DOI: https://doi.org/10.32782/2524-0072/2026-88-20

UDC 331.5:330.341.1:004

GENDER ASPECTS OF UNEMPLOYMENT IN OECD COUNTRIES IN THE CONTEXT OF TECHNOLOGY

ГЕНДЕРНІ АСПЕКТИ БЕЗРОБІТТЯ В КРАЇНАХ ОЕСР У КОНТЕКСТІ ТЕХНОЛОГІЧНОГО РОЗВИТКУ

Mlynko Semen
Postgraduate Student,
Ivan Franko National University of Lviv
ORCID: https://orcid.org/0009-0004-0306-3485

Млинко Семен Володимирович
Львівський національний університет ім. І. Франка

This research analyzes the impact of technological progress on gender inequality in the labor markets of OECD countries. Research is based on a specially developed technological development index that integrates educational, innovative, and digital parameters. The relationships between technological growth and gender labor dynamics were evaluated using Pearson and Spearman correlation coefficients, as well as comparative analysis. The findings prove that digital transformation acts as an equalizer, significantly boosting female labor force participation and balancing employment opportunities. This trend is most prominent among the youth, where digital competencies replace outdated selection criteria. A new phenomenon of slightly higher male unemployment in highly technologically developed countries was identified. These results can guide state policies in fostering labor equality.

Keywords: technological development; labor market; gender equality; economic activity; unemployment; OECD countries.

Динамічний розвиток сучасних технологій докорінно змінює традиційні засади функціонування ринку праці, суттєво послаблюючи історично сформовані гендерні стереотипи, створюючи передумови для формування інклюзивного середовища. У статті здійснено комплексний аналіз та кількісну оцінку впливу технологізації економік на трансформацію гендерних параметрів безробіття та економічної активності населення в межах високорозвинених держав світу, а саме ОЕСР. Реалізація поставлених завдань ґрунтується на застосуванні інструментів математико-статистичного аналізу. Автором розроблено та апробовано комплексний індекс технологічного розвитку, що інтегрує параметри освітнього рівня, інноваційної інфраструктури, наукового потенціалу та комерціалізації знань. Для забезпечення зіставності даних виконано процедури логарифмування мінливих показників та мінімаксної нормалізації. Оцінка взаємозв'язків між сформованим індексом та гендерними пропорціями зайнятості здійснена за допомогою розрахунку коефіцієнтів лінійної кореляції Пірсона та рангової кореляції Спірмена. Компаративний аналіз реалізовано шляхом групування країн за рівнем цифровізації з вивченням часової динаміки показників. За підсумками розрахунків статистично доведено наявність стійкого зв'язку між рівнем модернізації економіки та мінімізацією гендерної нерівності в країнах ОЕСР. Встановлено, що цифрова трансформація найбільшою мірою стимулює залучення жінок до складу робочої сили. Дослідження динаміки безробіття продемонструвало вирівнювання шансів на працевлаштування для обох статей у високотехнологічних суспільствах. Найбільш виражено зазначена тенденція прослідковується серед молодіжного сегмента ринку праці, де універсальні цифрові компетенції заміщують застарілі критерії відбору. Виявлено феномен локального переважання рівня безробіття серед чоловіків у країнах з найвищими позиціями інноваційного рейтингу. Результати дослідження можуть слугувати методологічним підґрунтям при формуванні довгострокових стратегій зайнятості та модернізації соціальної політики. Сконструйований індекс дозволяє здійснювати моніторинг різних аспектів ефективності економіки в залежності від технологічного рівня. Матеріали праці є цінними для розробки програм подолання дискримінації на ринку праці та оптимізації використання людського капіталу.

Ключові слова: технологічний розвиток; ринок праці; гендерна рівність; економічна активність; безробіття; країни ОЕСР.

Statement of the problem. The current stage of global economic development is characterized by a large-scale digital transformation that is fundamentally changing the structure of labor markets. Among other things, technology is associated with productivity growth as well as gender transformations. The gender gap in developed countries is now significantly narrower than it was in the past. However, there is uncertainty regarding the future impact of modern technologies. Comparing indicators of technological development with gender-based measures of employment and labor market participation will allow us to clearly determine whether technology truly acts as an "equalizer of opportunities" or whether it creates new hidden barriers. Without an understanding of these patterns, it is impossible to develop effective public policy and optimize the use of human capital in the future. It is particularly relevant to analyze developed countries, as new trends emerge there that later spread to less developed countries.

Analysis of recent research and publications. The gender gap in the labor market and the factors that help minimize it have long been the focus of leading global scholars. In particular, Hartmann H. [1] analyzed in detail the historical preconditions for the emergence of occupational segregation by gender and the role of social stereotypes in her work. Polachek S. W. [2] applies human capital theory to explain the narrowing of the gender pay gap due to the increasing continuity of women's employment and changes in their career expectations. Pieters J. and her co-authors [3] highlight the risks of automating routine tasks, demonstrating that technological changes can affect the employment of men and women differently depending on the intensity of their routine work. Blau, F. D., & Kahn, L. M. [4] identify occupational segregation and the "motherhood penalty" as the main causes of the gender gap. Olivetti C., Pan J., and Petrongolo B. [5] maintain that men and women possess similar basic skills, and that inequality is the result of specific institutional constraints.

Highlighting Previously Unresolved Parts of the Overall Problem. At the same time, there is a need to continuously analyze the latest trends in the labor market, particularly in developed countries, as this is where new trends emerge. It is also important to pay close attention to the impact of technology on the youth segment of the labor market and to address the question of whether technology helps to reduce inequality or only masks it.

Formation of the Objectives of the Article (Task Statement). The *purpose* of the research is to analyze and evaluate the impact of technological development in various countries on the transformation of gender dynamics in the labor market in developed countries (using OECD member states as an example). The following research *objectives* can be identified: to develop a proprietary comprehensive index of economic technological development; to examine its impact on the labor force participation of men and women, as well as on unemployment rates; to analyze the characteristics of youth unemployment in the context of technology. The *object* of the research is the labor markets of OECD countries. The *subject* of the research is the impact of technology on the gender gap in the labor market. The article employs *methods* of index construction, data transformation, correlation analysis, and comparative analysis.

Summary of the main research material. The impact of technology on the gender structure of the labor market should first and foremost be considered in the context of labor force participation and employment among men and women. Historically, under the influence of social stereotypes, occupations have been divided into "male" and "female" categories. "Male" occupations were characterized by a higher proportion of heavy physical labor and employment. For a long time, due to social factors, women were excluded from high-paying jobs, and a significant portion did not enter the labor market at all and were engaged exclusively in household work [1, p. 124].

With technological progress, hard physical labor has often become unnecessary. On the one hand, this has led to men doing less physical work; on the other hand, women have started working more and have entered sectors that were previously considered largely "male-dominated." In other words, a certain degree of equality is emerging in the labor market. One of the factors behind this has been the feminist movement; however, we should not underestimate the impact of technological progress on social stereotypes and the shaping of public opinion through the growing education of the population. Researchers also explain the narrowing of the gender gap in the labor market through the human capital model, in which expectations regarding the labor of men and women are becoming more equal [2, p. 27].

However, the influence of gender on the structure of the labor market should not be dismissed. It is noted that even now, in developed countries, work often remains gender-specific, with women continuing to participate less in the workforce, being more likely to be unemployed, working fewer hours, and facing wage inequality [3, p. 103].

Researchers identify two reasons for the unequal distribution of men and women in the labor market. The first view is that men and women have different preferences, skills, or psychological traits that determine their educational and career choices. In this case, gender inequality is simply a reflection of significant differences between men and women [4, p. 35]. The other perspective argues that men and women are similar in relevant dimensions but face different opportunities and constraints. In this case, gender inequality is a symptom of misallocation, and policies promoting gender equality can improve the efficiency of resource allocation [5, p. 6]. It is worth analyzing whether a gender gap in the labor market actually persists in developed countries (such as OECD members) and whether it is larger in more technologically advanced countries.

To analyze the impact of a country's technological development on the gender characteristics of unemployment in OECD countries, a proprietary index of technological development was developed. At the initial stage, the following indicators were selected for the index, corresponding to various aspects of the economy's technological development: the percentage of people with tertiary education among those over 25 years of age; R&D investment (% of GDP); scientific and technical journal articles; Global Innovation Index; balance of payments for the use of intellectual property (receipts – payments); mobile cellular subscriptions (per 100 people); secure servers (per 1 million people); high-tech exports (as a percentage of total exports) [6; 7]. Because of the strong correlation with other indicators, it was decided not to include the share of internet users.

Japan had to be excluded from the analysis because data was not available for some indicators. The indicators were also transformed as follows: for data from 2011 to 2022, the coefficient of variation was calculated, and those indicators for which this coefficient exceeded 40 were log-transformed (namely: articles in scientific journals, balance of payments for the use of intellectual property, secure servers, high-tech exports, and R&D investment). For the balance of payments for the use of intellectual property, a formula was used, calculating the logarithm of the absolute value of the number and subsequently assigning a negative value to the result if the number was negative. Afterward, all indicators were normalized using the formula:

$$\frac{Xi - Xmin}{Xmax - Xmin} \quad (1)$$

where Xi is the value of the indicator, Xmax is the maximum value of the indicator, and Xmin is the minimum value of the indicator.

To ensure the index's adequacy, components that are strongly correlated were removed: the Global Innovation Index and R&D investment were combined into a single sub-index, with each indicator weighted at 50%. The correlation matrix of indicators (data for 2011–2022) after normalization is presented in Table 1:

To determine the weights of the index components, an approach was chosen based on the source of origin and the effectiveness of innovation implementation (Table 2).

A higher weight was assigned to Block 3, as knowledge creation is identified as the primary

Table 1

Correlation matrix of index components

	GII&RDE	Articles	Int. prop	HTExp	Mobile	Server	Tert. edu
GII&RDE	1						
Articles	0,39	1					
Int. prop	0,54	0,24	1				
HTExp	0,40	0,07	0,29	1			
Mobile	-0,01	-0,35	-0,01	-0,05	1		
Server	0,48	0,13	0,28	0,19	0,04	1	
Tert. edu	0,64	0,17	0,28	0,45	-0,13	0,54	1

Source: compiled by the author based on [6; 7]

Table 2

Distribution of weights for index components

Block 1: Human Capital (20%)	Percentage of people with tertiary education – 20%
Block 2: Digital Infrastructure (20%)	Mobile users – 10%; secure servers – 10%
Block 3: Knowledge creation (25%)	Articles in scientific journals – 12.5% GII + R&D investment – 12.5%
Block 4: Innovation system (15%)	GII + R&D investment – 15%
Block 5: Commercialization (20%)	High-tech exports – 10%; balance of payments for the use of intellectual property – 10%

Source: compiled by the author

driver of technological progress in the research. After calculating the technological development index for the sample countries for the period 2011–2022, the values were converted to a scale of 0–100.

After establishing the index of technological development of the economy, the first stage of analysis was conducted: an examination of the relationship between this index and the ratio of women's and men's participation in the labor force [8; 9]. This analysis demonstrates women's fundamental readiness and ability to be part of the economy. Since technology hypothetically acts as an equalizing factor, it is expected that in countries with higher technological development, the gap between the share of men and women in the labor force will be smaller. That is, given that across all countries in the sample during 2011–2022, men's participation in the labor force is higher, and the ratio of "female labor force participation to male labor force participation" is no greater than 1, we can hypothesize that the higher the technological development index, the closer this ratio is to 1 – that is, there is a direct relationship. Additionally, the labor force participation ratio was normalized using Formula 1.

The Pearson correlation coefficient between the indicators for the data covering the examined period (a total of 444 observations: 12 years across 37 countries) is 0.687 (statistically significant), which confirms the hypothesis regarding the existence of a relationship and its direction. 47.2% of the variation in one indicator is explained by the variation in the other. To ensure the reliability of the result, Spearman's rank correlation coefficient was also calculated, which is 0.678 and is statistically significant. The slight difference between the Pearson and Spearman coefficients indicates the homogeneity of the data and the absence of a critical impact of outliers on the overall trend.

To compare the most and least technologically advanced countries in the sample, the average value of the technological development index over 5 years (2018–2022) was calculated, and the countries in the sample were ranked according to this value. The 10 most technologically advanced countries (Sweden, Netherlands, Finland, Israel, Denmark, South Korea, Germany, Switzerland, United Kingdom, and United States) and the 10 least technologically advanced countries (Italy, Latvia, Greece, Portugal, Slovakia, Turkey, Chile, Colombia, Costa Rica, and Mexico) were identified. When comparing these two groups of countries and calculating the group averages, the following relationships were found (Figure 1):

As previously mentioned, female labor force participation is lower in all countries in the sample. However, in the most technologically advanced countries, the gap is noticeably smaller, indicating that technology is helping to reduce gender inequality. Additionally, the gap is gradually narrowing in both groups of countries, suggesting that the increase in women's labor force participation is a global trend. Thus, technological development is a prerequisite for women's participation in the economy. A possible reason for this is that in technologically advanced countries, the economy is based on knowledge and services, which stimulates demand for capital that is gender-neutral. Additionally, unlike unemployment, labor force participation reflects social norms. The high correlation confirms that technological progress can contribute to the transformation of traditional employment models, in which women remained outside the labor market.

After confirming the first hypothesis, the second stage of the analysis was conducted: an analysis of the relationship between male and female unemployment (age over 15) rates and technological progress in the sample

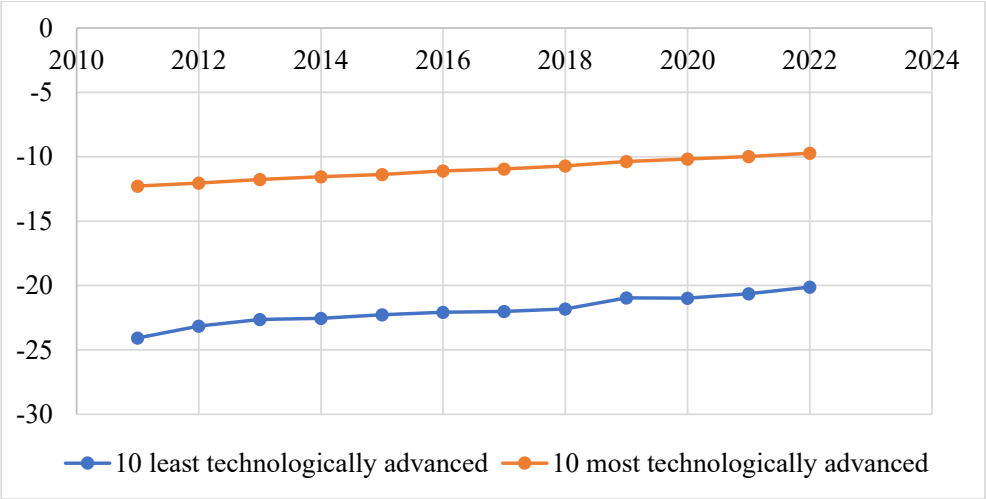

Fig. 1. Comparison of the ratio of female to male labor force participation in the most and least technologically advanced countries in the sample

Source: compiled by the author based on [8; 9]

countries for the period 2011–2022 [10]. The methodology remained unchanged: the ratio of "share of unemployed women/share of unemployed men" was calculated, and a correlation analysis was conducted between this indicator – normalized according to Formula 1 – and the technological development index. The hypothesis for this stage of the research is that in more technologically developed countries, the percentage of unemployed women is comparatively lower, and gender inequality is decreasing; therefore, the relationship should be inverse (since the smaller the difference between female and male unemployment, the smaller the calculated ratio).

The calculated Pearson correlation coefficient confirms the hypothesis. It is -0.509 and is statistically significant. The relationship is noticeably weaker than in the previous case. Spearman's rank correlation coefficient is -0.465 and is statistically significant. There is a moderate negative correlation between the indicators. This suggests that in countries with higher levels of technological development, there is a leveling of employment opportunities between women and men. The technological development index accounts for 25.9% of the variation in the ratio of female to male unemployment. The remaining 74.1% is attributed to other factors (such as social policy, cultural characteristics, the sectoral structure of the economy, etc.).

The results confirm the hypothesis that a country's technological development acts as a driver of gender equality in the labor market. This may be due to several factors:

1. Digitalization and remote work. Technology creates more flexible working conditions, which contributes to higher employment rates among women.
2. Changes in the economic structure. The transition from heavy industry to a knowledge-based economy reduces the role of physical labor and increases the value of intellectual capital, where gender differences are minimized.
3. Access to education. A high level of the technological development index depends significantly on education (which is included in the index as one of the factors). Access to education in more technologically advanced countries provides women with comparatively better starting conditions for employment.

By comparing the ratio in the 10 most and least technologically advanced countries and calculating the averages for both groups, conclusions can be made (Figure 2).

First, the overall unemployment rate is higher in countries with lower levels of technological development. The gap between female and male unemployment is also wider in these countries. Second, it is important to note that in the most technologically advanced economies, there is a slight predominance of unemployment among men. That is, with a comparatively higher labor force participation rate in these countries, women are also more likely to be employed. Third, when examining trends, the gap is widening in less developed countries and narrowing in more developed ones.

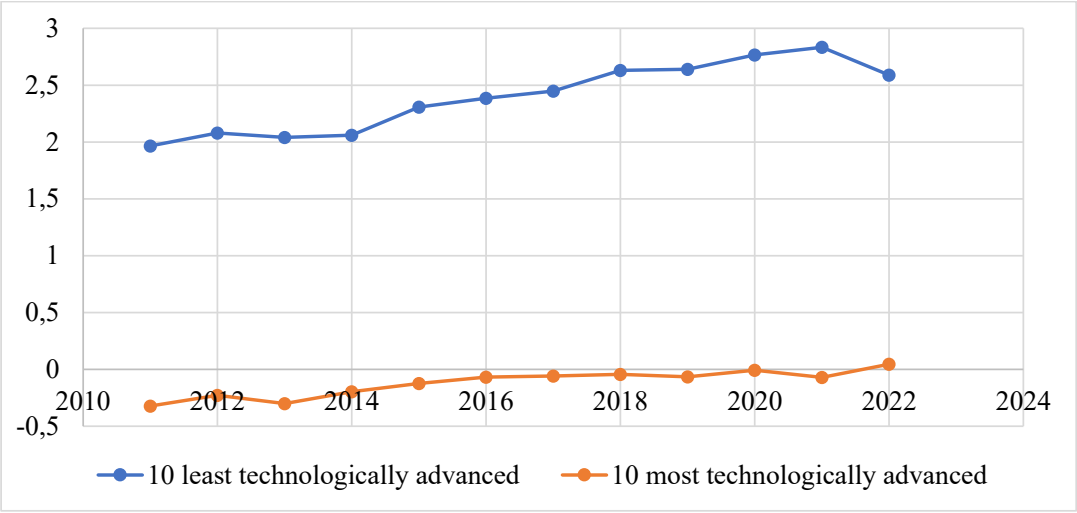

Fig. 2. Comparison of the ratio of female to male unemployment in two groups of countries

Source: compiled by the author based on [10]

The next stage of the research is an analysis of youth unemployment (people aged 15–24) [10]. This stage is important for understanding whether young people are more likely to adopt current trends. Furthermore, when youth unemployment is significant, it indicates the inability of the new generation to integrate into existing labor market conditions. The hypothesis for this stage of the analysis is that the gap between male and female unemployment is narrowing even more rapidly in this group.

The Pearson correlation coefficient between the ratio of "unemployment among young women to unemployment among young men" and the technological development index is -0.656 (statistically significant). Thus, a moderate negative relationship has been established. The factor explains 43% of the variation in the outcome variable. Spearman's rank correlation coefficient is -0.635 (statistically significant). The inverse relationship is also evident in the scatter plot (Figure 3).

The 15–18% increase in the strength of the correlation compared to overall unemployment rates allows us to conclude that technological development acts as a "leveler of opportunities"

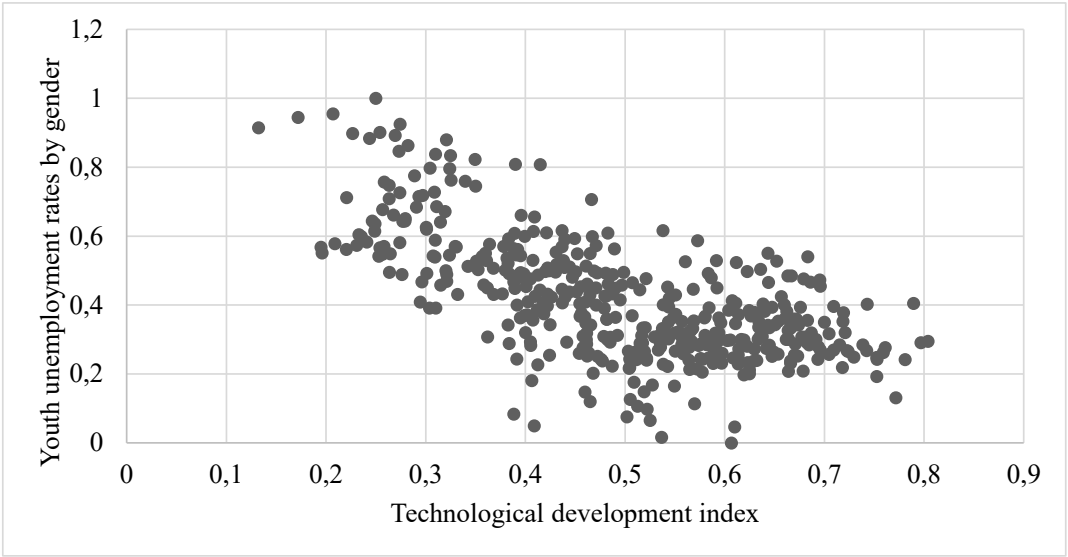

Fig. 3. Scatter plot of data on youth unemployment and the technological development index

Source: compiled by the author based on [10]

to a greater extent for the youth segment, as it replaces outdated social and physical selection criteria in the labor market with universal digital competencies. Young people in technologically advanced environments adapt more quickly to new tools (AI, automation, analytics). Since these skills are gender-neutral, the technological saturation of the economy creates an environment in which qualifications take precedence over gender. This explains why, for young women, a country's technological advancement is a more critical factor for successful employment than for older women, whose career paths were largely shaped under a different economic paradigm. Investment in technological development can be an important tool for addressing the gender gap in the labor market, particularly among young people.

When comparing the ratio of female to male youth unemployment in the 10 most and least technologically advanced countries, we can see that the contrast is, as expected, more noticeable than in the previous stage of the research (Figure 4). We see that while in less technologically advanced countries there remains a significant (and noticeably larger than for overall unemployment) gap in favor of men (i.e., female unemployment predominates), in the most technologically advanced countries there is an even greater gap in favor of women than in overall unemployment (male unemployment begins to prevail). This allows us to conclude that a new trend is emerging, one that is more noticeable among young people: technological development not only narrows the gap in employment between men and women, but also contributes to a slight prevalence of male unemployment over female unemployment.

The dynamic shows that the gender gap among youth is more sensitive to crises in less technologically developed countries (e.g., its increase in 2020), and it remains consistently high in these countries. The overall result confirms the research hypothesis (progress reduces inequality), but a new observation is the local prevalence of male unemployment over female unemployment in the most technologically advanced countries.

Conclusion. The calculated technological development index – which is based on different aspects of technology and its practical application – has revealed certain patterns. Technological development acts as a factor in the structural transformation of the labor market's gender profile, narrowing the gender gap in economic activity and unemployment, especially among young people, who are the first to react to structural changes, which confirms the research hypothesis. Technological development has the greatest impact not on whether a person finds a job (unemployment), but on whether they decide to enter the labor market at all (labor force participation). For women, a technologically advanced country creates an environment where professional fulfillment becomes more accessible and the expected norm. Technology also helps them avoid unemployment, especially young women. This reduces overall gender disparities.

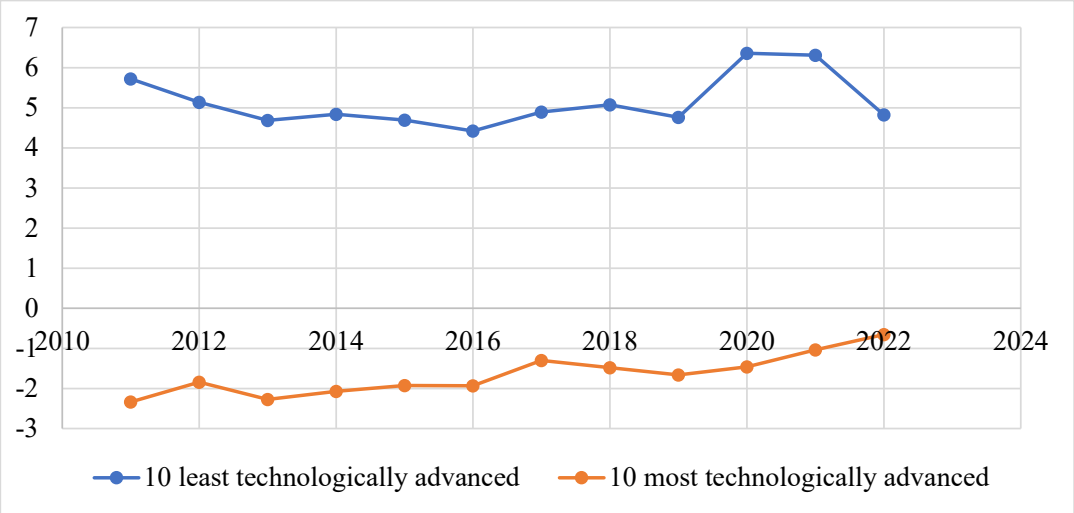

Fig. 4. Comparison of youth unemployment by a country's technological development

Source: compiled by the author based on [10]

Another trend identified is the prevalence of unemployment among men in the most technologically advanced countries in the sample. The causes and implications of this phenomenon require separate analysis in the future.

REFERENCES:

1. Hartmann, H. (1979). Capitalism, patriarchy and job segregation by sex. Z. R. Eisenstein (Ed.), *Capitalist patriarchy and the case for socialist feminism* (pp. 121–126). *Monthly Review Press*.

2. Polachek, S. W. (2004). How the human capital model explains why the gender wage gap narrowed. *IZA Discussion Paper* No. 1102. Available at: https://docs.iza.org/dp1102.pdf (accessed April 12, 2026).

3. Pieters, J., Kujundzic, A., Burger, R., & Gondwe, J. (2021). Inequality at risk of automation? Gender differences in routine tasks intensity in developing country labor markets. R. Albrieu (Ed.), Cracking the future of work: Automation and labor platforms in the Global South. Available at: https://fowigs.net/wp-content/uploads/2021/10/Cracking-the-future-of-work.-Automation-and-labor-platforms-in-the-Global-South-FOWIGS.pdf (accessed May 5, 2026).

4. Blau, F. D., & Kahn, L. M. (2016). The gender wage gap: Extent, trends, and explanations. *NBER Working Paper* No. 21913. Available at: https://www.nber.org/system/files/working_papers/w21913/w21913.pdf (accessed April 18, 2026).

5. Olivetti, C., Pan, J., & Petrongolo, B. (2024). The evolution of gender in the labor market. *NBER Working Paper* No. 33153. Available at: https://www.nber.org/system/files/working_papers/w33153/w33153.pdf (accessed April 29, 2026).

6. World Bank Data. Indicators. Available at: https://data.worldbank.org/indicator?tab=all (accessed April 02, 2026).

7. Global Innovation Index (2025). World Intellectual Property Organization. Available at: https://www.wipo.int/global_innovation_index/en/ (accessed April 10, 2026).

8. World Bank Data. Labor force participation rate, female (% of female population ages 15+) (modeled ILO estimate). Available at: http://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS (accessed April 15, 2026).

9. World Bank Data. Labor force participation rate, male (% of male population ages 15+) (modeled ILO estimate). Available at: https://data.worldbank.org/indicator/SL.TLF.CACT.MA.ZS (accessed April 15, 2026).

10. OECD Data Explorer. Monthly unemployment rates. Available at: https://data-explorer.oecd.org/vis?df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_LFS%40DF_IALFS_UNE_M&df[ag]=OECD.SDD.TPS&df[vs]=1.0&pd=2010%2C2023&dq=..._Z.Y.F%2BM%2B_T.Y_GE15..A&ly[rw]=REF_AREA&ly[cl]=TIME_PERIOD&to[TIME_PERIOD]=false&vw=tb (accessed May 7, 2026).

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ:

1. Hartmann H. Capitalism, patriarchy and job segregation by sex. Capitalist Patriarchy and the case for socialist feminism / ed. by Z. R. Eisenstein. New York : *Monthly Review Press*, 1979. P. 121–126.

2. Polachek S. W. How the Human Capital Model Explains Why the Gender Wage Gap Narrowed. *IZA Discussion Paper.* 2004. No. 1102. April. 25 p. URL: https://docs.iza.org/dp1102.pdf (дата звернення: 12.04.2026).

3. Pieters J., Kujundzic A., Burger R., Gondwe J. Inequality at risk of automation? Gender Differences in Routine Tasks Intensity in Developing Country Labor Markets. *Cracking the future of work. Automation and labor platforms in the Global South* / ed. by R. Albrieu. 2021. URL: https://fowigs.net/wp-content/uploads/2021/10/Cracking-the-future-of-work.-Automation-and-labor-platforms-in-the-Global-South-FOWIGS.pdf (дата звернення: 04.05.2026).

4. Blau F. D., Kahn L. M. The Gender Wage Gap: Extent, Trends, and Explanations. *NBER Working Paper.* 2016. No. 21913. January. URL: https://www.nber.org/system/files/working_papers/w21913/w21913.pdf (дата звернення: 18.04.2026).

5. Olivetti C., Pan J., Petrongolo B. The Evolution of Gender in the Labor Market. *NBER Working Paper.* 2024. No. 33153. November. URL: https://www.nber.org/system/files/working_papers/w33153/w33153.pdf (дата звернення: 29.04.2026).

6. World Bank Data. Indicators : вебсайт. URL: https://data.worldbank.org/indicator?tab=all (дата звернення: 02.04.2026).

7. Global Innovation Index / *World Intellectual Property Organization* : вебсайт. URL: https://www.wipo.int/global_innovation_index/en/ (дата звернення: 10.04.2026).

8. Labor force participation rate, female (% of female population ages 15+) (modeled ILO estimate) / World Bank Data : вебсайт. URL: http://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS (дата звернення: 15.04.2026).

9. Labor force participation rate, male (% of male population ages 15+) (modeled ILO estimate) / World Bank Data : вебсайт. URL: https://data.worldbank.org/indicator/SL.TLF.CACT.MA.ZS (дата звернення: 15.04.2026).

10. Monthly unemployment rates / OECD Data Explorer : вебсайт. URL: https://data-explorer.oecd.org/vis?df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_LFS%40DF_IALFS_UNE_M&df[ag]=OECD.SDD.TPS&df[vs]=1.0&pd=2010%2C2023&dq=..._Z.Y.F%2BM%2B_T.Y_GE15..A&ly[rw]=REF_AREA&ly[cl]=TIME_PERIOD&to[TIME_PERIOD]=false&vw=tb (дата звернення: 07.05.2026).

Дата надходження статті: 24.06.2026
Дата прийняття статті до публікації: 04.08.2026
Дата публікації статті: 11.08.2026