the explored variables indicating the gender gaps in its various fields and forms. Here, it is about to express that several occasions of prevalence of the random effects are not such a strong key in a field of further explanation of the obtained outcomes. It means that all the regression models are appropriate to be understood as they are constructed and as they are designed from a view of a particular regression analysis technique.

The first group of the explored variables are related to the gender employment gap. Having a look at the first group of the variables related to the employment gap, there is to note that the employment gap in city is considerably lower than the employment gap in town and suburb with an exception of the time effects regression models. On the other hand, there is an even lower level of the impact in a rural area. Hence, the first three research hypotheses are rejected. The same situation repeats for the time effects regression models, that is, a slightly opposite direction. It could be understood as a different influence in a case of the time impact. The overall employment gap looks like comprising a synergistic effect

Table 22 Testing of the regression models investigating the female executive

Examined model			Comparative model		Test	
Model	Effects	Effect type	Model	Effect type	Test statistic	p-value
No intercept	Fixed	Individual	No intercept	Individual	12.4408	$4.20.\ 10^{-4}$
		Time	No intercept	Time	663.6254	$2.43.\ 10^{-146}$
		Two-way	No intercept	Two-way	12.3893	$4.32.\ 10^{-4}$
	Between	Individual	No intercept	Individual	55.0835	$1.16.\ 10^{-13}$
		Time	No intercept	Time	165.7453	$6.29.\ 10^{-38}$
	Pooling		No intercept	Individual	777.2445	$4.78.\ 10^{-171}$
			No intercept	Time	45.8817	$1.26.\ 10^{-11}$
			No intercept	Two-way	1217.7399	$8.51.\ 10^{-267}$
	Fixed	Individual	Intercept	Individual	11.8507	$5.76.\ 10^{-4}$
		Time	Intercept	Time	20.6698	$5.46.\ 10^{-6}$
		Two-way	Intercept	Two-way	144.1607	$3.28.\ 10^{-33}$
Intercept	Between	Individual	Intercept	Individual	4.1190	$4.24.\ 10^{-2}$
		Time	Intercept	Time	231.2858	$3.13.\ 10^{-52}$
	Pooling		Intercept	Individual	29.1815	$6.59.\ 10^{-8}$
			Intercept	Two-way	8.2968	$3.97.\ 10^{-3}$

Source: own elaboration by the authors

of all the partial employment gaps. Their absolute values reach in a majority of the cases the highest levels. All the fixed effects regression models keep the negative direction of the illustrated impact with an exception of the sole two-way effect regression model related to the gender employment gap in city that is not statistically significant, so its interpretation can be omitted. Therefore, the fourth research hypothesis is rejected too. The similar outcomes are reached by the studies by Bassi and Guidolin (2021) and Le Feber and Smit (2022).

The second group of the observed variables comprise the gender employment gap examining the types of working positions. Full-time work, part-time work, and temporary contract are investigated separately at first. The employment gaps in full-time work and temporary contract possess the different direction of the impact than the employment gap in part-time work from a perspective of the individual effect. The time effect demonstrates the same impact direction as the other cases, that is, the negative one. It is an interesting finding that part-time work influences the eco-innovation index to a large extent. There is to remind that this situation could be interconnected to a number of the work positions or the structure of the labour market respectively. So, the fifth, the sixth, and the seventh research hypotheses are rejected. A specific position is kept by the underemployment gap in part-time work that possesses the highest impact among these variables in an absolute way. Followingly, the eighth research hypothesis is rejected. A span between the regression coefficients is the highest one for this group of the variables. These outcomes correspond with the studies by Moreno-Ureba et al. (2022) and Shen and Liao (2023).

Finally, the third group is partially heterogeneous as it involves the gender pay gap and the variables related to the female participation in business management. The gender pay gap demonstrates a similar position to the further two variables. This behaviour can be understood from several perspectives. On the other hand, the female board member behaves with the positive impact in all the cases. Based on the assigned regression models,

the ninth research hypothesis is rejected. Nevertheless, it is not so influential as the female executive. Although, this variable possesses the different impacts for the various effects applied. The fixed effects regression model with the individual effect shows an increase of the eco-innovation index, while the time effect causes the opposite impact. It is a very interesting situation as the female board member demonstrates female participation directly in the board of managers, whilst the female executive points to the position of whatever executive in the management. According the outcomes of the carried-out regression analysis, the eleventh and the twelfth research hypotheses are rejected too. These points are concentrated also in the studies by Jackman and Moore (2021) and Moreno-Mondejar et al. (2022).

To summarise the obtained findings, the research hypotheses can be evaluated followingly. A little limitation of the study is determined by the characteristics of the regression analysis itself and its types of estimation. The pooling and the random effects approaches are redundant for the Durbin–Wu–Hausman test partially as well as the fixed effects approach cannot be constructed involving a constant value, so its testing is done via relating the fixed effects regression model without the constant value to the random effects regression model with the constant value. Future research will be focused on examination of the impact of work experience in a relation to the success of implementing eco-innovation and enforcing the environmental policies in enterprises as well as declaring them to the public and stakeholders.

The study outcomes provide the valuable data for the creation of innovative environmental policies that have an impact on the employment processes and regional development. The research studies have confirmed the impact of these innovative environmental policies of the countries not only on economic growth, but also on the employment structure, on its future development potential and as well as on regional development. There are the obvious regional disparities and discrepancies in the infrastructural maturity and the innovation potential of the individual territories of the countries. This fact will also significantly influence the workforce structure, which is changed not only depending on economic and eco-innovative development, but also under the impact of the ongoing demographic changes and the globalisation influence. Therefore, it is necessary to create the policies focused on support of employment in the regions with the different levels of eco-innovative development and economic potential and thus, to create an optimal environment for balancing the regional disparities and building a new eco-innovation potential of the regions. It will be important to create such policies, which are related to the individual sectors, where the eco-innovation processes in them can differentially affect the structure of the workforce and thus, to favour or to disadvantage the certain population groups in the employment processes. The correct employment policy in the countries will create a space for the further development of eco-innovations and thus, it will take into account the importance of the different population groups in them, while it will provide the optimal opportunities for the development of employment and thus, to search for new occasions for building competitive regions.

7 Conclusion

The main goal of the study is to investigate the various types of the gender employment gap, the gender pay gap, and female participation in corporate management. The study brings the valuable findings about the gender inequality impact on the eco-innovations,

which can significantly affect not only innovative and environmental corporate strategies, but also the success of the corporate policies necessary for the competitiveness of enterprises. Despite more statistical significance levels involved in the analysis, there is to note that several findings can be viewed through a closer look. The estimation processes show there is considerable differentiation of the outcomes regarding their type. All the gender employment gap types regarding the geographical localisation are statistically significant regarding their impact on the eco-innovations as well as all the gender employment gap types related to the work type. Similarly, the gender pay gap behaves statistically significant in the terms of its impact on the eco-innovations. Female participation in corporate management demonstrates the statistical significance level too. The study outcomes will also be beneficial for the designers of national and regional environmental and innovation policies, for experts focused on the eco-innovative development of enterprises and regions as well as for regulatory authorities. This study also calls for the creation of environmental database systems and national environmental registers, necessary for the development of benchmarking indicators and the creation of evaluation and comparison mechanisms.

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Data availability Data are available upon request from authors.

Declarations

Conflict of interest The authors have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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