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e-mail: wydawnictwo@ur.edu.pl; <https://wydawnictwo.ur.edu.pl>

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*Dr Lidia Kaliszczak*¹ 

Department of Economics and Management
University of Rzeszów

*Dr Jolanta Wojnar*² 

Department of Quantitative Methods and Economic Informatics
University of Rzeszów

Eco-innovation performance of the Polish economy in the European Union context³

Abstract

The article analyses and assesses the level of eco-innovation in the Polish economy in comparison with other European Union countries and identifies the main barriers and directions for supporting the development of eco-innovation in Poland. The hypothesis tested was that Poland's position in the Eco-Innovation Index (Eco-IS) and its eco-innovative performance compared to the EU average are mainly influenced by insufficient government spending on R&D as well as research and development in the fields of environment and energy. Based on a detailed analysis of the degree and dynamics of changes in the Eco-Innovation Index (EII) for EU countries in 2014–2024 and its structure, an assessment of 12 sub-indicators in the EU and Poland in 2024 showed that in the 10-year period under review, Poland improved its score from 50.2 to 69.7, which indicates a 39% increase in the index value and a move up by one position in the ranking (from 26th to 25th place). Despite the increase, the country's ranking position improved only marginally, which reveals that other countries intensified their efforts in the field of eco-innovation. As a result, Poland did not move closer to the top-ranked countries and continues to rank at the bottom of the EU list. The authors identify insufficient R&D expenditure (% of GDP) as well as insufficient government funding and spending on research and development in the fields of environment and energy as the main reasons. The proposed increase in R&D expenditure in relation to GDP as a means of reducing barriers to the growth of eco-innovation in the Polish economy should be correlated with the development of eco-innovative investments and implementations, while simultaneously sustaining high levels of human capital.

Keywords: eco-innovation; eco-innovation index; the European Union; barriers to eco-innovation.

¹ Correspondence address: Uniwersytet Rzeszowski, Wydział Ekonomii i Finansów, M. Cwi-
klińskiej 2, 35-601 Rzeszów; e-mail: lkaliszczak@ur.edu.pl. ORCID: 0000-0002-1879-1352.

² Correspondence address: Uniwersytet Rzeszowski, Wydział Ekonomii i Finansów, M. Cwi-
klińskiej 2, 35-601 Rzeszów; e-mail: jwojnar@ur.edu.pl. ORCID: 0000-0001-6962-4610.

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Ekoinnowacyjność polskiej gospodarki na tle krajów Unii Europejskiej

Abstrakt

W artykule przeprowadzono analizę i ocenę poziomu ekoinnowacyjności polskiej gospodarki w porównaniu z innymi krajami Unii Europejskiej oraz wskazano na zasadnicze bariery i kierunki wspierania rozwoju innowacji ekologicznych w Polsce. Weryfikowaną hipotezą było twierdzenie, że na pozycję Polski w rankingu ekoinnowacyjności (Eco-IS) oraz dystans dzielący ją od średniej UE w głównym stopniu wpływa niski udział wydatków rządowych na B+R oraz na badania i rozwój w dziedzinie środowiska i energii. Na podstawie szczegółowej analizy poziomu i dynamiki zmian sumarycznego wskaźnika ekoinnowacyjności (EII) w krajach UE w latach 2014–2024 oraz jego struktury, oceniając wartości 12 wskaźników cząstkowych w UE i Polsce w 2024 r., wykazano, że w badanym okresie 10 lat Polska poprawiła swój wynik z poziomu 50,2 do 69,7, co oznacza wzrost wartości indeksu o 39% oraz awans o jedno miejsce w rankingu (z 26. na 25. pozycję). Mimo odnotowanego wzrostu poprawa pozycji nie była znacząca, co wskazuje, że pozostałe państwa intensyfikowały działania w obszarze ekoinnowacji. W rezultacie Polska nie zredukowała znacząco dystansu dzielącego ją od liderów i nadal plasuje się w końcowej części rankingu krajów UE. Jako główną przyczynę tej sytuacji Autorzy wskazują niski poziom wydatków na badania i rozwój (% PKB) oraz finansowania i wydatków rządowych na badania i rozwój w dziedzinie środowiska i energii. Postulowany wzrost nakładów na B+R w relacji do PKB jako ograniczanie barier wzrostu ekoinnowacyjności polskiej gospodarki powinien być skorelowany z rozwojem inwestycji oraz wdrożeń ekoinnowacyjnych, przy jednoczesnym utrzymywaniu wysokiego potencjału kapitału ludzkiego.

Słowa kluczowe: ekoinnowacje, sumaryczny wskaźnik ekoinnowacyjności (EII), Unia Europejska, bariery ekoinnowacji.

JEL: O30, O01, P47.

INTRODUCTION

Eco-innovations constitute a key factor in the implementation of the widely recognised concept of sustainable development. Also, they contribute to the growth of competitiveness among businesses and economies. The role of eco-innovations is underscored in the context of efficient use of resources, job creation, and the development of significantly improved products, processes, organizational structures, and institutional solutions, leading to the improvement of the natural environment (Rutkowska, Pakulska, 2023, p. 551). The implementation of eco-innovations is an important element in the strategies pursued by many industries and can constitute a barrier to market entry (Nowaczek, Kowalski, Kulczycka, Makara, 2025, p. 1). However, many enterprises identify limitations in the creation of innovative solutions, which translates into Poland's relatively low position in the EU Eco-Innovation Index of EU. In addition, the authors emphasise the fact that R&D spending is one of the main factors determining the degree of innovativeness, including eco-innovation. Greater investment inputs usually increase the capacity to create and implement eco-innovations.

The aim of the study is to analyse and assess Poland's performance in terms of eco-innovation in comparison with other EU Member States, identify constraints and barriers, and point to directions for supporting the development of ecological innovations in Poland.

In the ensuing paper, an attempt was made to test the following hypothesis: Poland's position in the Eco-Innovation Index (Eco-IS) and its eco-innovative performance compared to the EU average are mainly influenced by insufficient government spending on R&D as well as on research and development in the fields of environment and energy.

In pursuing the objective of the study and verifying the research hypothesis, the degree and dynamics of changes in the Eco-Innovation Index were examined in detail in EU Member States in the years 2014–2024. Furthermore, the values of the sub-indicators of the overall Eco-Innovation Index in the EU and Poland in 2024 were assessed. In addition, the level of expenditure on R&D (% of GDP) as well as government funding and spending on environmental and energy research and development were compared. The comparative analysis was based on statistical data from the Eco-Innovation Scoreboard and Eurostat. The comparison covered eco-innovation indicators for all EU Member States. The research is deductive in nature and draws on the relevant literature, reports, and existing research on eco-innovation.

THE ESSENCE AND SIGNIFICANCE OF ECO-INNOVATIONS IN THE DEVELOPMENT OF CONTEMPORARY ECONOMIES

In the face of growing environmental threats and problems related to the availability of natural resources, eco-innovations represent an opportunity not only to maintain economic growth, but also to enhance its environmental sustainability, which is a prerequisite for reducing pressure on the environment. It is not possible to completely eliminate the negative impact of human activity on the environment, but thanks to eco-innovations, it is being systematically reduced. Currently, environmental innovations constitute one of the most important factors in the development of EU Member States and, at the same time, one of the key areas supported by its policy.

Many researchers emphasise the relationship between innovation and economic competitiveness and claim that innovations are a tool for enhancing competitiveness (Węgrzyn, 2013; Korkosz-Gębska, 2015; Urbaniec, 2015; Kowalik, 2016; Oleksy, 2017; Pakulska, 2018; Chmielewska, Sławiński, 2021; Burzyńska, Hajdys, 2021; Wach, Głodowska, 2022). Eco-innovations are a special type of innovations in that they involve the creation and implementation of new products and processes that benefit both businesses and the environment (Rutkowska, Pakulska, 2023,

p. 550). In an article published in 2023 entitled *Exploring the Nexus of Eco-Innovation and Sustainable Development: A Bibliometric Review and Analysis*, eco-innovation is approached as a tool that simultaneously “supports sustainable economic growth and mitigates environmental impacts” (Fatma, Haleem, 2023). The role of eco-innovations is underscored as one of the key factors in implementing the concept of sustainable development. Eco-innovations promote the development of an environmentally friendly economy and facilitate the dissemination of the so-called clean technologies (Burzyńska, Hajdys, 2021, p. 63). In this context, it is postulated that eco-innovations stem from mutual social interactions, technological advancements and the application of new knowledge. Thanks to eco-innovations, new products and processes are developed that reduce negative environmental impacts (Flis, 2010, p. 27). Although previous research has often focused primarily on eco-innovative environmental implications, their transformative potential encompasses the economic, social, and environmental dimensions of sustainable development (Fatma, Haleem, 2023). However, recent approaches emphasize the need to integrate all three dimensions of sustainable development in explaining the role of eco-innovations, which simultaneously promotes economic growth, improves social welfare, and protects the environment (Radenović, Janjić, Talić, 2024, p. 189; cited in: Sopińska, 2025, p. 128).

In the relevant literature, the main objectives of introducing eco-innovations in organizations are identified and include: reduction or elimination of negative environmental impacts, improved economic performance e.g. through the reduction of operating costs, strengthened company’s image among its stakeholders, the general public, and environmental organizations, as well as an increase in the company’s perceived value among current and potential investors (Ryszko, 2014; Poznańska, Janiszewski 2024). Paipa-Sanabria, Montoya, and Hernandez (2025) also draw attention to a broader understanding of eco-innovation that goes beyond the environmental perspective. While analyzing eco-innovation theories and tools, the authors approach them as the key element leading to the achievement of “social sustainability.” They emphasise that eco-innovation encompasses not only technological solutions, but also a broad set of activities (technological, organizational, social) aimed at balanced economic, social, and environmental development.

ANALYSIS AND ASSESSMENT OF POLAND’S PERFORMANCE IN TERMS OF ECO-INNOVATION IN COMPARISON WITH EU MEMBER STATES

Eco-innovation is measured using 12 indicators grouped into five thematic areas: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency outputs, and socio-economic outputs.

Based on the Eco-Innovation Scoreboard (Eco-IS), which is calculated as an unweighted arithmetic mean of the sub-indicators and then compared with an average value for the European Union as a whole, a ranking of eco-innovations in EU Member States is created. Using the Eco-Innovation Scoreboard, EU Member States were divided into three equally sized groups. Thanks to this classification, individual Member States may be assigned to one of the three categories: eco-innovation leaders (9 EU countries), average eco-innovation performers (countries ranked 10–18), and countries catching up in terms of eco-innovation (ranks 19–27).⁴ Table 1 presents the changes in the Eco-Innovation Index scores for all EU Member States in 2024 and, by way of comparison, in 2014.

The eco-innovation performance varies greatly across EU Member States. The average eco-innovation index for the EU-27 increased from 100 to 127.5, indicating a 28% increase. This constitutes a clear sign that EU Member States have been gradually investing in green technologies, renewable energy innovations, circular economy, and other aspects of sustainable development.

Table 1. Eco-IS in EU Member States in 2014 and 2024

2014			2024			Change 2024/2014	
EU Member States	Eco-Innovation Index in 2014	Rank	EU Member States	Eco-Innovation Index in 2024	Rank	Index values (%)	Change in the ranking
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>
Finland	161.9	1	Finland	180.8	1	12%	0
Denmark	154.0	3	Denmark	177.5	2	15%	1
Austria	141.0	5	Austria	177.1	3	26%	2
Luxembourg	154.9	2	Luxembourg	175.1	4	13%	-2
Sweden	145.2	4	Sweden	165.2	5	14%	-1
Italy	110.9	6	Italy	150.1	6	35%	0
France	106.0	8	France	144.0	7	36%	1
Germany	108.3	7	Germany	140.7	8	30%	-1
Netherlands	94.6	10	Netherlands	133.1	9	41%	1
Spain	101.5	9	Spain	127.2	10	25%	1
Czechia	89.1	12	Czechia	125.6	11	41%	1
Slovenia	85.4	13	Slovenia	121.5	12	42%	1
Ireland	71.1	18	Ireland	121.2	13	70%	5
Estonia	90.0	11	Estonia	116.5	14	29%	-3
Latvia	76.4	17	Latvia	114.7	15	50%	2
Lithuania	61.4	22	Lithuania	114.7	16	87%	6
Portugal	79.0	16	Portugal	113.2	17	43%	-1

⁴ European Commission 2024.

<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>
Belgium	81.2	15	Belgium	109.2	18	34%	-3
Malta	53.2	25	Malta	99.2	19	86%	6
Slovakia	63.9	21	Slovakia	98.9	20	55%	1
Cyprus	64.0	20	Cyprus	97.6	21	53%	-1
Croatia	64.9	19	Croatia	96.6	22	49%	-3
Greece	56.4	24	Greece	91.0	23	61%	1
Romania	84.7	14	Romania	80.2	24	-5%	-10
Poland	50.2	26	Poland	69.7	25	39%	1
Hungary	59.4	23	Hungary	64.4	26	8%	-3
Bulgaria	29.8	27	Bulgaria	58.8	27	97%	0
EU27	100.0			127.5		28%	

	Eco-Innovation Leaders
	Average Eco-Innovation Performers
	Eco-Innovation Catching Up

Source: author's own elaboration based on (European Commission 2024).

Based on the data presented in the table it is noticeable that the increase is not uniform across individual Member States, which points to regional disparities as regards the development of eco-innovations. Several countries recorded impressive progress, while Romania reported a decline (-5%) and a significant drop of 10 positions in the ranking.

In the periods compared, the Scandinavian countries (Finland, Denmark, Sweden) and several Western European countries (Austria, Luxemburg, Italy, France, Germany) are at the top of the ranking. A detailed analysis revealed that Finland ranks first in the scoreboard, despite the fact that the index recorded only a slight increase of 12% during the period under study. This implies that the country already had a highly developed eco-innovation sector in 2014. Denmark advanced from third to second place with a moderate increase in the index (15%). Austria moved up from fifth to third place due to an increase in the index of 26%. These Member States are characterised by a stable and high level of investment in research and development, strong policies supporting green technologies as well as effective environmental regulation. Some countries, starting from a lower baseline in 2014, recorded spectacular progress. Bulgaria observed the most dynamic growth (97%), however its position in the ranking remained unchanged (27th place), which shows that also other countries developed eco-innovations dynamically. Lithuania recorded an increase by 87% and moved up from 22nd to 16th place. Malta registered an increase by 86% and moved up by six places, whereas Ireland went up from 18th to 13th place – an increase of 70%. These

countries demonstrate high potential for the development of green technologies in a relatively short period of time, which may result from new government strategies, EU funding or a dynamic private sector.

Poland improved its score from 50.2 to 69.7, i.e. by 39% and moved up by one place (from 26th to 25th place). Despite the increase, the country's ranking position improved only marginally, which reveals that other countries intensified their efforts in the field of eco-innovation. As a result, Poland did not move closer to the top-ranked countries and continues to rank at the bottom of the EU list.

Figure 1 illustrates the dynamics of changes in the synthetic eco-innovation index for Poland over the period 2014–2024 against the EU average.

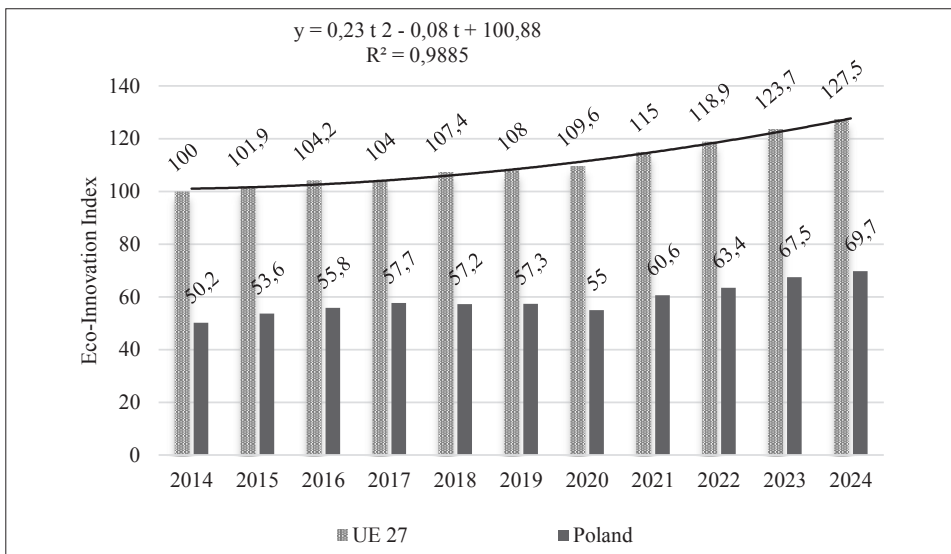


Figure 1. Eco-Innovation Index in the EU-27 and Poland in 2014–2024

Source: author's own elaboration based on: (European Commission 2024).

An analysis of numerical data in 2014–2024 reveals that Poland systematically narrowed the gap and moved closer to the EU-27 average in terms of eco-innovation. In 2014–2016, the difference between Poland and the EU average remained relatively stable, however in the years that followed the gap gradually widened. The EU average presented a steady increase, which was well captured by a polynomial trend function with a goodness of fit of 99%. At the same time, the pace of improvement in Poland was slower and less pronounced. In 2014, Poland lagged behind the EU-27 by 49.8 points in the eco-innovation index, whereas in 2024 the country reached a peak of 57.8 points, the highest level observed during the study period, which points to Poland's growing lag in the field of eco-innovation.

The results show that the pace of improvement proved insufficient to reduce the disparities between Poland and the EU-27. Poland does not keep pace with the rate of development of eco-innovations observed in most EU Member States. When examining the causes of Poland's poor eco-innovative performance – compared to other EU countries – an analysis of the structure of the Eco-Innovation Index was conducted and involved an assessment of 12 sub-indicators in the EU and in Poland in 2024. The data presented in Figure 2 demonstrate clear disparities across individual areas between Poland and the EU-27.

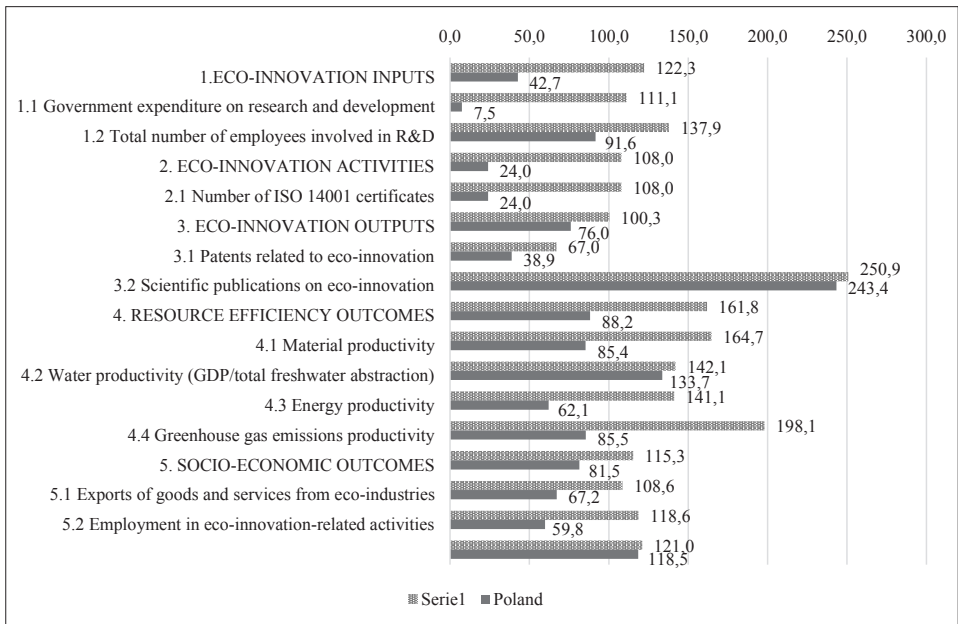


Figure 2. Sub-indicators of the Eco-Innovation Index in the EU and in Poland in 2024

Source: author's own elaboration based on: (European Commission 2024).

A comparative analysis of the eco-innovation indicators for Poland and the EU-27 revealed significant differentiation in terms of inputs, outputs, and socio-economic impacts related to eco-innovation processes. The data show that Poland is characterised by a relatively low level of eco-innovative investments and implementations, while at the same time maintaining moderate, and in some categories high scientific potential. Poland's position in the Eco-Innovation Index in 2024 is largely determined by low efficiency across all indicators, except for three categories:

- 1 – Scientific publications related to eco-innovation,
- 2 – Water productivity (GDP/total freshwater abstraction), which is used to assess the efficiency of water resource management,

3 – Added value in environmental protection and resource management activities.

A comparison of this kind reveals that despite investment and implementation constraints, Poland possesses certain strengths in the scientific and environmental domains that may form the basis for further development of eco-innovations.

DISCUSSION – BARRIERS TO ECO-INNOVATION IN POLAND

The values of the sub-indicators in the Eco-Innovation Index for Poland and relative to other EU Member States in 2024 (Figure 2) point to insufficient government spending on research and development in the fields of environment and energy as the primary constraint on the development of eco-innovations. The value of this indicator is the lowest among all 12 sub-indicators and deviates significantly from the EU-27 (7.5 for Poland and 111.1 for EU Member States). This indicator should be analysed in conjunction with the level of gross domestic expenditure on R&D (GERD) as a percentage of GDP.

In EU Member States, the expenditure on research and development amounts on average to 2.27% of GDP (2022). However, countries such as Germany, Sweden, Belgium and Austria achieve significantly higher levels, exceeding 3% of GDP.

Following the data from Statistics Poland (GUS), in Poland the expenditure on R&D was at the level of 1.45% of GDP in 2022, 1.56% of GDP in 2024 and 1.41% of GDP in 2024⁵. As the comparative analyses have shown, if the general expenditure on R&D (relative to GDP) are low or relatively lower than the EU average, part of the financial means is probably not allocated to R&D in the fields of environment and energy. This reduces the availability of technologies, know-how, research resources and projects intended for commercial use, which, in turn, translates into a low level of eco-innovation.

Furthermore, the relative level of R&D expenditure alone (as a percentage of GDP) is not sufficient. The structure is also important, showing what proportion of funds is allocated to green R&D, environmental protection, and green technologies. If the expenditure is too low, the effects on eco-innovation will be limited, as illustrated by the cases of Poland, the Czech Republic and Slovakia. Many analyses published in the context of the Eco-Innovation Index show that countries with low expenditure on R&D (including the green environmental R&D) need considerably more time to narrow the gap and move closer to the top-ranked Member States as far as eco-innovation is concerned (Hajdukiewicz, Pera, 2024, pp. 32–33; European Commission, 2024).

⁵ In 2024, the upward trend reversed for the first time – the value of the index in 2024 takes Poland back to 2021, when R&D expenditure accounted for 1.42% of GDP (Statistics Poland).

The analysis of data presented in Table 2 showed that only six EU Member States reached a level of expenditure exceeding 3% of GDP. The highest intensity of these expenditures was recorded in Sweden (3.64%), Belgium (3.27%), Austria (3.26%), Germany (3.13%) and Finland (3.09%). The lowest values were noted in Romania (0.52%), Malta (0.64%), Cyprus (0.68%) and Bulgaria (0.79%).

Poland is one of the three EU countries that recorded the most considerable increase in R&D expenditure over the past decade. Despite that fact, in 2023 the expenditure amounted to only 1.56% of GDP, which ranks the country 13th among the total of 27 Member States (Table 2).

Table 2. Government funds and expenditure on research and development in the fields of environment and energy (the value of the EII sub-indicator) and expenditure on R&D (%GDP) (2023)

EU Member States	Government funds and expenditure on research and development in the fields of environment and energy ⁶	Expenditure on R&D (%GDP)
<i>1</i>	<i>2</i>	<i>3</i>
Finland	155.8	3.09
France	155.8	2.18
Germany	155.8	3.13
Slovenia	155.1	2.13
Denmark	109	3.07
Netherlands	108.3	2.3
Austria	92.7	3.26
Latvia	87.3	0.82
Sweden	81.7	3.64
Italy	79.9	1.38
Spain	75.2	1.49
Czechia	65	1.82
Portugal	42.7	1.69
Belgium	33	3.27
Slovakia	32.3	1.03
Luxembourg	29.7	1.06
Estonia	28.9	1.83
Lithuania	28.2	1.05
Greece	27.5	1.49
Hungary	26.2	1.38
Romania	21.5	0.52
Ireland	18.8	1.54

⁶ The value of the EII sub-indicator.

<i>1</i>	<i>2</i>	<i>3</i>
Malta	13.7	0.64
Croatia	10.7	1.39
Poland	7.5	1.56
Bulgaria	6.7	0.79
Cyprus	2.6	0.68

Source: author's own elaboration based on: (European Commission 2024; Eurostat).

According to the data provided by Eurostat, in 2023 The European Union has allocated €389 billion to research and development, which corresponds to 2.26% of GDP. More than two thirds of these expenditures (66%) originate from the business sector, and the average expenditure per capita amounted to EUR 862. However, research conducted by other authors emphasises the significant role of the state (and public support) in the development of eco-innovation. The analysis reveals that the contribution of public R&D is often more important than that of enterprises (Krupnik, Szczucka, Lisek, 2022). As confirmed by numerous studies, limited access to funding and high costs associated with eco-innovative methods in particular are frequently identified as barriers faced by enterprises. (Nowaczek et al., 2025). Low expenditure on research and development (R&D) constitutes one of the most serious constraints on eco-innovation because the process of developing, testing and implementing new technologies is capital-intensive, lengthy and associated with a high risk of failure. Eco-innovations – especially these of technological nature – require intensive laboratory work, investing in prototypes, environmental testing and pilot phases. This implies that the initial costs quite frequently exceed the financial capacity of many enterprises, especially small and medium-sized ones that do not have their own R&D resources.

At the same time, companies face limited access to external sources of financing or to equity financing. Banks perceive eco-innovative projects as risky, because these relate to new technologies untested so far in the market and frequently with an uncertain rate of return. This further hinders the acquisition of the capital necessary to start or continue R&D activities, thereby deepening the so-called innovation financing gap.

Furthermore, insufficiently developed infrastructure supporting the commercialization of R&D results constitutes another constraint and encompasses, among others, technology transfer centres, specialised laboratories, green technology incubators and specialised advisory institutions. Without access to such resources, enterprises cannot successfully apply research findings in economic practice, which weakens the dynamics of eco-innovation development at the national level.

The above analyses confirm therefore the research hypothesis formulated in the article which assumes that Poland's position in the Eco-IS Index and the

degree to which the country diverges from the EU average is largely determined by insufficient government spending on R&D as well as on research and development in the fields of environment and energy. Poland, similarly to other countries with low public expenditure on R&D as a percentage of GDP, should strive to increase investment in R&D – both public and private – because inadequate government funding for R&D is widely documented as constraining innovation (Hägglmark, Elofsson, 2022, pp. 6–8).

CONCLUDING REMARKS

The results of the conducted analysis indicate that in almost all five themes (eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency outcomes, socio-economic outcomes) it is necessary to intensify efforts to improve Poland's score in the eco-innovation ranking. In 2014, countries with a high eco-innovation performance score demonstrated moderate growth and maintained their position in the ranking. At the same time, countries starting from a lower baseline have the potential for rapid growth, provided that the technological gap is bridged. Poland has improved its level of eco-innovation, however the pace of this process is insufficient to reach the EU-27 average. The growing distance between Poland and the EU confirms Poland's persistent structural lag in the field of eco-innovation.

An improvement in Poland's eco-innovation performance score requires intensified efforts supporting environmental innovations, increased expenditure on research and development and a more effective use of EU policy instruments. Financial support remains the key determinant of successful eco-innovation, which emphasises the need to introduce systemic changes to public policy. Sustained efforts, a well-developed R&D infrastructure and the formation of human capital and strategic frameworks are necessary for the available funding to translate into real growth in eco-innovation.

Grants, financial instruments, cooperation networks, inter-entity collaboration as well as successful and efficient policy for socio-economic development based on rational and responsible financial management may also constitute an important factor. Finally, the development of eco-innovation should not be constrained by excessive regulatory burdens such as complex administrative procedures, lengthy permit approval processes, legal instability or high costs associated with regulatory compliance. Rather than encouraging the adoption of environmentally friendly technologies, regulations most frequently complicate investment processes and lower enterprises' readiness to take risks associated with innovations. The presented results and the conclusions drawn from the research and statistical data analyses provide relevant and up-to-date knowledge that may

be useful particularly for decision makers responsible for formulating Poland's national environmental policy as well as defining the opportunities and directions for the country's continued socio-economic development. Therefore, the findings provide justification for further research and analyses of this kind primarily for the purpose of their verification and updating.

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Dr hab. Maria Miczyńska-Kowalska, prof. UP¹ 

University of Life Sciences in Lublin

Development of pro-ecological energy in Poland

Abstract

Poland is in the phase of adjusting its economy to the challenges of the energy and climate transition. The concept of the transition assumes a reduction in energy production from sources emitting greenhouse gases, including CO₂. The energy sector is the main sector included in the concept of the European Green Deal. In the EU, a 30% share of energy produced from RES by 2030 is assumed. For Poland, this means very significant obligations in the process of reducing energy production from high-emission conventional sources. This will mean accelerating the development of production from ecological sources, including wind farms, photovoltaic farms, and the generation of energy from biogas and biomass. It will be necessary to launch energy production from nuclear power.

In view of the above, the article refers to documents shaping Poland's energy policy, namely: *Energy Policy of Poland until 2040* and *National Development Concept 2050*. The aim of the article is to present the development of pro-ecological energy in Poland, its adaptation to the requirements of sustainable development: to present trends in Polish energy in the years 2020–2025, and to present the development trends of energy generation and distribution in Poland until 2040. The following research questions were posed in this study:

1. Which renewable energy sources are used in Poland?
2. Does the implementation of pro-environmental energy policy threaten energy security?
3. How does electricity prosumption contribute to the pro-environmental development of the Polish energy sector?

After conducting the analysis, the answers to these research questions are as follows:

1. In the analysed period 2020–2025, both ecological energy sources based on biomass, biogas, and gravitational systems, as well as solar and wind energy, are utilized. Photovoltaic energy is developing the most dynamically. Other sources have relatively low installed capacity. A decline in production and installed capacity in coal-fired power plants is also observed.
2. During 2020–2025, the fastest growth occurs in photovoltaic installations. These installations are highly dependent on weather conditions, time of day, and season, and they possess very high installed capacity. The nature of their operation causes significant energy surpluses or shortages in the power system within very short periods. This entails substantial risks in maintaining proper energy quality parameters. In extreme cases, it could lead to a blackout, representing a serious threat to Poland's energy security.

¹ Correspondence address: Uniwersytet Przyrodniczy w Lublinie, Katedra Roślin Przemysłowych i Leczniczych, Zakład Socjologii Wsi, 20-950 Lublin, ul. Akademicka 15; e-mail: maria.miczynska@up.lublin.pl. ORCID: 0000-0003-0013-6349.

3. Prosumer energy generation in Poland, as a phenomenon, clearly supports the development of pro-environmental energy. However, its implementation faces challenges. Poland is experiencing an uncontrolled increase in the number of PV installations, while other renewable energy sources are developing relatively slowly. The construction of wind farms – which should be regarded as far less weather-dependent than solar installations – has been practically blocked by legislation. Biomass and biogas sources are also not widely adopted, even though they are completely independent of weather conditions.

The article uses the analytical-synthetic method. Available data concerning both the theoretical dimension and the practice of functioning of the energy system in Poland were analysed.

It was found that Polish energy faces many challenges and problems to be solved. The undertaken actions, although costly, are necessary to achieve the goal of living in a pollution-free environment, without the effects of global warming, in a state that eliminates the risk of 'energy poverty.'

Keywords: energy development, RES, prosumption, sustainable development, decarbonisation.

Rozwój proekologicznej energetyki w Polsce

Abstrakt

Polska znajduje się w fazie dostosowywania gospodarki do wyzwań transformacji energetycznej i klimatycznej. Koncepcja transformacji zakłada ograniczenie produkcji energii ze źródeł emitujących gazy cieplarniane, w tym CO₂. Sektor energetyczny jest głównym sektorem znajdującym się w koncepcji Europejskiego Zielonego Ładu. W UE do 2030 r. założono osiągnięcie 30-procentowego udziału energii produkowanej z OZE. W sytuacji Polski oznacza to bardzo duże zobowiązania w procesie ograniczania produkcji energii z wysoko emisyjnych źródeł konwencjonalnych. Będzie to oznaczało przyspieszenie rozwoju produkcji ze źródeł ekologicznych, w tym: farm wiatrowych, fotowoltaicznych i wytwarzania energii z biogazu oraz biomasy. Niezbędne będzie uruchomienie produkcji z energii jądrowej.

Wobec powyższego w artykule przywołano dokumenty kształtujące politykę energetyczną Polski, tj.: *Politykę Energetyczną Polski do 2040* i *Koncepcję Rozwoju Kraju 2050*. Celem artykułu jest ukazanie rozwoju proekologicznej energetyki w Polsce, dostosowywanie jej do wymogów zrównoważonego rozwoju: przedstawienie tendencji w energetyce polskiej w latach 2020–2025 oraz prezentacja trendów rozwoju wytwarzania i dystrybucji energii w Polsce do 2040 r. W opracowaniu postawiono następujące pytania badawcze:

1. Które odnawialne źródła energii znajdują zastosowanie w Polsce?
2. Czy wdrażanie proekologicznej polityki nie zagraża bezpieczeństwu energetycznemu?
3. W jaki sposób prosumpcja energii elektrycznej wpisuje się w proekologiczny rozwój energetyczny polskiej?

Po przeprowadzonej analizie odpowiedzi na pytania badawcze są następujące:

1. W badanym okresie 2020–2025 wykorzystywane są zarówno źródła ekologiczne wytwarzające z biomasy, biogazu, grawitacyjne, jak i ze słońca i z wiatru. Najbardziej dynamicznie rozwija się energetyka z fotowoltaiki. Pozostałe źródła mają stosunkowo niewielką moc zainstalowaną. Obserwuje się też spadek produkcji i mocy zainstalowanej w elektrowniach węglowych.
2. W badanym okresie 2020–2025 najbardziej dynamicznie rozwija się wytwarzanie energii w instalacjach fotowoltaicznych. Są one najbardziej zależne od warunków pogodowych, pory dnia i pory roku i mają bardzo dużą moc zainstalowaną. Charakter ich pracy powoduje bardzo dużą nadprodukcję lub niedobór energii w systemie energetycznym w bardzo krótkim czasie. Niesie to ze sobą duże ryzyko nieutrzymania właściwych parametrów jakościowych energii. W skraj-

nym przypadku może prowadzić do blackoutu. Jest to poważne zagrożenie dla bezpieczeństwa energetycznego Polski.

3. Prosumpcja w Polsce jako zjawisko wpisuje się w rozwój proekologicznej energetyki oczywiście pozytywnie. Gorzej z wykonaniem. W Polsce mamy do czynienia z niekontrolowanym przyrostem ilości instalacji PV, pozostałe OZE rozwijają się stosunkowo wolno. Ustawowo niemalże zablokowano budowę farm wiatrowych, które należy traktować jako dużo bardziej niezależne od pogody niż instalacje solarne. Biomasa i biogaz są również mało popularne, a są całkowicie niezależne od pogody.

W artykule posłużono się metodą analityczno-syntetyczną. Przeanalizowano dostępne dane dotyczące zarówno wymiaru teoretycznego, jak i praktyki funkcjonowania systemu energetycznego w Polsce.

Stwierdzono, że przed polską energetyką stoi wiele wyzwań i problemów do rozwiązania. Podejmowane działania, mimo że są kosztowne, są niezbędne dla osiągnięcia celu, jakim jest życie w środowisku wolnym od zanieczyszczeń, bez efektów globalnego ocieplenia, w stanie wykluczającym ryzyko „ubóstwa energetycznego”.

Słowa kluczowe: ekologiczne źródła energii, proekologiczny rozwój energetyki, OZE, prosumpcja, dekarbonizacja.

JEL: O33, O36, M21, L7.

INTRODUCTION

Poland is in the phase of adjusting its economy to the challenges of the energy and climate transition. The concept of the transition assumes a reduction in energy production from sources emitting greenhouse gases, including CO₂. The energy sector is the main sector included in the concept of the *European Green Deal* (Europejski Zielony Ład, [http](http://)). Since 2005, Polish energy policy has been shaped by EU energy policy. In the EU, a 30% share of energy produced from RES by 2030 is assumed. For Poland, this means very significant obligations in the process of reducing energy production from high-emission conventional sources. This will mean accelerating the development of production from ecological sources, including wind farms, photovoltaic farms, and the generation of energy from biogas and biomass. This direction can be described as the development of pro-ecological energy. It will be necessary to launch energy production from nuclear power. Until the completion of the process of achieving zero emissions, demand for electricity will be met on the basis of conventional energy sources – lignite and hard coal. Of course, these sources will gradually be phased out. An expansion of the energy system with RES sources is planned, as well as the construction of a nuclear power plant. At the same time, a programme for the development of prosumption on the energy market is developing. This brings significant challenges for the energy distribution system in terms of maintaining proper energy parameters. At present, the professional energy sector is struggling with the problem of excess electricity during periods of high solar radiation,

related to production from photovoltaic installations, or excess energy resulting from production by wind farms.

The issue of making production sources more ecological should therefore be considered in a multidimensional way through the prism of:

- a) protection of the environment against greenhouse gas emissions, including CO₂;
- b) conservation of natural resources;
- c) stability of the energy distribution system (the National Power System, hereinafter referred to as NPS).

This widely known action plan stems from the adopted Polish Energy Policy until 2040 (Polityka Energetyczna Polski do 2040, [http](#)) and the National Development Concept 2050 (Konceptcja Rozwoju Kraju 2050, [http](#)). These documents are based on the European Green Deal (Europejski Zielony Ład, [http](#)).

The aim of the article is to present the development of pro-ecological energy in Poland, its adaptation to the requirements of sustainable development: to present trends in Polish energy in the years 2020–2025, and to present the development trends of energy generation and distribution in Poland until 2040.

The article uses the analytical-synthetic method. Available data concerning both the theoretical dimension and the practice of functioning of the energy system in Poland were analysed.

RESEARCH METHODOLOGY

The article concerns the development of pro-ecological energy production in Poland. It highlights the need to adapt the national energy sector to the requirements of European Union legislation. The directions of change are presented on the basis of documents that define the development path of the Polish energy sector. These include, above all, the Energy Policy of Poland until 2040 (Polityka Energetyczna Polski do 2040, [http](#)) and the National Development Concept 2050 (Konceptcja Rozwoju Kraju 2050, [http](#)).

The structure of the paper includes:

1. Research methodology.
2. The need for development of pro-ecological energy.
3. Ecological energy sources in Poland.
4. Energy policy vs. energy security of Poland.
5. Prosumer energy.
6. Legal conditions for the development of Polish energy industry.
7. Energy transformation in Poland in 2020–2025 – identification of challenges and risks.
8. Conclusions.

The article presents Poland's energy policy in the context of the challenges posed by the European Union and analyses data illustrating the actual condition of the Polish energy sector in the years 2020–2025. The data come from the Energy Market Agency. This timeframe is justified by the fact that the most significant development of photovoltaic installations has been observed since 2020. The data concern the installed capacity in individual energy sources and its changes over the examined period, as well as the amount of energy fed into the grid by prosumers (surplus production exceeding their own needs).

The data show:

1. Electricity production in the winter and summer seasons in the years 2020–2025 by energy source.
2. The installed electrical capacity in particular energy sources used in Poland. The data indicate a trend of increasing production from RES and decreasing production from conventional sources.
3. The growth of prosumer activity in 2020–2025, broken down by generation source. Prosumer activity is determined by installed capacity. The highest share of installed capacity is recorded for photovoltaics, while other sources have marginal shares.
4. The increase in the volume of energy fed into the grid by prosumers in 2020–2025. A very high surplus production exceeding prosumers' own needs has been identified.

The article demonstrates that there is a systematic decline in energy production from hard coal and lignite; the share of production from natural gas, biogas, biomass, and wind power plants is increasing. However, the most significant impact on the stability (security) of the energy system comes from the rapid growth of photovoltaic production. Accordingly, the changes in installed capacity for individual energy sources are presented. A significant disproportion in photovoltaic production relative to other RES sources used by prosumers is also shown.

The analysis includes data for January, representing the winter period, and June, representing the summer period. There is therefore no need to present data for other months, as the trends and values remain similar.

The article poses the following research questions:

1. Which renewable energy sources are used in Poland?
2. Does the implementation of pro-ecological energy policy threaten energy security?
3. How does electricity prosumption fit into Poland's pro-ecological energy development?

In the context of these research questions, there is also a need to identify risks associated with the use of ecological energy sources.

THE NEED FOR DEVELOPMENT OF PRO-ECOLOGICAL ENERGY

There are many indications that we are dealing with an anthropogenic climate change. The burning of fossil fuels – coal, natural gas, and crude oil – for the purpose of generating electricity contributes to the release of greenhouse gases into the atmosphere, resulting in the so-called greenhouse effect. Climate warming should be considered not only in terms of the increase in average air temperature, but also the frequency and structure of precipitation, storms, droughts, and other consequences having a negative impact on the natural environment.

Excessive production of greenhouse gases began to intensify with the era of the industrial society, already in the 18th century. The intensification of this process, however, took place in the 20th century. In socio-economic development, in the existing model of socio-economic development, humanity maximised the importance of the economy, including the size of the Gross Domestic Product,² disregarding its negative impact on the environment. Most streams of economics treated the natural environment in a superficial way. For example, W. Petty in the 17th century already took into account two factors of economic development – labour and land; A. Smith – labour, land, and capital. He treated natural resources as a barrier to economic development. Another economist, T. Malthus, emphasised the limitation of natural resources. A. Marshall (19th/20th century), on the other hand, drawing attention to the scarcity of natural resources, created the concept of external effects – external costs and benefits (Czuma, Jarosz, 1998, pp. 43, 50, 79). Within this concept – global external costs – contemporary climate changes are now included.

Until quite recently, the model of socio-economic development was highly intensive in terms of natural resources. The basis of state development was non-renewable fossil resources: crude oil, lignite and hard coal, and natural gas, causing excessive emission of greenhouse gases. In the existing model, it was assumed that the degradation of the natural environment was a normal phenomenon in the initial phase of socio-economic development. After reaching the turning point, that is, a high level of income, the second phase of development was to bring an improvement of the natural environment.

The economic crisis in the mid-20th century, having causes in the environment, contributed to the interest of social sciences, including economics, in the issues of the natural environment. The first mention of the depletion of the Earth's energy resources appeared in the First Report to the Club of Rome – *The Limits to Growth*. Environmental economics emerged, followed by ecological economics, which criticised the former. The greatest achievement of ecological economics is the paradigm of socio-economic development, referred to as sustainable development.

² Based on: 2022-ZMKL-02-Tekst 13..29 (<https://publikacje.pan.pl/Content/126593/PDF/2022-ZMKL-03.pdf>).

It was formulated in 1987 in the Report of the United Nations World Commission on Environment and Development – Our Common Future. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is associated with the integration of political, economic, and social activities while maintaining natural balance. The definition of sustainable development was given by the World Commission on Environment and Development. Sustainable development is “that which meets the needs of the present without jeopardising the ability of future generations to meet their own needs” (Brundtland, 1987, p. 11).

ECOLOGICAL ENERGY SOURCES IN POLAND

The impact of climate on the energy transition should be considered through the prism of the technology used for energy generation. It can be divided into 3 methods of energy production (Zacharski, Chędożko, 2021, p. 275):

- conventional energy,
- energy based on RES,
- nuclear energy.

The conventional sources with the largest share in electricity production include coal-fired power plants fueled by hard coal and lignite, as well as gas-fired power plants. The disadvantage of these power plants is their reliance on fossil fuels. In the case of wind power plants, a significant problem is the high emission of greenhouse gases. Renewable energy generation is based mainly on wind farms and photovoltaic installations; their major drawback is the strong dependence on weather conditions and seasonal variation, which is particularly evident in photovoltaics. Other renewable power plants include biogas and biomass facilities (Mohammad, Bolton, Wong, Pandey, 2019). Their advantage lies in independence from weather conditions and the ability to utilize waste. Nuclear power plants are perceived as stable and safe. In the Polish context, they are expected to replace coal-fired power plants (Jelley, 2022).

Poland is largely dependent on conventional energy sources. An increasing share of RES in the energy mix is observed, but production is dominated by sources highly dependent on weather conditions. Nuclear energy, considered ecological, is unfortunately still in the preparatory phase for construction. The development of RES production independent of weather influence is, however, costly and currently marginal both in terms of installed capacity and its share in total production.

The development of energy in Poland is based on 3 pillars (Jabłoński, 2023, pp. 17–18):

1. Security of the energy system, related to the continuity of energy supply and optimal system operation.

2. Economic operation of the system, related to the acceptance of energy prices by its users.
3. Sustainable development of the natural environment.

The task of the pro-ecological development of the energy system in Poland is to combine the indicated priorities in practice. However, at this stage, the implementation of points 1 and 2 is at risk. For point 1, due to the dynamic development of energy sources dependent on weather conditions, which in extreme cases can negatively affect the stability of the NPS. For point 2, due to negative energy prices in the event of excess energy in the grid.

Currently, electricity constitutes one of the fundamental factors in the functioning of societies. A continuous increase in demand is observed along with socio-economic and technological development. The 20th century is the period in which the demand for energy particularly increased. This trend continues into the 21st century. Data from the International Energy Agency clearly show an increasing demand for electricity. Thus, given the necessity to implement ecological policies, the need to use renewable energy sources grows.

The direction of the energy transition is determined by:

- a) the process of implementing the European electricity market;
- b) the process of changing the structure of sources generating electricity, and
 1. actions of the European Commission aimed at the efficient and safe functioning of interconnected power systems in Europe, systems based on generation sources using clean technologies and supporting the decarbonisation of the European economy (Myślecki, 2018).

In the context of EU goals, the Ministry of Economy document “Energy Policy of Poland until 2040” assumes that part of the demand for electricity will be met by renewable energy sources, which are sources using wind, solar, marine (wave) energy, biomass, gas, geothermal energy, and biogas in the conversion process (Sobierajski, 2017, p. 11). The European Commission has also published two Action Plans regarding the challenges facing the EU in relation to long-term reductions in greenhouse gas (GHG) emissions. These plans, in a perspective up to 2050, assume a reduction of GHG emissions to nearly 0. Therefore, an energy policy focused on decarbonisation becomes necessary (Sobik, 2023, p. 12) and intensification of the use of ecological energy sources.

ENERGY POLICY VS. ENERGY SECURITY OF POLAND

The aim of energy management in Poland is to ensure the continuity of energy supply and to minimise energy costs on a national scale. Energy policy constitutes a part of the state’s economic policy. Its main tasks are:

- a) energy security;

- b) protection of the natural environment;
- c) sustainable development;
- d) development of modern technology;
- e) reduction of energy consumption.

Energy policy should integrate the implementation of security and development (Sobik, 2023, pp. 34–35). Policy is a set of coherent, precise, and legally compliant regulations, rules, and procedures through which the state influences energy management: acquisition, processing, management, and access to energy resources. The objective of energy policy is to ensure energy security (Sobik, 2023, pp. 35–26). Energy security, in turn, encompasses:

- energy,
- economic growth, and
- political authority.

New problems and challenges facing the energy sector contribute to considering energy security not only in geopolitical terms but also from the perspective of ensuring oil supply. Currently, energy security is approached in terms of a global strategy, taking into account challenges and threats both from the past and those that may arise in the future. A strategy constitutes a supreme, long-term plan concerning primarily energy enterprises (Gryz, Podraza, Ruszel, 2018, pp. 49–63).

In connection with the above, Polish energy faces the challenge of adapting to EU requirements. The main problems are (Szczerbowski, 2013, p. 207):

- a) technological adaptation of electricity generation and heating systems with regard to emission levels;
- b) dependence of electricity generation and heating on coal;
- c) poor technical condition of energy generation and heating sources and networks;
- d) limited use of RES;
- e) lack of nuclear energy;
- f) low energy efficiency in the use of energy, generation sources, and electricity networks.

Therefore, in the context of Poland's situation, three scenarios for building Poland's energy security can be indicated:

- a) basing energy security on hard coal and lignite;
- b) subordinating the energy sources used to overarching criteria related to the protection of the natural environment;
- c) treating all energy sources equally (Bożyk, 2013, p. 32).

Taking into account EU energy and ecological policy, as well as the "Development Strategy for Poland until 2025" and "Energy Policy of Poland until 2040," the implementation of the second scenario is determined.

In the context of implementing the second development scenario, ecological energy sources can be divided into two categories:

1. Independent of the season and weather conditions – sources generating energy from biogas, biomass, and gravitational systems.
2. Dependent on the season and weather conditions – sources generating energy from wind and solar power, such as wind farms and photovoltaic installations.

The first category has a positive impact on the stability (security) of the energy system, as these sources are predictable and easy to control. The second category, however, poses a threat to the stability (security) of the energy system due to the unpredictability of weather conditions. This results from sudden increases and decreases in production within short time intervals (power deficits and surpluses in the system) (Marszałek, 2018).

PROSUMER ENERGY

Due to the increasing energy needs of the state and the necessity of ensuring energy security, Poland continues to seek innovative solutions in the energy sector. One of the concepts that has gained very substantial financial and legislative support in recent years is prosumer energy, in which the client is both producer and consumer. There is a transition from being an energy consumer to being an energy prosumer (Bożyk, 2013, p. 155). Three segments of prosumer energy can be distinguished (Całus, Flaszka, Szczepański, Michalski, Luft, 2016, p. 124):

- a) homeowners, farms, housing communities;
- b) local governments, cooperatives;
- c) entrepreneurs, railway infrastructure (PKP).

The development of the prosumer model is currently preferred by the European Commission (Godlewska-Majkowska, Wachowiak, Strojny, Majewski, 2020, p. 143).

Unfortunately, the construction of prosumer installations based on energy sources highly dependent on weather on the scale seen in Poland poses a threat to the stability of the NPS. Poland's situation, for example German where the prosumer model works well, differs due to the lack of nuclear or other ecological energy independent of weather conditions. The regulation of production in a nuclear power plant is fluid and very easy. When weather conditions allow high RES production, nuclear output is reduced. In Poland, this is not so easy due to the characteristics of coal-fired power plants, which are difficult to regulate. Therefore, the rapid implementation of a nuclear power plant programme in Poland should be pursued. The second direction for building energy stability is energy storage (Rifkin, 2012). Of course, due to technological limitations, the construction of galvanic storage is not feasible here. The focus should be on gravity-based storage and, above all, on using surplus produced energy to generate the most environmentally friendly fuel, hydrogen.

The European electricity market stabilizes the situation in transmission networks. National Power Systems are interconnected, and in the event of excess energy in Poland's system, energy can be transmitted to neighboring country, which purchases it at an attractive price and simultaneously reduces its nuclear production. Of course, this mechanism also works in the opposite direction, i.e., in the event of an energy shortage in the system, energy can be acquired from abroad (Koszarek-Cyra, 2017).

Prosumer energy generation has both advantages and disadvantages. Its main advantage is its positive impact on the environment. In addition, it provides financial savings for prosumers who consume the energy they generate or have the possibility to "store" the surplus energy in the power grid. However, an excessive number of prosumer installations feeding surplus production into the grid becomes a disadvantage, as it significantly reduces the profitability of prosumer systems (negative electricity prices). From the perspective of the professional energy sector, excessive surplus production from weather-dependent energy sources destabilises the power system.

LEGAL CONDITIONS FOR THE DEVELOPMENT OF THE POLISH ENERGY INDUSTRY

The process of Poland's energy transformation is governed by a series of acts and regulations. These are supplemented and amended as needed. They are executive and regulatory documents. Long-term assumptions, however, have been set out in two main documents: *Energy Policy of Poland until 2040* and *National Development Concept 2050*.

The document entitled *National Development Concept 2050* assumes "the development of ecological energy sources, energy storage, nuclear energy, and the production and utilisation of hydrogen." The document recommends the introduction of a series of "legislative solutions as well as investments in the generation, storage, and utilisation of alternative energy sources" (Koncepcja Rozwoju Kraju 2050, [http](#)). The aim of the document is to outline a direction allowing for increased energy efficiency and achieving a "state close to zero emissions" by 2050. In recent years, Poland has made extensive use of ecological solutions for generation of electricity. Solutions allowing electricity generation from the sun, wind, and biomass (biogas) have been widely introduced in Poland. "The pursuit of ensuring energy security has resulted in legislative and investment solutions that support the generation, storage, and utilisation of energy from alternative sources, such as RES" (Koncepcja Rozwoju Kraju 2050, [http](#)). Recently, the development of so-called citizen energy has also been observed. "A particular role will be played by the creation of local structures, focusing on cooperation and the mutual satisfaction of energy needs, e.g., energy cooperatives

or other forms of social economy” (Koncepcja Rozwoju Kraju 2050, [http](#)). These assumptions align with the concept of prosumer energy, which aims to generate energy for personal needs and feed surpluses into the NPS. However, the assumptions of the National Development Concept 2050 go further towards maintaining a stable level of energy production. Within the scope of the National Development Concept 2050 and Energy Policy of Poland until 2040, “possible directions of energy transformation are considered, focusing on the opportunities and risks associated with the proposed solutions to the coal gap problem. (...) The coal gap will vary over time, depending on the decommissioning of successive coal units, so it is better to act preventively and faster than international/EU obligations require” (Raport Transformacja Energetyczna w Polsce, [http](#)).

The document *Energy Policy of Poland until 2040* (PEP2040) “defines the framework for the energy transformation in Poland. It contains strategic assumptions regarding the selection of technologies serving the construction of a low-emission energy system. PEP2040 contributes to the implementation of the Paris Agreement, concluded in December 2015 during the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21), taking into account the need to carry out the transformation in a just and equitable manner. (...) The policy considers the scale of challenges related to adapting the national economy to EU regulatory conditions associated with the climate and energy targets for 2030, the European Green Deal, the economic recovery plan after the COVID pandemic, and the pursuit of climate neutrality according to national capabilities, as a contribution to the implementation of the Paris Agreement” (Polityka Energetyczna Polski do 2040, [http](#)). Of course, such ambitious goals carry risks for the NPS in terms of maintaining proper electricity parameters. Currently, in addition to the risk of electricity shortages or surpluses in the system, attention must be paid to the geopolitical situation and potential shortages of non-renewable resources. It is necessary to fully agree with the conclusion drawn in the PETiREE study stating that “One of the most important challenges faced by the Polish economy and administration in 2024 was ensuring and maintaining the country’s energy security under variable geopolitical conditions. Therefore, the harmonious cooperation of all entities involved in the energy transformation is essential to achieving the EU goal of climate neutrality by 2050” (Energetyka, Dystrybucja, Przesył PTPiREE 35 lat, [http](#)). It is important to emphasise the risk associated with the stability of the NPS in the context of the rapid development of energy from relatively cheap sources dependent on weather conditions.

It is worth emphasising the limited use of sources based on ecological products, such as biogas and biomass, as well as the low growth dynamics in energy production from gravity-based sources (hydropower plants). Concern is also raised by the distant perspective of building nuclear energy.

ENERGY TRANSFORMATION IN POLAND IN 2020–2025 – IDENTIFICATION OF CHALLENGES AND RISKS

After outlining the directions of development recorded in the documents *Energy Policy of Poland until 2040* and *National Development Concept 2050*, to fully illustrate the situation in which Poland finds itself in 2025 and the chances of achieving the assumptions, it is necessary to examine the actual state. For this purpose, publicly available reports from the Energy Market Agency for the years 2020–2025 can be used. The main parameters illustrating the situation and development trends are: the value of energy production, installed capacity, the increase in installed capacity by prosumers, and the value of capacity introduced into the grid by prosumers.

The analysis was conducted with a division by energy generation sources. The analysis of energy production volumes was based on the production values from renewable and non-renewable energy sources in summer and winter periods. Data are provided for January, which is representative of the winter period, and for June, which is representative of the summer period. There is no need to show other months as the trends and values are similar.

The data refer to January, which is representative of the winter period, and June, which is representative of the summer period. There is no need to present data for the remaining months, as the trends and values are similar.

Energy production in the winter period is illustrated in Figure 1.

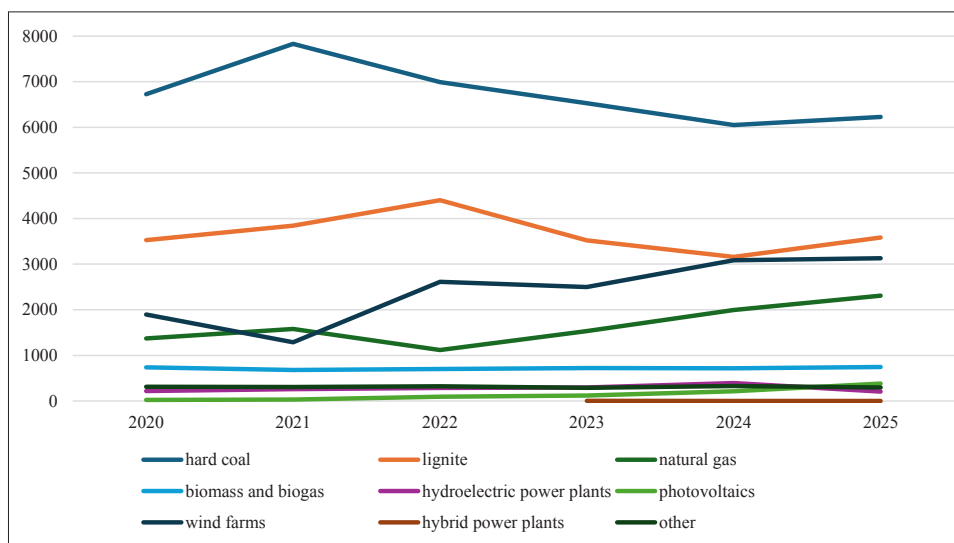


Figure 1. Electricity production in the winter period [GWh] (January)

Source: own elaboration based on (Agencja Rynku Energii / Energy Market Agency, [http](http://)).

Energy production in the summer period is illustrated in Figure 2.

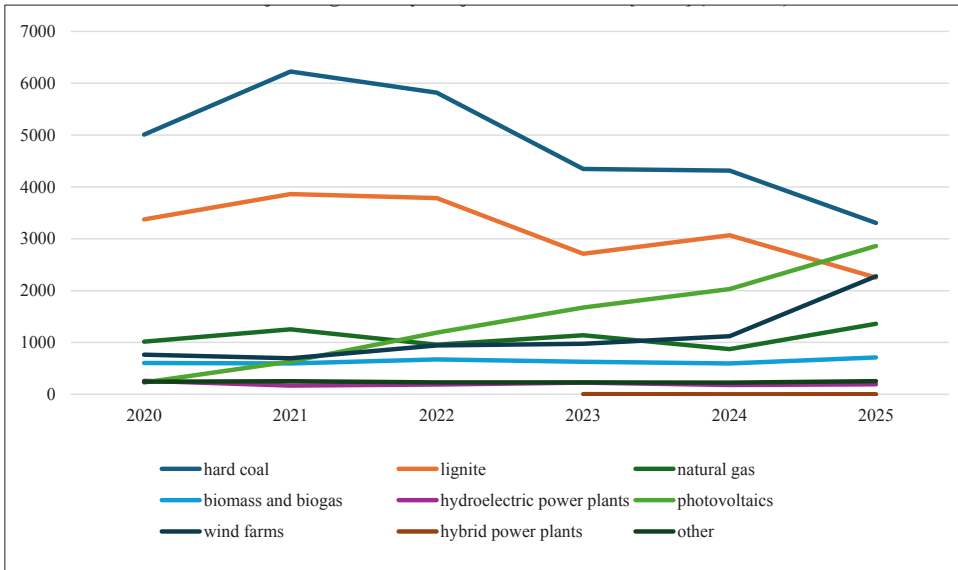


Figure 2. Electricity production in the summer period [GWh] (June)

Source: own elaboration based on (Agencja Rynku Energii / Energy Market Agency, [http](http://)).

Analysing the trends in the graphs for both winter and summer periods, a decline in energy production from hard coal is visible from 2021. In the case of lignite, the decline begins in 2022.

It was also noted that from 2022 there has been a systematic increase in energy production from natural gas, which, although not classified as a renewable fuel, is recognised as an ecological source. In the case of this source, it should also be noted that it is independent of weather conditions and easily adjustable. Production from biogas and biomass, as well as from hydroelectric power plants and sources classified as “other,” remains at a constant level without a clear upward trend. These sources are classified as Renewable Energy Sources. At the same time, they are easy to regulate and independent of weather conditions.

During the period under study, a high growth dynamic in production from wind power plants is also evident. This trend is visible in the winter period. Particular attention is drawn to the very high growth dynamics in the summer period from photovoltaic installations. These sources are dependent on weather conditions and, in extreme cases, may cause an energy surplus in the NPS. From 2023, a new category of sources defined as hybrid appears. These should be understood as consisting of more than one generation, with the generations based on different energy sources, e.g., solar and wind, or biogas and biomass, or all three.

Analysing the installed capacity of energy sources, illustrated in Figure 3, a clear trend can be seen towards the development of relatively inexpensive sources generating energy from the sun.

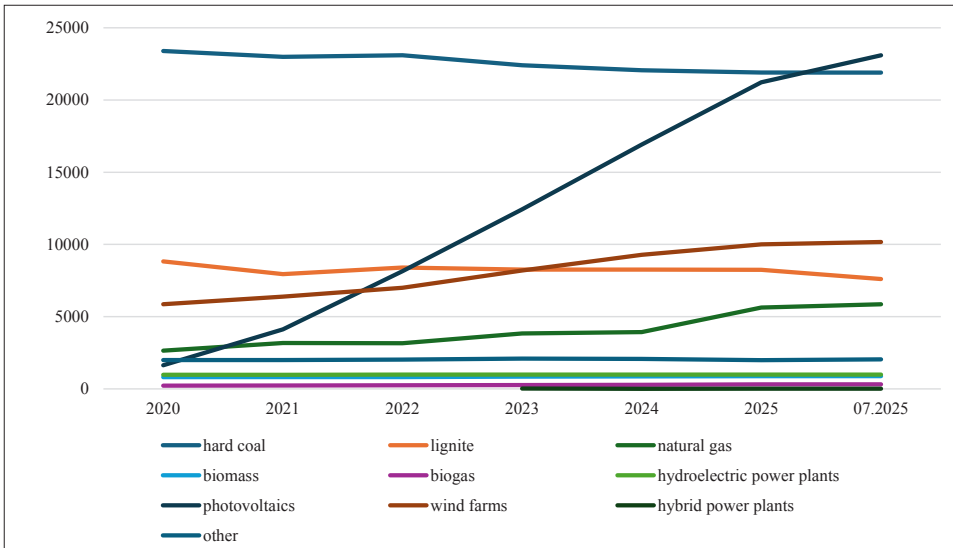


Figure 3. Installed electric capacity [MW]

Source: own elaboration based on (Agencja Rynku Energii / Energy Market Agency, [http](http://)).

In 2025, the installed capacity of photovoltaics exceeded the installed capacity of coal-fired power plants and is currently dominant. A steady upward trend is also visible in the installed capacity of wind power plants and power plants generating energy from natural gas.

Other renewable energy sources (RES) are not developing as dynamically. Unfortunately, this constitutes a significant risk factor for maintaining the stability of the NPS due to the strong dependence of energy generation sources on weather conditions. However, the dominant RES source is photovoltaic installations due to their relatively low cost. The reason for this phenomenon is the enormous development of prosumer installations. The scale of the phenomenon is evidenced by the installed capacity of photovoltaic installations and the huge disparity in comparison with other RES generation sources. The data are shown in Table 1.

Table 1. Prosumer energy installed capacity [MW]

	01/2022	01/2023	01/2024	01/2025	07/2025
<i>I</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>
Hydro	1.23	1.04	1.04	0.73	0.72
Wind	0.68	0.32	0.37	0.44	0.55

1	2	3	4	5	6
Photovoltaic	6,113.27	9,019.21	10,749.22	12,101.56	12,661.96
Hybrid	0.6	1.04	0.15	0.32	1.01
Biogas	0.53	0.8	0.88	1.07	1.2
Biomass	0.14	0.36	0.41	0.03	0.03
Other			1.21	1.59	2.23

Source: own elaboration based on (Agencja Rynku Energii / Energy Market Agency, <http>).

The table illustrates the scale of the disparity.

This disparity is also visible when analysing the energy fed into the grid. The data are illustrated in Figure 4.

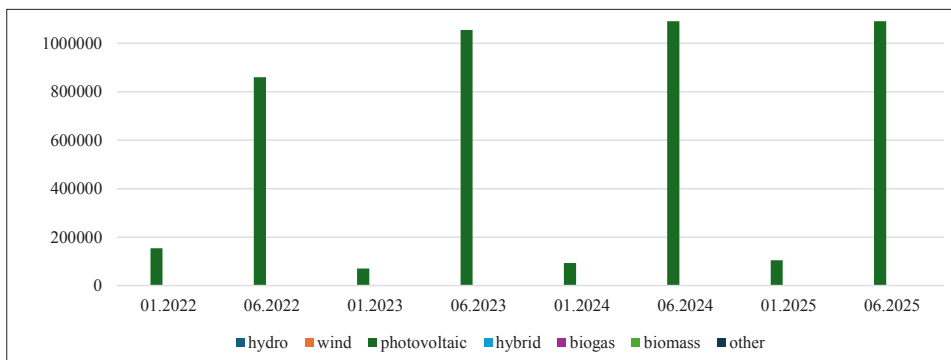


Figure 4. Prosumers – Energy fed into the grid [MW]

Source: own elaboration based on (Agencja Rynku Energii / Energy Market Agency, <http>).

To show the scale of disproportions, these data are reproduced in Table 2 because they are marginally small and not visible on the graph Figure 3. To illustrate the scale of the disproportions, these data are presented in Table 2, as they are very small and therefore not visible on the graph shown in Figure 3.

Table 2. Prosumers – Energy fed into the grid [MW]

	01.2022	06.2022	01.2023	06.2023	01.2024	06.2024	01.2025	06.2025
Hydro	162,5	138,8	165,1	146,8	148,9	152,1	135,5	100,5
Wind	6,2	22,3	2,6	30,1	17,2	30,3	4,6	25,6
Photovoltaic	153938,2	860407,1	69810,8	1055222	92636,5	1091750	104187,7	1091434
Hybrid	14,2	55,4	7,2	102,6	0,8	2,5	0,9	47,1
Biogas	43,6	65	93,8	113,2	115,2	119,3	147,1	162
Biomass	4,8	25	2,9	37,9	2,2	41	0	0
Other					22,8	98,9	12,9	226,9

Source: own elaboration based on (Agencja Rynku Energii / Energy Market Agency, <http>).

In this case, concern arises from the strong dependence of production on weather conditions and the season. With such a high installed capacity in photovoltaic installations, it is evident that prosumers feeding surplus energy into the grid during the summer period generate a risk of NPS destabilisation. The graph also shows the scale of solar prosumption compared to other renewable energy sources.

CONCLUSIONS

One of the fundamental economic objectives facing Poland is energy transformation. The most important actions fall within the framework of decarbonisation, including the development of RES and the increase of energy security. The measures taken by Poland have a long-term scope. The goals set for the Polish energy sector have been specified, among others, in the following documents: *Energy Policy of Poland until 2040* and *National Development Concept 2050*. The outlined direction is consistent with the concept of sustainable development. Considering the need to reduce greenhouse gas emissions, the broadly understood assumptions of ecological policy, and the limited availability of natural resources, this is the only proper direction. In recent years, there has been a dynamic development of ecological renewable energy sources in Poland. A decline in production from coal-based sources is also observed. This is a path towards achieving the country's decarbonisation. After conducting the analysis, the answers to the research questions are as follows:

1. In the analysed period 2020–2025, both ecological energy sources based on biomass, biogas, and gravitational systems, as well as solar and wind energy, are used. The fastest-growing sector is photovoltaic energy. Other sources have relatively low installed capacity. A decline in production and installed capacity in coal-fired power plants is also observed.
2. In the analysed period 2020–2025, the most dynamic growth is recorded in photovoltaic installations. These are the most dependent on weather conditions, time of day, and season of the year, and they also have very high installed capacity. The nature of their operation causes significant surpluses or shortages of energy in the power system within very short time intervals. This entails substantial risks in maintaining proper energy quality parameters. In extreme cases, it may lead to a blackout. This constitutes a serious threat to Poland's energy security.
3. Prosumer energy generation in Poland, as a phenomenon, clearly fits into the development of pro-environmental energy production. The problem lies in its implementation. Poland is experiencing an uncontrolled increase in the number of PV installations, while other RES sources are developing relatively slowly. The construction of wind farms – which should be treated as far less

weather-dependent than solar installations – has been practically blocked by legislation. Biomass and biogas sources are also not widely used, even though they are completely independent of weather conditions.

The following threats should also be noted:

- a) excessive growth dynamics of energy from sources dependent on the season and weather conditions, particularly photovoltaic installations;
- b) lack of easily regulatable energy sources that could quickly respond to surplus or deficit in the NPS, e.g., nuclear power plants;
- c) legislative barriers to the development of wind energy, which should be treated as more stable than photovoltaic installations;
- d) low share of hybrid RES solutions;
- e) lack of developed energy storage technology;
- f) too slow development of hydrogen-based energy;
- g) high energy prices,
- h) economic risks for producers and prosumers resulting from the Energy Market (negative energy prices). Of course, issues such as negative electricity prices and non-market production limitations are only briefly mentioned in this study, as these topics are very extensive and deserve a separate analysis;
- i) low share of biomass and biogas power plants in production due to high construction costs.

Thus, the Polish energy sector faces many challenges and problems to resolve. The undertaken actions, although costly, are necessary to achieve the goal of living in a pollution-free environment, without the effects of global warming, in a state that eliminates the risk of ‘energy poverty.’

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*Ing. Mgr. Petra Prošková*¹ 

Department of Economics
University of Economics, Prague (VŠE)

Impact of circadian rhythms on business efficiency and economic growth²

Abstract

Because circadian rhythms control key processes such as sleep, cognition and metabolism, their disturbance is now widely viewed as a significant factor reducing worker productivity and influencing economic performance. While biomedical research provides extensive evidence on the health consequences of circadian misalignment, its implications for labour efficiency, organizational outcomes, and public finances remain underexamined in economic literature. This review synthesizes findings from empirical studies published between 2011 and 2025 to assess how sleep disruption, shift work, and chronotype mismatch affect individual performance, workplace efficiency, and broader economic indicators. Results consistently show that circadian misalignment reduces cognitive functioning, increases error rates and absenteeism, and contributes to long-term health risks, including metabolic and cardiovascular disorders. These outcomes impose substantial costs on firms through productivity losses, higher turnover, and increased injury risk, while also generating financial burdens for public healthcare and social insurance systems. The review highlights several evidence-based strategies such as chronotype-aligned scheduling, predictable shift systems, improved lighting conditions, and sleep-hygiene interventions that can mitigate these negative effects. The study concludes by emphasising the economic relevance of integrating circadian science into workplace policies and human resource management practices.

Keywords: circadian rhythms, productivity, economic impacts, shift work, workplace efficiency, public finance.

¹ Correspondence address: University of Economics, Prague (VŠE), Department of Economics, W. Churchill Sq. 1938/4, 130 67 Prague 3, Czech Republic; e-mail: prop11@vse.cz. ORCID: 0009-0007-1429-4432.

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Wpływ rytmu dobowego na efektywność biznesową i wzrost gospodarczy

Abstrakt

Ponieważ rytmy dobowe regulują kluczowe procesy, takie jak sen, funkcje poznawcze i metabolizm, ich zaburzenie jest obecnie powszechnie postrzegane jako istotny czynnik obniżający produktywność pracowników i wpływający na wyniki gospodarcze. O ile badania biomedyczne dostarczają obszernych dowodów na zdrowotne konsekwencje rozregulowania rytmu dobowego, o tyle jego implikacje dla efektywności pracy, wyników organizacyjnych oraz finansów publicznych pozostają w literaturze ekonomicznej niedostatecznie zbadane. Niniejszy przegląd syntetyzuje wyniki badań empirycznych opublikowanych w latach 2011–2025, aby ocenić, w jaki sposób zaburzenia snu, praca zmianowa oraz niedopasowanie chronotypu wpływają na indywidualną wydajność, efektywność w miejscu pracy oraz szersze wskaźniki ekonomiczne. Wyniki jednoznacznie pokazują, że rozregulowanie rytmu dobowego obniża funkcjonowanie poznawcze, zwiększa liczbę błędów i absencję oraz przyczynia się do długoterminowych zagrożeń zdrowotnych, w tym zaburzeń metabolicznych i sercowo-naczyniowych. Skutki te generują znaczne koszty dla przedsiębiorstw w postaci strat produktywności, wyższej rotacji pracowników i zwiększonego ryzyka wypadków, a jednocześnie obciążają publiczne systemy ochrony zdrowia i ubezpieczeń społecznych. Przegląd wskazuje na kilka strategii opartych na dowodach empirycznych – takich jak planowanie pracy zgodne z chronotypem, przewidywalne systemy zmianowe, poprawa warunków oświetleniowych oraz interwencje z zakresu higieny snu – które mogą ograniczać te negatywne efekty. Badanie kończy się podkreśleniem ekonomicznego znaczenia integracji wiedzy o rytmach dobowych z politykami miejsca pracy oraz praktykami zarządzania zasobami ludzkimi.

Słowa kluczowe: rytmy cyrkadianowe, produktywność, skutki ekonomiczne, praca zmianowa, efektywność w miejscu pracy, finanse publiczne.

JEL: J24, M54, I12.

INTRODUCTION

Employee productivity is a central determinant of firm competitiveness and long-term economic growth. Traditional economic approaches highlight human capital, skills, motivation, and technological progress as key drivers of performance. In recent years, however, growing interdisciplinary evidence has shown that biological mechanisms particularly circadian rhythms play an equally important role in shaping daily fluctuations in cognitive abilities, alertness, decision-making, and overall work capacity. Circadian rhythms regulate the sleep-wake cycle, hormonal secretion, metabolism, and numerous physiological processes essential for maintaining stable cognitive and physical performance. When work schedules conflict with these natural biological patterns, individuals experience sleep deprivation, reduced alertness, impaired decision-making, and increased levels of fatigue and stress. At the organizational level, such misalignment leads to lower productivity per hour worked, greater error rates, higher accident risks, and increased employee turnover. At the macroeconomic level, chronic circadian

disruption contributes to rising healthcare expenditure, increased sickness benefits, and lower aggregate labour efficiency factors with measurable effects on public finances and economic growth. Despite robust biomedical evidence, the economic literature has only partially addressed how circadian misalignment affects firm-level and economy-wide outcomes. As modern labour markets increasingly rely on shift work, global time coordination, and flexible schedules, understanding the economic consequences of biological rhythms becomes essential for designing effective workplace policies and supporting sustainable human capital. The aim of this study is therefore to synthesise existing empirical findings on the relationship between circadian rhythms, worker performance, and economic outcomes. The review seeks to answer the following research question:

What are the economic implications of understanding, managing, and applying circadian rhythms in the workplace?

The contribution of the paper therefore lies in:

- a) integrating biomedical and economic evidence on circadian misalignment;
- b) identifying mechanisms through which biological rhythms influence productivity and organisational efficiency;
- c) outlining implications for firms, human resource management, and public policy.

METHODOLOGY

This study is based on a systematic literature review covering the period 2011–2025. Relevant publications were identified through four major academic databases PubMed, Web of Science, Scopus, and Google Scholar and were supplemented by expert monographs and reports from international organisations such as the OECD, ILO, and WHO. The initial search yielded 212 records, from which duplicates and studies lacking relevance were removed through title and abstract screening. Following this screening procedure, 30 studies met the final inclusion criteria, comprising 19 primary empirical studies and 11 systematic reviews or meta-analyses. Studies were included if they were written in English, reported a clearly defined research design, contained a minimum sample size of more than ten participants, and addressed circadian rhythms in relation to productivity, labour outcomes, or economic performance. Excluded were studies focusing exclusively on paediatric or clinical populations, publications without identifiable methodology, and studies that did not report measurable outcomes relevant to work performance, health, or economic indicators. The search was conducted using combinations of keywords such as “circadian rhythm,” “chronotype,” “shift work,” “sleep deprivation,” “productivity,” “economic performance,” “economic growth,” “absenteeism,” “daylight saving time,” and “sleep hygiene,” linked with Boolean operators (AND, OR) to capture a broad spectrum of interdisciplinary

evidence. For each included study, information was extracted regarding research location, methodology, sample size and characteristics, study objectives, and the primary variables examined. A narrative thematic synthesis was applied to integrate findings and identify recurring patterns across studies, with particular emphasis on the links between circadian misalignment, worker productivity, health-related outcomes, and economic implications. This methodological approach makes it possible to summarise heterogeneous evidence in a structured manner and provides a theoretical foundation for understanding the economic relevance of circadian rhythms in contemporary labour markets.

BIOLOGICAL BACKGROUND OF CIRCADIAN RHYTHMS

Circadian rhythms are endogenous biological cycles of approximately 24 hours that regulate essential physiological processes, including sleep-wake patterns, metabolism, hormonal secretion, and cognitive performance. These rhythms are governed by the suprachiasmatic nucleus in the hypothalamus, which functions as the body's central pacemaker and synchronises internal processes with external environmental cues, particularly light (Potter et al., 2016). Because these physiological mechanisms influence alertness, reaction time, decision-making, and energy levels, circadian rhythms represent a fundamental biological factor shaping employee productivity and organisational efficiency. Individual differences in the timing of circadian phases give rise to chronotypes, which determine a person's preferred and most productive hours of the day. Research commonly identifies three chronotype groups: morning types ("larks"), who typically reach peak cognitive performance shortly after waking; evening types ("owls"), whose performance improves later in the day; and intermediate types, who do not exhibit strong temporal preferences (Iannitelli, Biondi, 2020). Morning types generally show higher morning alertness associated with elevated cortisol levels and readiness for cognitively demanding tasks, whereas their productivity declines toward the afternoon. Evening types, in contrast, exhibit delayed peaks in alertness and cognitive functioning, often performing best in the late afternoon or evening due to differences in sleep-wake timing and hormonal regulation. These chronotype patterns have direct implications for the alignment between biological predispositions and standard work schedules.

Melatonin, a hormone produced primarily by the pineal gland, plays a central role in regulating the sleep-wake cycle. Its secretion increases during darkness, signalling the need for rest, while exposure to light suppresses melatonin production and promotes wakefulness (McClung, 2011). Stable melatonin rhythms support consistent sleep patterns, cognitive performance, and overall daytime functioning. Conversely, disruptions to melatonin regulation such as those caused by night-

-shift work, exposure to artificial lighting at night, or extensive use of electronic devices before bedtime can desynchronise the biological clock. Such disruptions often result in shortened sleep duration, impaired concentration, slower reaction times, and reduced work performance (Potter et al., 2016).

CIRCADIAN RHYTHMS AND EMPLOYEE PRODUCTIVITY

Circadian misalignment is one of the most consistently documented biological factors impairing employee performance. Sleep deprivation often resulting from work schedules that conflict with natural circadian rhythms disrupts autonomic regulation and increases activation of the hypothalamic–pituitary–adrenal axis. This dysregulation elevates cortisol levels, intensifies fatigue, and impairs key cognitive functions such as sustained attention, decision-making, working memory, and problem-solving (Meerlo, Sgoifo, Suchecki, 2008). As sleep quality deteriorates, cognitive performance declines further, creating a self-reinforcing cycle of stress, insufficient recovery, and reduced workplace efficiency. The negative consequences of sleep loss are particularly pronounced in occupations requiring continuous attention, rapid decision-making, and high cognitive load. Evidence from healthcare demonstrates this clearly: a cross-sectional study among Malaysian physicians reported that more than 78% experienced clinically relevant sleep deprivation, which was associated with impaired communication, higher rates of diagnostic errors, and increased accident risk after night shifts (Daher, Burud, Subair, Mushahar, Xin, 2024). Similar patterns have been observed in other high-risk fields such as transportation, manufacturing, and emergency services. Sleep deprivation is not only a short-term impairment but is also systematically associated with long-term health risks. Analysis of Danish workers by Nabe-Nielsen et al. (2024) shows that approximately 7.5% of the labour force regularly engages in night-shift work, with clear evidence of reduced sleep duration, poorer sleep quality, and higher prevalence of sleep disorders. These disruptions contribute to elevated risks of cardiovascular and metabolic diseases, weakened immune function, and chronic fatigue. Research further suggests that slow-rotating shift systems produce more severe sleep disturbances than fast-rotating ones, and although some individuals show partial adaptation to consecutive night shifts, full circadian alignment is rare.

Chronic circadian disruption is also linked to poorer mental health outcomes. Individuals with irregular sleep patterns exhibit higher cortisol reactivity and reduced melatonin production, which together weaken emotional regulation and increase susceptibility to psychological distress (Melo, Abreu, Neto, de Bruin, de Bruin, 2017; Hickie, Naismith, Robillard, Scott, Hermens, 2013). Experimental evidence from nurses demonstrates that night-shift-induced circadian desynchronization

leads to heightened neuroticism, affective instability, and symptoms consistent with stress-related disorders (Poormoos, Amerzadeh, Alizadeh, Kalhoret, 2024). A related phenomenon is social jet lag, the misalignment between biological time and socially imposed schedules, which further increases psychological discomfort and contributes to cumulative sleep debt.

These findings fit within a broader body of research linking circadian misalignment to depressive symptoms and emotional instability. Studies indicate that individuals repeatedly exposed to night work or inconsistent sleep-wake timing face increased risks of mood disorders (Emens, Lewy, Kinzie, Arntz, Rough, 2009). Physiological dysregulation including altered cortisol secretion, disturbed gastrointestinal rhythms, and fluctuations in body temperature further contributes to metabolic disorders, gastrointestinal problems, and subjective sleepiness (Park, Nang, Cho, Chung, Kim, 2024). The effects of circadian rhythms on productivity extend beyond momentary alertness. Sleep plays a critical role in memory consolidation and learning, meaning that circadian disruption reduces the ability to integrate new information and decreases performance on cognitively demanding tasks. Shift workers frequently report lower vigilance and greater fatigue, which increases the probability of workplace accidents and decreases operational efficiency (Drake, Wright, 2011). Experimental evidence supports these patterns: workers exposed to chronic circadian disruption perform significantly worse in object-recognition and source-recall tasks, with night shifts having the strongest negative effect on performance (Mawdsley, Grasby, Talk, 2014). However, the literature also highlights individual differences in the ability to adapt to irregular schedules. Richardson et al. (2018) observed that older adults with chronic insomnia did not exhibit significantly poorer working-memory performance than well-rested peers, suggesting that age moderates the relationship between sleep disruption and cognitive outcomes. Similarly, Boudreau, Dumont, and Boivin (2013) documented partial adaptation among police officers, with 41% showing measurable delays in melatonin rhythms after seven consecutive night shifts. Despite this, evidence indicates that complete circadian adaptation is extremely rare. Boivin and Boudreau (2014) found that no more than 3% of night-shift workers achieve full entrainment of the circadian pacemaker to nocturnal work schedules, even after prolonged exposure, highlighting persistent misalignment between internal biological processes and external work demands.

ECONOMIC IMPLICATIONS OF CIRCADIAN RHYTHM DISRUPTION

Disruptions of circadian rhythms have significant consequences not only for individual well-being but also for organisational efficiency and broader labour market outcomes. Misalignment between biological rhythms and fixed work

schedules reduces cognitive performance, increases error rates, and elevates fatigue-related risks, all of which translate into measurable productivity losses for firms. Empirical studies consistently show that sleep deprivation and circadian misalignment are associated with higher absenteeism, increased employee turnover, and reduced operational effectiveness, imposing additional costs on employers and public health systems. Workplace interventions aimed at improving circadian alignment such as flexible scheduling, chronotype-based shift allocation, predictable roster planning, and exposure to natural or high-quality artificial light have been shown to reduce fatigue, enhance alertness, and improve overall work performance (Swanson et al., 2011; Roach, Lamond, Dorrian, 2005). In shift-based industries, even moderate improvements in schedule design can significantly decrease accident risk and improve cognitive functioning during work hours. Evidence from occupational health research underscores the economic relevance of these mechanisms. Early morning shifts, which require employees to wake before 5 a.m., result in marked reductions in total sleep time and impair REM and stage 2 sleep phases essential for cognitive recovery and emotional regulation (Kecklund, Åkerstedt, Lowden, 1997). Workers exposed to extended or irregular shifts exhibit cumulative sleep deficits that impair concentration and increase workplace errors, consistent with findings from manufacturing and transportation sectors (Lowden, Kecklund, Axelsson, Åkerstedt, 1998). Access to natural light within workplaces has been shown to partially mitigate these effects by supporting circadian entrainment, reducing fatigue, and enhancing daytime performance (Boivin, Boudreau, Tremblay, 2012).

The predictability of work schedules is another critical factor. A recent study among Korean firefighters demonstrated that frequent and unpredictable shift changes were strongly associated with insomnia and elevated stress, particularly among older employees and women (Jeong et al., 2024). Such instability contributes to chronic fatigue, heightened accident risk, and increased susceptibility to burnout. Given that burnout was formally recognised by the World Health Organization in 2019 as a condition linked to chronic workplace stress, its economic implications are substantial (WHO, 2019). In Sweden, for example, stress-related health conditions accounted for sickness benefits equivalent to 0.33% of total labour income in 2019, approaching half of the expenditures associated with unemployment benefits (Nekoei, Sigurdsson, Wehr, 2024). Burnout and chronic stress undermine organisational performance through reduced productivity, diminished innovation capacity, and elevated turnover costs. Employees experiencing emotional exhaustion exhibit impaired problem-solving abilities, slower decision-making, and reduced engagement, leading to lower-quality outputs and increased rates of costly operational errors (Yanna, Yang, Lin,

2023). These effects are particularly pronounced in shift workers, whose disrupted sleep-wake cycles impair memory consolidation, learning, and vigilance functions essential for sustained productivity.

Circadian disruption is also linked to metabolic dysregulation, unhealthy eating behaviours, and elevated risks of obesity and cardiovascular disease, particularly among shift workers. Studies among healthcare and industrial workers show associations between irregular schedules, higher BMI, poorer dietary quality, and increased prevalence of metabolic syndrome (Migdanis et al., 2024; Vallejo-Giraldo, Sanchez-Medina, Vasquez-Trespacios, 2023). Hormonal mechanisms involving leptin and ghrelin appear to mediate these effects, contributing to higher energy intake and irregular eating patterns (Yoshizaki et al., 2010). These health consequences lead to increased sickness absence, reduced long-term work capacity, and higher healthcare expenditures for employers. Experimental evidence further suggests biological pathways connecting circadian disruption with emotional dysregulation and addictive behaviours. Animal models indicate that disruption of circadian genes can reduce lifespan, impair neurochemical balance, and increase preference for stimulants, findings that parallel human studies on sleep loss, psychological distress, and addictive tendencies (Lateef, Pokharel, Shafin, 2023). Although such experimental research cannot be directly translated into economic outcomes, it provides mechanistic insight into the biological foundations of reduced work capacity and stress-related illnesses.

Taken together, the literature demonstrates that circadian misalignment has substantial economic implications. It reduces labour productivity, increases operational risks, raises healthcare and absenteeism costs, and contributes to long-term declines in human capital. Addressing circadian disruption is therefore essential for effective labour management, organisational sustainability, and economic performance.

Table 1 summarises the main characteristics and findings of the empirical studies included in this review. Across the studies, three consistent patterns emerge: 1) circadian misalignment and sleep deprivation reliably reduce cognitive performance and increase error rates; 2) shift work and irregular schedules are strongly associated with long-term health risks, including metabolic disorders and psychological distress; and 3) interventions such as chronotype-based scheduling, increased light exposure, and flexible working hours show measurable improvements in performance and well-being. Taken together, the evidence highlights the economic relevance of circadian rhythms by demonstrating their impact on productivity, absenteeism, and long-term labour capacity.

Table 1. Overview of analysis results – primary study

Number	Reference	Location	Design / Method	Sample Size	Sample Composition	Aim	Key Variables
1	Park et al. 2024	South Korea	Experimental (3 feeding schedules in mice, urinary rhythm & bladder mRNA)	5 n = 6 per group	6 Laboratory mice	7 Determine how a feeding-time shift (mimicking night shifts) disrupts urinary rhythm.	8 Feeding schedule; genotype; urinary rhythm; antioxidant treatment
2	Poormoosa, Amerzadeh, Alizadeh 2024	Iran	Questionnaire survey	n = 378	21.2% male; 78.8% female nurses	Assess impact of circadian rhythm on nurses' work effectiveness, with QWL as mediator.	Quality of Work Life; circadian rhythm; nursing productivity; fatigue; error rate
3	Daher et al. 2024	Malaysia	Questionnaire survey	n = 206	Pediatric (13.6%), ER (5.3%), other (81.1%)	Determine prevalence of sleep deprivation and its perceived impact on doctors' performance.	SDIS; sleep-deprivation status; socio-demographics; work factors
4	Nabe-Nielsen et al. 2024	Denmark	Two prospective field cohorts	n = 160 (90 permanent night; 70 rotating)	90 permanent night workers; 70 three-shift police	Examine effect of consecutive night shifts on sleep duration/quality and chronotype differences.	Shift type; consecutive nights; chronotype; TST; PSD; sleep efficiency; subjective sleep quality
5	Lowden et al. 1998	Sweden	Questionnaire (before/10 mo after shift change)	n = 32	Chemical plant shift-workers	Evaluate impact of 8h→12h shift change on satisfaction, sleep, sleepiness, reaction time, health.	Shift type; timepoint; worker type; satisfaction; sleep quality; sleepiness; RT; health; recovery

1	2	3	4	5	6	7	8
6	Emens et al. 2009	USA	Pilot observational study	n = 18	Women with MDD, age 19–60, stable meds	Test correlation of sleep phase relative to DLMO with depression severity in MDD.	PAD; HAM-D score; sleep diary; actigraphy metrics
7	Mawdsley, Grasby, Talk 2014	Australia	Field experiment (sleep vs. wake intervals)	n = 40	50% shift-workers; 50% permanent day-workers	Assess effect of 12h sleep vs. wake on item recognition & source memory.	Work regime; interval type; memory performance (item & source)
8	Richardson et al. 2018	Australia	RCT, 2-phase	n = 83 adolescents	DSWPD (~42); good sleepers (~41)	Test cognitive deficits in DSWPD teens and effect of 3wk light therapy.	Diagnostic group; intervention; sleep timing; sleep duration; sleepiness; cognitive scores
9	Boudreau, Dumont, Boivin 2013	Canada	Within-subject field design	n = 15	7 M; 8 F police officers	Examine circadian adaptation over seven consecutive night shifts on sleep, performance.	Sleep parameters (PSG/actigraphy); PV/T; subjective alertness/mood; melatonin; HRV
10	Swanson et al. 2011	USA	Telephone survey	n = 1000	US workers ≥ 18 yrs, mixed demographics	Characterize links between work hours, sleep quality/duration, absenteeism, injuries.	Work hours; shift status; sleep outcomes; absenteeism; injury; presenteeism; demographics
11	Roach et al. 2005	South Australia	Lab simulation: 9 nights (1 adaptation; 1 baseline; 7 shifts)	n = 15	7 M; 8 F healthy volunteers	Assess adaptation to seven night shifts via urinary aMT6s and sleep measures.	Sleep type; urinary aMT6s; TST; sleep latency; sleep structure
12	Kecklund, Åkerstedt, Lowden 1997	Sweden	Within-subject (workday vs. day off)	n = 22	Female flight attendants	Test effect of early shift start on sleep duration, quality, and alertness.	Subjective awakening difficulty; non-restorative sleep; sleepiness; TST; sleep stages; EEG power

<i>I</i>	2	3	4	5	6	7	8
13	Boivin, Boudreau, Tremblay 2012	Canada	Field + lab (urine, saliva, PVT)	n = 17	8 intervention; 9 control police	Test bright-light + orange-goggles intervention on circadian adaptation.	Light intervention; sleep routine; PVT; subjective sleepiness; chronotype
14	Jeong et al. 2024	South Korea	Cross-sectional online survey	n = 8587	Firefighters, mixed demographics	Assess if schedule instability increases insomnia risk in firefighters.	Notice timing; shift swaps; insomnia (ISI \geq 15)
15	Migdamis et al. 2024	Greece	Cross-sectional online survey	n = 418	Healthcare workers (doctors, nurses)	Compare dietary habits & MedDiet adherence on night vs. day shifts during COVID-19.	Shift type; meal frequency; food intake; MedDiet-S score; beliefs
16	Vallejo-Giraldo et al. 2023	Colombia	Cross-sectional records analysis	n = 763	Food production workers (637M; 126F)	Examine shift vs. day work on BMI, WHR, lipids, glucose.	Shift type; BMI; WHR; cholesterol; glucose; covariates
17	Rabanipour et al. 2019	Iran	Cross-sectional (records + questionnaire)	n = 3063	Steel workers: 1683 rotating; 1380 day	Test rotating shift as risk for overweight/obesity & abdominal adiposity.	Shift type; BMI; WC; WHR; demographics; lifestyle
18	Yoshizaki et al. 2010	Japan	Questionnaire survey	n = 2758	1179 day; 1579 rotating nurses	Assess shift-type impact on BMI & mediators (diet, activity, sleep).	Shift type; SSB intake; sleep; activity; BMI; age; tenure
19	Lateef, Pokharel, Shafiq 2023	USA	Experimental (Drosophila, 3 groups)	n = 60–90 per group	20–30 flies/vial	Test circadian dysfunction & sleep deprivation on lifespan, behavior, caffeine preference.	Group; survival; geotaxis; caffeine preference

Source: own study.

RESULTS

A synthesis of the reviewed studies reveals three major patterns regarding the economic implications of circadian misalignment.

First, circadian disruption consistently reduces cognitive performance, increases error rates, and elevates fatigue-related risks effects that translate into lower labour productivity across occupations. Reduced alertness, slower reaction times and impaired decision-making are particularly pronounced in shift workers and employees exposed to irregular or early-morning schedules. Second, circadian misalignment is strongly associated with long-term health risks, including metabolic disorders, cardiovascular disease, and psychological distress. These conditions contribute to increased absenteeism, higher turnover, and reduced work capacity, creating measurable economic costs for firms and public health systems. Third, although some evidence suggests partial adaptation to irregular schedules, full circadian entrainment is rare. Individual differences in chronotype and resilience explain substantial heterogeneity in outcomes. Chronotype-aligned scheduling, exposure to natural or dynamic lighting, and stable roster planning consistently emerge as effective interventions for mitigating productivity loss.

DISCUSSION

The evidence demonstrates that circadian rhythms are not merely a biological phenomenon but a fundamental determinant of labour productivity, human capital accumulation, and organisational performance. Misalignment between biological clocks and work schedules reduces the efficiency with which employees convert hours worked into effective output. This has direct implications for firms that rely on continuous attention, cognitive precision or physical endurance. From an economic perspective, circadian disruption represents a form of implicit productivity tax. Reduced cognitive functioning increases operational errors, accident rates and quality deficits each of which raises production costs. At the macroeconomic level, elevated morbidity associated with circadian misalignment contributes to higher healthcare expenditure, increased sickness benefits, and a decline in aggregate labour efficiency. Burnout emerges as a critical mediating mechanism linking circadian disruption to long-term economic loss. Chronic sleep deprivation weakens emotional regulation, reduces motivation, and diminishes innovation capacity. These effects undermine organisational performance by increasing turnover and reducing employee engagement. For governments, burnout and stress-related illnesses represent substantial fiscal burdens, as illustrated by Sweden, where sickness benefits related to chronic work stress account for a measurable share of national labour income. Despite the

increasing recognition of circadian processes, organisational practice often fails to incorporate chronobiological evidence. Flexible working hours, chronotype-based shift allocation, and predictable roster planning offer promising avenues for improving labour efficiency. Likewise, exposure to natural or circadian-sensitive artificial lighting can enhance alertness and reduce fatigue, particularly in shift-based industries. However, gaps remain. Research often relies on self-reported measures, with limited use of objective biological or behavioural data. Furthermore, sector-specific differences and individual-level variability require deeper examination. Future research should quantify the economic returns to interventions such as dynamic lighting systems, wearable sleep monitoring, and structured sleep-hygiene programmes.

This review is limited by the inclusion of only English-language publications and by the predominance of studies relying on self-reported data. In addition, a substantial proportion of Further work should develop economic models that quantify the cost of circadian misalignment and evaluate the effectiveness of chronotype-based scheduling interventions. Randomised field trials and objective monitoring tools represent promising directions for strengthening the evidence base.

CONCLUSION

This review demonstrates that circadian rhythms are a fundamental determinant of employee performance, organisational efficiency and long-term labour capacity. Across the reviewed evidence, circadian misalignment is consistently associated with reduced cognitive functioning, higher error rates, increased accident risk and diminished productivity. These effects extend beyond the individual level, contributing to higher morbidity, elevated burnout incidence and rising healthcare and social-insurance costs. For firms, chronic circadian disruption manifests as lower output per hour worked, greater absenteeism and higher turnover, all of which erode operational effectiveness and increase labour-related expenditures. The findings also show that full adaptation to irregular schedules is rare, and that individual chronotypes play a meaningful role in shaping vulnerability to misalignment. Organisational practices that do not take biological rhythms into account therefore impose a hidden economic burden both through direct productivity losses and through the long-term depreciation of human capital. Implementing chronotype-sensitive scheduling, improving light exposure at the workplace and supporting healthy sleep patterns emerge as cost-effective strategies to enhance employee well-being and performance. For policymakers, recognising the economic importance of circadian alignment is essential for designing labour regulations, occupational-health standards and

prevention programmes that sustain workforce productivity in the long run. Overall, respecting circadian biology is not solely a matter of employee comfort, but a structural factor that influences firm competitiveness and macroeconomic outcomes. Integrating chronobiological evidence into labour-market practice offers a promising pathway to strengthening productivity, reducing health-related costs and supporting sustainable human capital development.

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*Dr hab. inż. Roman Chorób, prof. UR*¹ 

Department of Quantitative Methods and Business Informatics
Faculty of Economics and Finance, University of Rzeszow

Outsourcing in the context of the cluster business model

Abstract

The main goal of this paper is to present outsourcing as a tool supporting business model modification in cluster structures, which is one of the factors influencing increased competitiveness and success. The next section explores the issue of coepetition between business entities in terms of increasing their competitiveness and achieving business success. A brief presentation of business models and strategies in the context of clusters, as well as outsourcing as business model conversion, is provided. The importance and role of outsourcing in cluster structures is discussed, and examples of implementing outsourcing elements in domestic and international clusters are presented. These considerations are supported by research findings, thus enriching the subject matter. The paper proposes the research thesis that implementing outsourcing in clusters enables cost optimization, increased efficiency, and a focus on core competencies. Due to its complexity and importance, this issue constitutes a premise for further research in the future.

Keywords: cooperation, competition, innovation, coepetition, business model, outsourcing.

Outsourcing w kontekście klastrowego modelu biznesu

Abstrakt

Głównym celem niniejszego opracowania jest próba ukazania outsourcingu jako narzędzia wspomagającego modyfikację modelu biznesu w odniesieniu do struktur klastrowych będącego jednym z czynników wpływających na wzrost konkurencyjności i osiągnięcie sukcesu. W dalszej części przybliżono zagadnienie koopetycji podmiotów gospodarczych w aspekcie podniesienia ich konkurencyjności, jak też osiągania przez nich sukcesu biznesowego. Dokonano krótkiej prezentacji modeli i strategii biznesowych w kontekście klastrów i outsourcingu jako konwersji modelu biznesu. Poddano rozważaniom znaczenie i rolę outsourcingu w strukturach klastrowych oraz

¹ Correspondence address: Uniwersytet Rzeszowski, Wydział Ekonomii i Finansów, M. Ćwiklińskiej 2/312, 35-601 Rzeszów; e-mail: rchorob@ur.edu.pl. ORCID: 0000-0003-2045-6251.

przybliżono przykłady implementacji elementów outsourcingu w klastrach krajowych i zagranicznych. Rozważania poparto wynikami badań, wzbogacając tym podjętą problematykę. W opracowaniu postawiono tezę badawczą, że wdrożenie outsourcingu w klastrach umożliwia optymalizację kosztów, zwiększenie efektywności i koncentrację na swoich kluczowych kompetencjach. Z uwagi na złożoność i ważność niniejsza problematyka stanowi przesłankę do podjęcia kolejnych badań w przyszłości.

Słowa kluczowe: współpraca, konkurencja, innowacje, kooperacja, model biznesu, outsourcing.

JEL: D41, F20, L20, O19, R11.

INTRODUCTION

The increasing integration of the global economy, on the one hand, fosters the development of all forms of interconnection, and on the other, stimulates businesses to compete with each other, including globally. External economic conditions force businesses to seek ways to counteract intensified competition. One such approach is to seek synergies resulting from collaboration with other entities and institutions in the business environment, particularly with research and development facilities. Business practice confirms the significant importance of business connections in generating innovation. Ties and contacts between companies and their contractors, institutions, and universities constitute a system within which companies with limited access to knowledge acquire it from outside sources, which in turn enables them to generate innovative ideas (Górzyński, Pander, Koć, 2006, p. 5).

An increasingly popular and, as international experience indicates, effective form of such cooperation is the creation of cluster structures. Enterprises operating in such structures, usually through specialization, increase their competitiveness and productivity. In a broader sense, creating a cluster initiative means a change in the philosophy of operation for the companies operating within it. It is a shift from the classic offering of products and services to functioning in a cooperation network that offers potential to customers. This is no longer a product offered by an individual enterprise, but the ability to flexibly and quickly respond to market needs through cooperation and competition among entities associated in the cluster (Dobrzyński, Dziekoński, Jurczuk, 2013, p. 76). It is worth emphasizing that in the globalization of the world economy and the knowledge-based economy, where the key factor guaranteeing high competitiveness is the ability to implement innovative solutions, leveraging the positive effects of cluster cooperation to create enterprise value is extremely popular (Kuczevska, 2014, p. 227).

Phenomena and trends currently occurring in organizations' environments, such as the development of communication and information technologies, the increasing prevalence of cooperation, and the ubiquity of networks, necessitate

modifications to enterprise business models and organizational boundaries (Chorób, 2022, pp. 86–89; Drzewiecki, 2014, p. 317). As a result, the ways in which management methods and techniques are used are also changing. Outsourcing, one of the most common management methods used in Polish enterprises, deserves particular attention in this context (Kłos, 2009, pp. 140–149; Lisiński, Sroka, Brzeziński, 2012, p. 28). The features of this method, such as: versatility, the ability to achieve diverse organizational goals, taking into account the structural aspect of the organization and the processes of cooperation and collaboration, mean that modern outsourcing should be treated as a method supporting the process of modifying the business model and shaping the boundaries of the organization (Nogalski, Waśniewski, Kalicki, 2012, p. 117).

The main goal of this paper is to present outsourcing as a tool supporting business model modification in cluster structures, which is one of the factors influencing increased competitiveness and success. In light of the importance of cooperation, particular attention is paid to the initiation, operation, and development of innovative forms of integration links, which cluster structures are considered to represent. The next section explores the issue of cooperation between economic entities in terms of increasing their competitiveness and achieving business success. A brief presentation of business models and strategies in the context of clusters, as well as outsourcing as business model conversion, is provided. The importance and role of outsourcing in cluster structures is discussed, and examples of the implementation of outsourcing elements in domestic and foreign clusters are presented. The research methods used included analysis of existing data and analysis of the subject literature. These considerations are supported by research findings, thus enriching the subject matter. The study presents a research thesis that the implementation of outsourcing in clusters enables cost optimization, increased efficiency and concentration on core competencies.

COOPETITION AS A PREREQUISITE FOR CLUSTERS' COMPETITIVENESS

Collaboration between cluster-member companies and research and development institutions and local government units contributes to increased company credibility. Collaboration within a cluster lowers entry barriers to the sector in which the cluster operates, while a well-functioning cluster improves the flow of information between members. A jointly defined strategy and goals streamline information flow and collaboration between cluster members. Furthermore, cluster members often engage in export activities, which directly impacts the region's financial situation and its international image. This also facilitates the acquisition of higher financial resources for the development of local entrepreneurship (Adamiak, 2013, p. 156).

Coopetition, the subject of this section, is the merging of competition and cooperation into a single type of relationship and interaction. However, the literature offers various approaches and research perspectives explaining this phenomenon. Despite this, there is agreement that this type of strategy is intended to bring specific benefits to the enterprise. These benefits also constitute the fundamental motivations for cooperative activities. It should be emphasized that globalization and the shifting boundaries of organizations also have a significant impact on these activities (Cyfert, 2012; Luo, 2004; Zakrzewska-Bielawska, 2013, pp. 420–422).

Coopetition therefore focuses on the processes of value creation and deriving benefits from it, not only on the essence of the relationships between the parties. Therefore, it is defined as a strategy of joint value creation under competitive conditions in the division of these values, with partial convergence of goals and a variable structure of a positive-sum game (Jankowska, 2009, p. 5). In the concept of coopetition, enterprises simultaneously become customers, suppliers or service providers, competitors, and partners. They undergo mutual co-evolution, both in terms of competition and cooperation. Co-evolution involves sharing the same vision, forming alliances, negotiating agreements, and establishing comprehensive relationships at the level of management and administration. It is worth emphasizing that coopetition can occur at various levels in the hierarchy of economic systems. Coopetition can be discussed at the macroeconomic, mesoeconomic, and microeconomic levels (Balicka, 2014, pp. 13–15; Stanienda, 2012, p. 185).

The essence of coopetition is that enterprises strive to gain a competitive advantage through specific resources, competencies, and a defined market position, while simultaneously attempting to integrate their strengths with those of rivals, suppliers, customers, and other business partners. It should be emphasized that enterprises wishing to benefit from coopetition must recognize the importance of both competition and cooperation. In cooperative relationships, creating conditions conducive to fair cooperation and rivalry is particularly important, and managing trust in business partners is a crucial skill. A key challenge is developing management skills that will allow for combining these opposing strategic approaches and protecting each company's business secrets (Chorób, 2013, pp. 86–87; Jankowska, 2012, pp. 58–61; Benchmarking..., 2025, pp. 90–94).

BUSINESS MODELS AND STRATEGIES IN THE CONTEXT OF CLUSTERS

A holistic approach to a business model combines business strategy, business organization, and business systems (Osterwalder, Pigneur, Tucci, 2005, p. 9). Business strategy expresses the company's long-term goals and the

resources necessary to achieve them. Business organization involves dividing the business into units, defining their competencies and tasks, and coordinating and controlling their activities and outcomes. Business systems, on the other hand, are coherent courses of action undertaken by the company to achieve a specific effect.

Constructed business models can be more or less detailed, i.e., present a greater disaggregation of individual components. It should be emphasized that the current business model should take into account the changes that have occurred in the contemporary globalized economy, such as the development of the knowledge-based economy, internet communications, e-commerce, outsourcing and offshoring, and the emergence of new types of financial instruments and methods of financing transactions, sometimes very complex and risky (Goliński, 2018, pp. 183–187; Rymarczyk, 2017, pp. 144–145).

The shape of a company's business model (Banaszyk, 2006) depends primarily on the sector, as it is the way in which it conducts its business within the identified and diagnosed state of the environment. This method is a specific configuration of resources, activities, and offered products or services that ensures the creation of value for the customer and the generation of profit for the company's owners. Due to the volatility of the environment, the company's strategic business model should also be subject to periodic change (redefinition). Its change constitutes an adequate response of the entity to the ongoing changes in the conditions of its operation, which is referred to as strategic renewal (Nogalski, 2009, p. 8).

The need to develop cluster development strategies that would clarify the goals to be achieved and establish the role of various entities in implementing activities for cluster expansion is indicated by Klimczuk-Kochańska (2012, p. 171). The opportunities for regional development based on smart specializations depend on supporting existing and emerging clusters through co-financing the activities of coordinators, including the cluster initiatives they lead. This enables the functioning of institutions that play a key role in the development of cooperation, interactions, and knowledge flows within clusters of economic activity, thus increasing their competitiveness and innovation (Borkowska-Niszczota, 2019, p. 121; Ropega, 2016, p. 102).

In the typology of clusters, they can be divided according to their country of origin, meaning that certain forms are characteristic of specific countries and these types are also becoming widespread in other countries (Dworzecki, Żłobińska, 2002, pp. 310–311; Gorynia, Jankowska, 2007, pp. 329–332). One of them is the Italian model, characterized by: lack of a formalized structure, lack of capital ties, lack of a separate management (coordinating) structure, relationships between companies initiated by owners, strong family ties within and between companies, a high level of regional identity, a long tradition of strong craft guilds, and significant independence from the central government. Another type of

cluster, based on informal ties, is the Danish model. A network broker plays an important role in this model, initiating contacts between partners and coordinating cluster activities. The Danish model was also implemented in Hungary, and modified versions that took into account cultural and economic differences were implemented in the United Kingdom, the United States, Canada, Australia, and New Zealand. Another type of cluster is the Dutch model, characterized by close cooperation between enterprises and a research institution.

A review of the roles of enterprises within a cluster allows us to identify leading entities capable of making largely independent strategic choices that influence the activities of other companies. These criteria are primarily met by network leaders, followed by specialized enterprises, system integrators, and branches of transnational corporations. In addition to their relative independence of choices and ability to influence the strategies of other entities, these companies are also characterized by the cross-border reach of market and business relationships and a level of competence that allows them to compete internationally (Gancarczyk, Gancarczyk, 2011, pp. 64–65).

OUTSOURCING AS A BUSINESS MODEL CONVERSION

Dynamic changes taking place in the environment of currently operating enterprises, i.e.: virtualization of organizational structures, increasing diversity of forms of cooperation between entities, business networking, and the increasingly frequent occurrence of cooperation, mean that strategy in its classic form is increasingly no longer an adequate tool for describing an organization (Drzewiecki, 2014, p. 318). Its place is taken by a business model, used as a tool for organizational management for strategic planning, designing and implementing organizational changes, describing and analyzing the enterprise, identifying competitive advantages, strategic resources, and verifying strategies (Drzewiecki, 2013, pp. 69–71).

One example of a business strategy is outsourcing, which refers to the practice of delegating certain tasks, functions, and company processes to external providers rather than performing them internally. This practice is often used to reduce costs, increase efficiency, gain access to specialized knowledge, access to financial resources, and more. Examples of outsourcing include customer service, accounting, production, IT, research and development, management, organization, and more. Companies choose outsourcing for various reasons, but it's always important to manage the process well and choose the right external partners to achieve the intended benefits (Dominguez, 2009; Foltys et al., 2024, p. 94).

The widespread nature of outsourcing and its growing importance stem from the fact that decisions taken at the interface between the organization and the

environment are becoming increasingly important for the success of an organization, including decisions regarding, among others, the value chain structure, the adopted forms of cooperation (e.g. joint capital ventures), cooperation (e.g. whether and how to organize cooperation with competitors), the position of the enterprise in the network (e.g. the heterarchy dilemma) and formal and informal relations with stakeholders and network participants (Drzewiecki, 2014, p. 318).

The motives for using outsourcing include: the client making a make or buy decision (to produce or buy); analyzing the main reasons for using outsourcing each time and deciding on the form of cooperation with a specific outsourcing partner (Byrski, 2018, pp. 3–4). In economics, the make or buy decision is defined as a compromise between additional management costs related to vertical integration on the one hand (make decision) and transaction costs resulting from searching and incomplete contracts (expenditures on finding suitable outsourcing partners) on the other hand (buy decision) (Grossmann, Helpman, 2002, p. 118).

In light of the above, an alternative to the make decision may be outsourcing, i.e., abandoning or limiting one or more types of internal activities in favor of using the services of external contractors (outsourcing partners). Outsourcing, however, is not an ordinary assignment, as it results in deeper changes in the organization, involving the company's focus on core activities that determine competitive advantages. This means establishing a long-term and permanent partnership, in which the process was previously handled in-house (Kupczyk, Koralewska-Mróż, Czerwonka, 1998, p. 96).

The variety of outsourcing projects makes it, on the one hand, a versatile method that allows for the achievement of diverse organizational goals, and on the other, demanding in terms of decision-making. The available literature on the subject provides numerous examples of how outsourcing can be implemented (Bravard, Morgan, 2010; Dominguez, 2009; Essinger, Gay, 2002; Niemczyk, 2006; Trocki, 2001; Wodecka-Hyjek, 2011).

THE IMPORTANCE AND ROLE OF OUTSOURCING IN CLUSTER STRUCTURES

In light of the above meaning and forms of outsourcing, it is worth emphasizing that in cluster structures, it plays a significant role in shaping the competitiveness and innovation of enterprises and the entire cluster. The application of outsourcing in the definition, construction, and operation of clusters remains extremely interesting. Outsourcing in clusters, as indicated by research results, influences competitiveness, operational efficiency, access to knowledge and resources, and supports enterprises in general, particularly the SME sector, in the following areas (Foltys et al., 2024, pp. 103–104; Zorska, 2012, pp. 30–32; Liu, Feils, Scholnik, 2011, p. 568):

1. Increasing competitiveness: outsourcing in clusters allows enterprises to use external services, which can contribute to increasing their competitiveness. Access to high-quality services at competitive prices can help companies in an industrial cluster stay in the market.
2. Increasing operational efficiency: Using outsourcing in clusters can enable companies to focus on their core competencies and business processes, while other tasks are handled by external service providers.
3. Accessing specialized knowledge and resources: Industrial clusters often accumulate specialized knowledge, experience, and resources in a specific field. Outsourcing in clusters allows companies to access these specialized resources by collaborating with companies located in the cluster.
4. Stimulating innovation: Collaboration between companies in a cluster can stimulate innovation through the exchange of knowledge, experience, and ideas. Using external services can also contribute to the introduction of new technologies and innovative solutions.
5. Creating synergies: Outsourcing in clusters can create unique opportunities for collaboration and synergies between different companies in the cluster. Using external services can foster the formation of business partnerships and the exchange of know-how between companies.
6. Support for small and medium-sized enterprises: Industrial clusters often provide a conducive environment for the development of small and medium-sized enterprises. Outsourcing can provide SMEs with access to specialized services and resources they do not have internally.

As a result, outsourcing plays a significant role in supporting the development of industrial clusters by increasing their competitiveness, operational efficiency, innovation, and inter-company synergies. By collaborating with external service providers, cluster companies can more effectively respond to changing market conditions and remain leaders in their respective industries. It's also worth noting that outsourcing can be used by cluster companies in various areas and disciplines to achieve diverse benefits. The primary applications of outsourcing within a cluster can be IT, meaning that companies often outsource IT services such as software development, IT infrastructure management, technical support, and IT security. Outsourcing IT services can help companies gain access to specialized knowledge and skills, increase operational flexibility, and reduce operating costs.

It's worth emphasizing that, in addition to the benefits of outsourcing, there are also noticeable limitations and challenges for businesses (see Kuźmicki, 2025; Kocot, Błaszczak, 2025). Figure 1 presents strengths and opportunities, as well as weaknesses and threats, in the form of a SWOT analysis.

<p style="text-align: center;">STRENGTHS</p> <ul style="list-style-type: none"> – Focus on key activities: the company can focus on its core business – Savings: reduced operating costs, staff retention, and resource costs – Access to expertise: utilizing the knowledge and experience of external specialists – High quality: guaranteed standards and professionalism from specialized partners – Flexibility and scalability: quick adaptation to changing needs 	<p style="text-align: center;">WEAKNESSES</p> <ul style="list-style-type: none"> – Loss of control: reduced oversight of outsourced processes – Vendor dependency: risks related to vendor stability, decisions, and quality – Data loss risk: potential cybersecurity threats and information leaks – Hidden costs: potential additional costs associated with contract management
<p style="text-align: center;">OPPORTUNITIES</p> <ul style="list-style-type: none"> – Innovation: faster implementation of new technologies thanks to an external partner – Expansion: easier entry into new markets with the supplier's support – Optimization: continuous process improvement thanks to specific knowledge 	<p style="text-align: center;">THREATS</p> <ul style="list-style-type: none"> – Concentration risk: excessive dependence on a single supplier – Market situation: legal, economic, or political changes affecting the supplier; – Cultural incompatibility: conflicts between the company's culture and the partner's – Changing requirements: difficulty adapting services to changing needs

Figure 1. SWOT analysis for outsourcing

Source: own study.

SWOT analysis for outsourcing assesses the company's internal Strengths and Weaknesses as well as external Opportunities and Threats related to entrusting tasks to an external supplier, which allows you to identify benefits (such as focus on goals, savings, access to knowledge, flexibility) and risks (such as loss of control, supplier dependence, cyber threats) and make strategic decisions on whether and in what form outsourcing is profitable and safe.

A SWOT analysis (or the related TOWS analysis) aids in strategic decision-making. It identifies whether outsourcing is profitable, what risks should be minimized, and what opportunities should be maximized to ensure a favourable and secure decision for the company, especially in the case of critical services. This analysis helps make informed outsourcing decisions, maximizing benefits and minimizing potential losses, which is crucial especially when outsourcing functions of significant importance to the company.

EXAMPLES OF IMPLEMENTATION OF OUTSOURCING AS A BUSINESS STRATEGY IN CLUSTERS

In the current economic reality, as mentioned in the introduction, there is a noticeable increase in the importance and role of cooperation between entities.

A special type of cooperation is cooperation concerning innovative forms of integration links, such as the analysed clusters. Cooperation, as emphasized, plays an important role in knowledge transfer, which is a fundamental element in growth theory and in the concept of (national and regional) innovation systems (Chorób, 2016, p. 30).

In the practice of family businesses, for example, specific examples of these companies cooperating within cluster structures using outsourcing can be found. This applies both to Poland and other countries. In the Polish economic environment, such examples include: the Podkarpackie Aviation Cluster, the “Dolina Ekologicznej Żywności” Food Industry Cluster, the “Lubelski Klaster Zaawansowanych Technologii Chemicznych” Chemical Cluster, the Masovian ICT Cluster, the Pomeranian ICT Cluster INTERIZON, the North-South Logistics and Transport Cluster, the Lower Silesian Automotive Cluster, the “Białostocka Meblarnia” Furniture Cluster, the “Łódzki Klaster Tekstylny” Clothing Cluster, and the “Zielone Mazowsze” Tourism Cluster (Foltys et al., 2024, p. 133). Due to the volume, below we present a brief description of only a few selected clusters related to the region of south-eastern Poland.

The Podkarpackie Aviation Cluster. This cluster comprises family-owned companies specializing in the production of components for the aviation industry. Collaboration between companies often involves outsourcing processes such as machining, painting, and quality control. A family-owned company producing aircraft structural components outsources the production of certain metal parts to other cluster members specializing in high-precision metalworking. This allows the company to focus on final assembly and product testing.

The “Dolina Ekologicznej Żywności” Food Industry Cluster. Family businesses in this cluster specialize in the production of healthy and organic food. Instead of investing in full production lines, many companies outsource certain stages of production, such as packaging and logistics, to other companies in the cluster that have the appropriate infrastructure. A family business producing organic fruit preserves outsources the packaging and labelling of finished products to a company in the cluster that has a modern packaging line. This allows the company to focus on producing high-quality products, while packaging costs are significantly reduced.

The “Lubelski Klaster Zaawansowanych Technologii Chemicznych” Chemical Cluster. In the chemical cluster, family businesses collaborate on the research and development of new chemical products, outsourcing some specialized research to external laboratories. A company producing paints and varnishes outsources the testing of its products for durability and safety to the laboratory of another family business in the cluster, which specializes in such testing. This allows the company to reduce research costs and bring its products to market faster.

Examples of family business clusters using outsourcing operating in other countries include: the Furniture Cluster in Arnsherg (Germany), the Agro-Food Industry Cluster in Parma (Italy), the Information Technology Cluster in Bangalore (India), the Wine Cluster in Rioja (Spain), the Bicycle Manufacturing Cluster in Taichung (Taiwan), the Cosmetics Cluster in Grasse (France), the Maritime Cluster in Norway, and the Fashion Industry Cluster in Milan (Italy) (Foltys et al., 2024, pp. 135–136).

Arnsherg Furniture Cluster (Germany). Arnsherg is known as a key center for furniture production, home to numerous family-owned businesses. In this region, family businesses cooperate within the cluster, outsourcing various aspects of furniture production. Arnsherg furniture companies often outsource services such as hardware production, furniture surface finishing, and logistics. This allows companies to focus on design and sales, while specialized entities within the cluster handle selected production processes. Outsourcing final assembly or transport to specialized logistics companies within the cluster allows for savings and greater flexibility in order fulfilment.

Parma Agrofood Cluster (Italy). Parma is the centre of the Italian food industry, particularly known for its production of Parmigiano Reggiano and Parma ham. The region is home to numerous family-owned businesses that collaborate within the food industry cluster, outsourcing various processes, including processing and packaging tasks, to other companies in the cluster that have modern production lines. This collaboration also includes logistics outsourcing, particularly in the export sector, where specialized companies manage transport and distribution of products to foreign markets.

CONCLUSION

Contemporary business conditions require the search for and implementation of new solutions. A cluster structure is one example of a business model. Almost all definitions of a cluster (cluster, cluster) refer to networked collaboration and the spatial proximity of cooperating entities. These structures take various forms, most encompassing companies producing finished goods or services, suppliers of specialized production resources, machinery, and services, financial institutions, and entities in related sectors. Based on an analysis of their functioning, it is possible to identify models of cluster structure solutions. One example of a business strategy is outsourcing, which can be successfully implemented within these structures.

The presented discussions and examples demonstrate that outsourcing allows clustered companies to access resources and technologies that would normally be beyond their reach, as well as to collaborate in ways that enhance their competitiveness

and innovation. Outsourcing within clusters abroad allows companies to optimize costs, increase efficiency, and focus on their core competencies. This confirms the research thesis adopted in the introduction. Therefore, outsourcing not only reduces costs but also enables flexible scaling of operations and faster market introduction of innovative products. Cluster structures create favourable conditions for cooperation between companies and specialized entities, which strengthens the competitiveness of enterprises in local and global markets.

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Mgr Jan Neugebauer, Ph.D., MBA¹ 

University of Jan Evangelista Purkyně in Ústí nad Labem, Czech Republic

Mgr Ivana Lovětínská, MBA² 

University of Jan Evangelista Purkyně in Ústí nad Labem, Czech Republic

Ing. Marek Vokoun, Ph.D.³ 

University of Jan Evangelista Purkyně in Ústí nad Labem, Czech Republic

Ing. Bc. Jiří Rotschedl, Ph.D.⁴ 

CEVRO University, Prague, Czech Republic

Economic barriers and their impact on access to healthcare facilities⁵

Abstract

Healthcare access is very standard nowadays. Healthy people generally do not prioritize how they access healthcare facilities. However, the most common client of a healthcare facility is not a healthy person, but one who is suffering. In this case, many limitations can impact access to proper care.

The study's primary objective was to identify all potential economic barriers that affect access to healthcare facilities. We established the theoretical basis using the PRISMA-PICOT approach, then focused on the qualitative approach, using semi-structured interviews to test our theories.

Results show that a few spectrums of people are in different conditions, making them vulnerable. Based on the group's vulnerability and specific needs, there are various economic barriers, ranging from low income to inadequate travel approaches. For example, people from rural

¹ Correspondence address: Jungmannova 28/17, 110 00 Praha 1, Czech Republic; e-mail: Jan.Neugebauer@cevro.cz. ORCID: 0000-0001-5216-1015.

² Correspondence address: Jungmannova 28/17, 110 00 Praha 1, Czech Republic; e-mail: Ivana.Lovetinska@cevro.cz. ORCID: 0009-0006-7203-5415.

³ Correspondence address: Jungmannova 28/17, 110 00 Praha 1, Czech Republic; e-mail: Marek.Vokoun@cevro.cz. ORCID: 0000-0001-5659-3085.

⁴ Correspondence address: Jungmannova 28/17, 110 00 Praha 1, Czech Republic; e-mail: Jiri.Rotschedl@cevro.cz. ORCID: 0000-0002-0117-3427.

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areas often have limited transportation options, and many are unable to use their mobile phones to call for an emergency. Social services in the Czech Republic provide support to individuals in managing specific situations. However, it does not resolve the financial crisis or the health issues of vulnerable patients. Some knowledge should be spread to this group to reduce risks. It can lead to a better understanding of one's health and access to healthcare when needed.

Keywords: barriers, healthcare, needs, vulnerability, people.

Bariery ekonomiczne i ich wpływ na dostęp do usług ochrony zdrowia

Abstrakt

Dostęp do opieki zdrowotnej jest obecnie bardzo powszechny. Osoby zdrowe zazwyczaj nie przywiązują wagi do sposobu dostępu do placówek opieki zdrowotnej. Jednak najczęstszym klientem placówki opieki zdrowotnej nie jest osoba zdrowa, lecz cierpiąca. W takim przypadku wiele ograniczeń może wpływać na dostęp do odpowiedniej opieki.

Głównym celem badania była identyfikacja wszystkich potencjalnych barier ekonomicznych, które utrudniają dostęp do placówek opieki zdrowotnej. Stworzyliśmy podstawy teoretyczne, wykorzystując metodę PRISMA-PICOT, a następnie skupiliśmy się na podejściu jakościowym, wykorzystując wywiady półstrukturyzowane do weryfikacji naszych teorii.

Wyniki pokazują, że różne grupy osób funkcjonujące w odmiennych uwarunkowaniach są podatne na zagrożenia. W zależności od podatności danej grupy i jej specyficznych potrzeb istnieją różne bariery ekonomiczne – od niskich dochodów po niewystarczające możliwości podróżowania. Na przykład osoby z obszarów wiejskich często mają ograniczone możliwości transportu, a wiele z nich nie jest w stanie skorzystać z telefonu komórkowego, aby wezwać pomoc w nagłych wypadkach. Służby socjalne w Czechach zapewniają wsparcie osobom w radzeniu sobie z konkretnymi sytuacjami. Nie rozwiązuje to jednak kryzysu finansowego ani problemów zdrowotnych pacjentów w trudnej sytuacji. Żeby zredukować ryzyko występujące wśród tej grupy osób, należy edukować i upowszechniać wiedzę. Może to prowadzić do lepszego zrozumienia własnego zdrowia i dostępu do opieki zdrowotnej, gdy jest ona potrzebna.

Słowa kluczowe: bariery, opieka zdrowotna, potrzeby, podatność, ludzie.

JEL: I11, I13, I14, I18, J15.

INTRODUCTION

The healthcare sector in Central Europe and worldwide is diverse and influenced by several factors. It is typically appropriate to consider which perspective we want to use to understand the whole concept. Understanding the dynamics requires a deeper examination of multiple perspectives, such as health economics (Franco, Lima, Giovanella, 2021).

Within the framework of defining the cornerstones of factors influencing access to healthcare, its very anchoring and philosophy belong. There is a strong belief that universal access is an appropriate solution to cover the highest level of patients, promoting and maintaining the population's health (Maarse, 2006; Matin

et al., 2021). This universal approach offers comprehensive public healthcare systems financed by the taxes of the state's citizens. This therefore aligns with the philosophical and political belief that healthcare is a fundamental human right (Preker, Cotlear, Kwon, Atun, Avila, 2021). Global perspectives differ, particularly in privatized systems that emphasize market-oriented solutions and personal responsibility in healthcare (Garcia-Subirats et al., 2014). This concept, therefore, relies on the residents' sense of responsibility for their health, and, in the event of illness, they must be adequately protected by other institutions, such as insurance, against imminent financial expenses, or have sufficient funds saved for these needs (Politzer, Shmueli, Avni, 2019). According to research, it is evident that privatized systems are less humane towards the masses (there is no possibility of comprehensive examinations for each person), but in return, there are shorter waiting times, more friendly treatment options, and the residents themselves place great emphasis on personal prevention (Reilly, 2021; Garcia-Subirats et al., 2014).

Healthcare is a concept that evaluates and continuously develops one field at a time – the person. It consistently focuses on ensuring that healthcare meets patients' individual needs and preferences, and recognizes them as active participants rather than passive recipients (Franco et al., 2021). For these reasons, the health concept is developed in great detail into systematic fields that always strategically focus on the relevant part of the body and health philosophies. The socio-economic perspective and health economics see the intersection of possibilities in preventing diseases, acute care, planned care, and long-term care (Kehr, Muinde, Prince, 2023; Matin et al., 2021).

Healthcare as a scientific discipline is no longer described in this general way. However, it is systematically divided into sub-parts that form not only the core itself, but also shape the circumstances and encourage society to common goals, such as the eradication of diseases, prevention of transmission, prevention of the onset or development, repair of already dispensarized parts, etc (Matin et al., 2021; Garcia-Subirats et al., 2014). Here, ethical and moral dilemmas are often discussed, confronting healthcare professionals and patients with topics such as long-term care, irreversible changes, neglected or missing care, incurable diseases, or death (Kehr, 2023; Politzer et al., 2019). For these reasons, the entire perspective is not limited to patients, although the concept primarily focuses on patient care (Reilly, 2021). It is also about healthcare professionals, who within individual systems can be significantly overburdened by the large number of patients demanding healthcare in a universal system (Franco et al., 2021). Healthcare professionals often have to respond to legal complaints. They are compelled to speak out publicly against changes that would only entail additional work responsibilities, although they should also consider protecting themselves (Neugebauer, 2023).

GENERAL BARRIERS TO ACCESS TO HEALTHCARE

A barrier in this context is any activity, situation, or condition that negatively impacts the standard achievement of adequate healthcare. These barriers undoubtedly include models of financing healthcare facilities, which can be public or private systems (Matin et al., 2021). The allocation of resources is also significant, as investments in healthcare infrastructure are a major phenomenon, and healthcare technology receives more substantial support in Central Europe than in other parts of Europe (Neugebauer, Vokoun, 2024). These technological advances primarily focus on the potential for significantly faster treatment and increased access to professional care for individuals in both urban and rural areas (Garney et al., 2021; Neugebauer, Vokoun, Lovětinská, 2024).

Both systems discussed have advantages and negative impacts; another topic addressed is the trade-off between cost and quality (Kyriopoulos et al., 2014). There are trade-offs between maintaining quality of care and controlling costs, which underlines the significant importance of efficient management. However, it is always true that higher quality is also associated with higher costs. In healthcare, this rule applies more than anywhere else, because the quality of care includes not only the treatment itself, but also the equipment used, materials, premises, medical team, dispensary, education, staff approach, waiting times, list of possible examinations/treatments, and much more (Kyriopoulos et al., 2014).

Commonly discussed issues focusing on the economic aspect of access to healthcare facilities include insurance options, unexpected expenses, low income or low family budgets, language, acute and chronic limitations in movement, mental deficits, changes in social role or identity, cultural differences, and poor accessibility (Ahmed, Lemkau, Nealeigh, Mann, 2021; Carrillo et al., 2011; Doležalová, Tóthová, Neugebauer, Sadílek, 2021; Neugebauer et al., 2021; Neugebauer et al., 2024; Sheikh-Mohammed, Macintyre, Wood, Leask, Isaacs, 2006). Numerous studies have shown that high healthcare costs deter individuals from seeking medical care. This includes both direct costs, such as service fees, and indirect costs, including transportation and lost earnings. It is also directly related to the country in which the population is located (Neugebauer, Vokoun, 2024). In low-income countries, even small health care costs can be unaffordable (Sheikh-Mohammed et al., 2006). In middle- to high-income countries, significant costs are often associated with specialized and chronic care (Ahmed et al., 2001). Insurance is a frequently discussed issue, as evident from various sources, which indicate that the presence and type of health insurance significantly influence access to care. Individuals with comprehensive insurance are more likely to seek and receive care promptly than those who are uninsured or underinsured. For example, in the United States, studies have highlighted significant access problems related to underinsurance, whereas European countries with universal insurance systems report lower barriers related to

insurance status (Carrillo et al., 2011; Politzer et al., 2019). High out-of-pocket costs remain a critical barrier, particularly affecting low-income groups. Studies highlight that these costs often lead to delayed care or missed treatment. In countries without public health systems, out-of-pocket costs can push families into poverty, a trend commonly observed in regions of Africa and parts of Asia (Neugebauer et al., 2024; Sheikh-Mohammed et al., 2006). Research also continues to link high-income inequality to disparities in healthcare access. Individuals from lower socioeconomic backgrounds face greater challenges in accessing healthcare (Neugebauer et al., 2024; Carrillo et al., 2011; Kyriopoulous et al., 2014; Garney et al., 2021).

MATERIALS AND METHODS

We established the theoretical basis using the PRISMA-PICOT approach and subsequently focused on the qualitative approach, utilizing semi-structured interviews to validate our theories. The study design is guided by a combination of anchoring theoretical concepts and standardized search strategies. That is why the first phase outlined theoretical concepts and anchored them using the qualitative method of semi-structured interviews, which was employed in subsequent phases.

DATA COLLECTION AND ANALYSIS

The PICOT research question should be the best choice for our kick-off part. The research question was formulated: *What economic barriers have affected patients' access to healthcare facilities in recent years?* Data were collected from the Web of Science and Scopus databases. PRISMA flow was a standardized procedure for all the screening and data analysis. Firstly, we used the following keywords: economic barriers, disparities, healthcare facilities, healthcare, access, and impact. We identified 419 articles from both databases. However, we did not include more criteria for the first selection of all articles found. A specific date criterion (a 5-year range, 2024–2020) was applied, and 248 articles were excluded, leaving 171 remaining. Then, we used a particular range of citations in databases (Q1–Q3) and excluded 64 articles, leaving 107 remaining.

Secondly, we employed the PRISMA flow diagram to adhere to a standardized procedure. We screened the remaining articles for duplication (17 excluded), different languages (5 excluded), and inappropriate topic names (9 excluded). After this phase, the 76 articles remain. The next phase was abstract selection and full article reading. This phase reveals additional variables of focus, including vulnerable populations, which are defined by new terminology: *vulnerable populations, vulnerable groups of people, and specific types of vulnerability (e.g., economic vulnerability, social vulnerability, or health vulnerability)*. Based on the new variables, we presented

data in other articles (Neugebauer, 2024; Neugebauer et al., 2024). This phase was crucial for gaining a deeper context, although we had to exclude some articles due to the work's aims. The abstract selection excluded 16 articles, and the full text reading excluded 19. Overall, the data presented in this study were collected from 41 articles; however, not all the data collected are presented. Few articles were used just to verify the information already said by other authors.

Thirdly, we prepared all the articles and gathered all the possible data about the economic barriers. We categorized all the data into groups and marketed them using the proper and relevant names in a general sense.

Finally, we consulted with the relevant individuals from each vulnerable population group regarding the economic barriers, drawing on the data and theories we had collected. These semi-structured interviews, which lasted an average of 30 minutes, supported the views of Czech citizens. To better understand, we created a picture as a visual grounding (Figure 1).

PARTICIPANTS' DATA

We identified seven groups of people typically affected by disparities in healthcare access due to economic barriers. We asked at the beginning of the interviews about characteristic information of our participants (see Table 1 below). We did 21 interviews (3 for each group), which should support or refute our theories. Our priority was to find relevant participants from the group they represent to assess the validity of our theories. Participants were identified on internet websites and in the databases of third-party companies. Choosing was by simple random sampling. After selection, we arrange the meeting with the participants. If they were no longer available (as can happen in individuals with chronic illnesses, pregnant women, and older adults), we would choose the next person based on the same criteria.

Table 1. Characteristic information of participants

	Group of participants	Age	Nationality	Financial income	Job	Region/ area
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
P1	Minorities	27	Iraqis	40.000,- CZK	IT staff	City
P2	Minorities	41	Indians	61.000,- CZK	Team leader IT	City
P3	Low-income people	26	Czechs	21.000,- CZK	Nursing staff	Rural area
P4	Minorities	33	Nigerian	44.000,- CZK	Payroll leader	City
P5	Pregnant women	28	Czechs	15.000,- CZK	Cleaner	Rural area
P6	Older adults	71	Czechs	18.500,- CZK	Pensioner	Rural area
P7	Low-income people	49	Czechs	17.000,- CZK	Factory worker	Small town
P8	Unemployed	36	Czechs	20.000,- CZK	Unemployed	City

1	2	3	4	5	6	7
P9	Chronically ill people	55	Czechs	35.000,- CZK	Unemployed	Small town
P10	Low-income people	51	Slovaks	20.000,- CZK	Unemployed	Rural area
P11	Pregnant women	31	Czechs	21.000,- CZK	Unemployed	Rural area
P12	Older adults	79	Czechs	15.000,- CZK	Pensioner	Rural area
P13	Immigrants and refugees	43	Ukrainians	58.000,- CZK	Company leader	City
P14	Immigrants and refugees	41	Ukrainians	60.000,- CZK	HR leader	City
P15	Chronically ill people	69	Czechs	21.800,- CZK	Pensioner	Rural area
P16	Chronically ill people	71	Slovaks	19.300,- CZK	Pensioner	Rural area
P17	Unemployed	29	Slovaks	28.000,- CZK	Unemployed	City
P18	Unemployed	33	Czechs	16.000,- CZK	Unemployed	Small town
P19	Older adults	74	Czechs	16.700,- CZK	Pensioner	Small town
P20	Pregnant women	26	Czechs	51.000,- CZK	HR	City
P21	Immigrants and refugees	24	Poles	31.000,- CZK	Nursing staff	Rural area

Source: own research.

RESULTS

Our results were categorized into three categories, with the theoretical concept supported by the participants' data. For a better understanding of the relationships between, see Figure 1.

LOW ECONOMIC STATUS

This category includes individuals who are dissatisfied with their income. On a basic level, it includes people with a low income or a limited family or personal budget. Due to changing financial situations, pregnant women and older adults are also included.

Theories refer to the insurance system as one of the barriers for selected groups of people. This was also mentioned in the interviews with the participants. It is not about whether they can or cannot have the insurance. However, there is more to all the participants than not having the money to cover those risks. If they would like to have it, the answer was: *“I love to have it, but we would rather choose food and some cultural aspects to stay in the social environment than cover risks that cannot happen now.”* Supporting information was mentioned: *“You never know what will happen to you, and I know the people who cover their risks and spend thousands of crowns on it. I prefer to improve my children's lives by buying things for their happiness.”* As we can see from this category, it is more about choosing between stuff, because they do not have enough money to cover both.

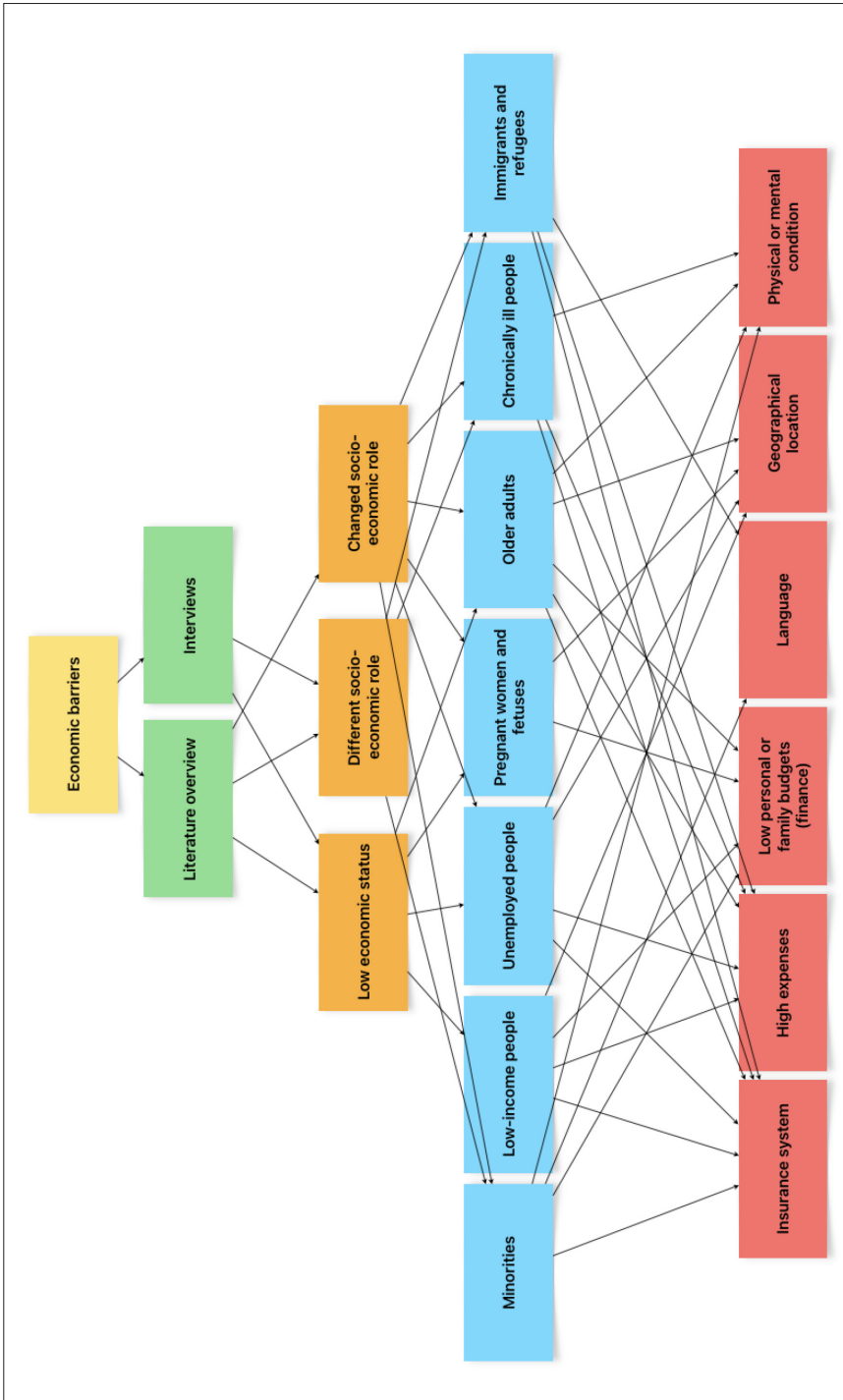


Figure 1. An overview of selected participant groups and their barriers

Source: own research.

The following situation concerns the age or health condition that excludes the clients from the opportunity to pay for it. Our participants refer to it as: *“I do not know the people my age who already have insurance. At this age, you only have a pension and little energy for another job. To be honest, I don’t want to spend more time at work. I accept the statement that I cannot have personal insurance.”* We should note that the participants were from the Czech Republic, where the country provides comprehensive health insurance, and personal insurance is an optional, additional coverage that includes aspects such as injuries or specific diseases requiring long-term treatment. They continued with their living situation: *“We sometimes don’t have money for the bus or train. It’s expensive to go there, and I sometimes don’t feel bad enough to call the ambulance car.”* It also refers to rural areas with no available buses or trains; people would prefer to stay home if it is expensive.

The last situation was mentioned as part of a different culture that is unfamiliar with its workings. Typically, it occurs in minorities, immigrants, and refugees: *“I do not have any idea how it works practically. I already read all the information, but I’m still terrified about copayments.”* Other participants supported this by saying, *“I am terrified of how much I will pay there. And I cannot argue based on my poor Czech language.”*

DIFFERENT SOCIO-ECONOMIC STATUS

This category refers to people with a different socio-economic status from most people in the country (typically minorities, immigrants, refugees, and chronically ill people). Our theories did not mention chronically ill people, but from their perspective, it was part of the new lifestyle that leads to different socio-economic status. *“We lived much more easily before the chronic pain and other symptoms started. After that, we had to cancel the job and stay home to receive a disability pension. I can’t go to work and get more money, or live with the same values as before.”* The disease can impact the patient’s overall health, sometimes rendering them unable to attend the hospital. Participants supported this theory: *“If I feel bad, I do not have the choice to do anything. I can call my son to help me, or if I cannot move and do not have my phone around, I have to wait till someone comes.”*

The next people were discussing the various languages and treatment styles. Different treatment methods and diagnostic systems make them vulnerable, and more education is needed. They support our theories with: *“It is bad to say it, but we do not know how it works here. I don’t have the opportunity to go to the hospital. Or should I go to the healthcare facility you call Poliklinika? Many healthcare staff do not speak English and often make unusual facial expressions and comments. So I prefer to look at the internet and use online physicians.”* All the participants also mentioned the high expenses, co-payments, or bad conditions.

The people of different nationalities stay consistent: *“I am afraid of what will happen. We have to go to work and pay our bills. There is no chance of being ill.”*

CHANGED SOCIO-ECONOMIC ROLE

This category refers to individuals who have changed their socio-economic role, allowing them to return to their previous position. Czech pregnant women did not support our theories, who said: *“I do not feel any discomfort in this area. I am pregnant, but my job is very stressful, and I can do it in this condition as well.”* Some women work as long as possible to prepare the budget. One of them had a bad condition during the pregnancy and described to us: *“Sometimes there is a painful stomachache, and you have fear about your baby. It makes you panic and forces you to spend a lot of money to reach the hospital. I have no idea what I should do if I were somewhere in the countryside.”* Some people also refer to money for extra technical support and treatment. They told us: *“We wanted the 3D picture of our baby or any other technical screening. But it was for extra payment, and we are happy to travel to the hospital and find some cheap furniture at home before the baby comes.”*

There was also some information about geographical preferences that supports both groups, pregnant women and older adults: *“In this condition, you have to predict what happened and whether you can reach the hospital. We are saving money for a taxi, in case there is nobody around to take me there.”* Older adults prefer to stay home if symptoms appear and they cannot accurately assess them. Most say, *“We have had this condition for years, so we know what can happen. There are no symptoms that we do not expect or did not have before.”*

DISCUSSION

Based on the study's selected objective, we wanted to identify the economic barriers that can lead to disparities in access to healthcare facilities and proper care. Our results reflect six potential obstacles that can be linked to a specific group of people.

The first barrier is the insurance system, which is problematic and a barrier to healthcare access. Results also suggest that misunderstandings exist in the education of foreign citizens in Central Europe, where universal insurance is funded through taxes (Garney et al., 2021). Ahmed et al. (2001) support this domain as a barrier, but used the American system as an example. Those who need to undergo treatment cannot afford it if they do not have the necessary funds. Insurance is the best choice for people who cannot afford the payment (Juarez, 2023). On the other hand, some information is available about how insurance works in the Czech

Republic and European countries, which can help prepare individuals who plan to live in different countries (Lewandowska, Kowalski, Majcherek, Hegerty, 2024; Šlegerová, Bryndová, Michenka, Kočí, 2025). Tkachenko and Kyrylenko (2023) support the information about the insurance companies and their work in each country. They also reveal information about investment strategies that everyone can apply. Some people use a combination of insurance, where they pay for the “money pillow” if they do not yet have sufficient funds. With this insurance, they also create investments that create this extra budget for unexpected expenses. After a few years, they reach the budget for covering the health problems, and paying for that “money pillow” is unnecessary (Thomas, Diclemente, Snell, 2013; Gordon, Booyesen, Mbonigaba, 2020).

The second barrier is connected to the first and refers to the high expenses associated with treatment or healthcare. Our results support that people fear spending money in healthcare facilities or buying medication in pharmacies. We must mention examples from other countries, where people pay for visits to the physician, physical examinations, technical assessments, blood tests, and therapeutic plans (Carrillo et al., 2011; Gordon et al., 2020). Compared to this system, European treatment is significantly less expensive (Lewandowska et al., 2024). There is also a co-payment, but only for medications or additional treatments not covered by general insurance (Maarse, 2006; Neugebauer, 2024, Neugebauer, Vokoun, 2023).

The third barrier is a low family or personal budget. Our results support this domain as a significant barrier in non-European countries. The universal system is well-suited for individuals who cannot afford treatment, but still require it. Maarse (2006) describes this situation and notes that people from other countries also come for acute treatment to pay less than they would in their home country. It makes sense why we still have a lot of work to do, given the shortage of employees in healthcare facilities (Thomas et al., 2013). Ahmed (2001) used the American system as an example of how much people must pay. It makes sense for the people there to create an extra budget of money without the panic about what will happen. However, it does not make sense in European countries to create an additional budget or be afraid about what will happen if more than 90% of the budget is covered by health insurance, and social insurance can also support some money loss because of the treatment (Lewandowska et al., 2024; Neugebauer, 2024; Šlegerová et al., 2025).

Language is the fourth barrier to accessing healthcare; therefore, all hospitals and healthcare facilities should have a translator available. Our results support the theory that language can act as a barrier. People are hesitant to visit healthcare facilities for proper care due to negative past experiences. Sheikh-Mohammed, Macintyre, Wood, Leask, and Isaacs (2006) discuss language as a significant issue in small countries with their languages, such as the Czech Republic. There can be more than a misunderstanding that can lead to improper care, missing care,

or delayed care. It can also lead to unnecessary tests, repeat visits, and incorrect treatments. All of these factors contribute to increased healthcare costs for patients and providers. It disproportionately affects minority and immigrant communities, exacerbating existing economic disparities and limiting their access to quality healthcare (Juarez, 2023; Neugebauer, 2024; Thomas et al., 2013). This type of barrier also encompasses some religious or culturally diverse preferences, which can lead to discrimination or unusual behavior from healthcare staff (Rapp, Volpe, Hale, Quartararo, 2021).

Geographical location is the fifth barrier on the list. Results indicate that individuals from rural areas have less access to healthcare compared to those in cities. This is due to the proximity of their residence to the healthcare facility. Many of them must travel more than 30 minutes to visit the physician. Neugebauer, Vokoun, and Lovětinská (2024) and Neugebauer, and Vokoun (2023) demonstrate in their studies that there are more connections with this barrier, and the distance from the healthcare facility can have a profoundly detrimental impact on the rest of the person's life. Local bus companies or healthcare services can help address the transportation issue (Juarez, 2023). Reilly (2021) described this as a factor that can lead to an increase in the co-payment. Imagine that some people rely on healthcare transportation services because they lack access to transportation or other alternatives. They must include the money for transport in the budget, and as Ahmed, Lemkau, Nealeigh, and Mann (2001) note, the treatment and examination are often cheaper than the transport (Yu, Meng, 2022). It is also about the facility preferences in connecting with the staff's behavior. Some people, mostly from different countries, prefer culturally sensitive facilities (Rapp et al., 2021).

These barriers are connected with the last one, the patient's health condition. Our results support the theories and environmental research. The patient relies on other services to transport them to the healthcare facility, depending on their physical condition. This condition makes them very vulnerable, and we can discuss many changes based on actual diagnoses, mental or physical status. Reilly (2021) refers to some people who cannot pay for themselves because they are in pain or under the control of the disease. It can also be very uncomfortable for both healthcare workers and patients to discuss payment before they begin treatment. Let us focus more on European style, where we do not have these issues due to a universal healthcare payment system (Lewandowska et al., 2024). Neugebauer et al. (2024) described some of these disabilities that can be caused by the lack of care or an unreachable healthcare facility. Their results contain information about healthcare facilities prepared for all transportation possibilities in big cities, including helicopters. In the Czech Republic and other countries with similar healthcare systems, people can be transported without a mandatory copayment. As Neugebauer (2024) reflected, if there is any suspicion of misdiagnosis or delayed care, the healthcare facilities communicate with each other and provide the fastest care for the patient.

CONCLUSION

The economic concept of barriers that lead to different access to healthcare is numerous and interconnected. Patients often encounter multiple barriers that affect their access to a healthcare facility. In addition to other health financing systems, co-financing or choice of transport is more dominant.

Six fundamental barriers were identified, including language barriers, a limited budget, an inadequate insurance system, geographical location, health status, and high healthcare costs.

In addition to this list of fundamental barriers, it was also found that patients are hesitant to seek medical help due to previous experiences or references from their home countries. One of the common barriers is also living in the countryside, which can signal that a person may be far from medical assistance. In the Czech Republic, social services are available to help individuals cope with specific situations. However, this does not solve the financial crisis and illnesses of vulnerable patients. Some knowledge should be disseminated to this group to reduce risks. This can lead to a better understanding of one's health and access to healthcare if necessary.

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*Ing. Ján Kollár, PhD.*¹ 

Department of Economics, Faculty of Economics
Matej Bel University in Banská Bystrica

*Bc. Vanesa Kováčiková*² 

Department of Economics, Faculty of Economics
Matej Bel University in Banská Bystrica

Household management and the gendered division of unpaid work in dual-earner couples: Theoretical and methodological insights³

Abstract

This paper explores the theoretical and methodological foundations of household management in the context of unpaid work, focusing specifically on dual-earner couples. Unpaid work, including household chores, childcare, and eldercare, represents a critical yet often invisible component of both economic and social life. Despite its importance, the management and division of unpaid work have received limited scholarly attention, particularly in countries like Slovakia. This paper provides a review of key theoretical approaches and international empirical research, highlighting how gender roles and negotiation processes shape the distribution of unpaid labour. While the article does not analyse gender inequalities as its primary focus, it acknowledges the gendered nature of household management practices and their potential implications for work-life balance and well-being. The paper argues for the integration of management perspectives into unpaid work studies, emphasizing the need to understand households not only as sites of consumption but also as units of organization and coordination. Finally, it outlines directions for future research, calling for context-specific empirical studies to better capture the unique features of dual-earner households in Slovakia and similar socio-economic environments. The findings have implications for public policy, gender equality initiatives, and the well-being of individuals within dual-income families.

Keywords: dual-earner couples, gender roles, household management, unpaid work.

¹ Correspondence address: Ekonomická fakulta Univerzity Mateja Bela, Tajovského 10, 975 90 Banská Bystrica; e-mail address: jan.kollar@umb.sk. ORCID: 0000-0001-7317-6654.

² Correspondence address: Ekonomická fakulta Univerzity Mateja Bela, Tajovského 10, 975 90 Banská Bystrica; e-mail address: vkovacikova4@student.umb.sk. ORCID: 0009-0009-2715-1216.

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**Zarządzanie gospodarstwem domowym a zróżnicowany
ze względu na płeć podział nieodpłatnej pracy w związkach dwuzarabiających:
ujęcie teoretyczne i metodologiczne**

Abstrakt

Niniejszy artykuł analizuje teoretyczne i metodologiczne podstawy zarządzania gospodarstwem domowym w kontekście pracy nieodpłatnej, ze szczególnym uwzględnieniem związków dwuzarabiających. Praca nieodpłatna, obejmująca obowiązki domowe, opiekę nad dziećmi oraz opiekę nad osobami starszymi, stanowi istotny, choć często niewidoczny element życia gospodarczego i społecznego. Pomimo jej znaczenia zarządzanie i podział pracy nieodpłatnej były dotychczas w ograniczonym stopniu przedmiotem badań naukowych, szczególnie w takich krajach jak Słowacja. Artykuł przedstawia przegląd kluczowych podejść teoretycznych oraz międzynarodowych badań empirycznych, podkreślając, w jaki sposób role płciowe i procesy negocjacyjne kształtują rozkład pracy nieodpłatnej. Choć analiza nierówności płci nie jest głównym celem artykułu, Autorzy uznają płciowy charakter praktyk zarządzania gospodarstwem domowym oraz ich potencjalny wpływ na równowagę między życiem zawodowym a prywatnym oraz dobrostan jednostki. W artykule argumentuje się na rzecz włączenia perspektyw zarządczych do badań nad pracą nieodpłatną, z naciskiem na potrzebę postrzegania gospodarstw domowych nie tylko jako miejsc konsumpcji, ale także jako jednostek organizacji i koordynacji. Na koniec przedstawiono kierunki przyszłych badań, wskazując na potrzebę kontekstowych badań empirycznych, które lepiej uchwycą specyfikę związków dwuzarabiających w warunkach słowackich i w podobnych środowiskach społeczno-ekonomicznych. Wnioski artykułu mają znaczenie dla polityki publicznej, inicjatyw na rzecz równości płci oraz dobrostanu osób żyjących w rodzinach o podwójnych dochodach.

Słowa kluczowe: pary z podwójnymi dochodami, role płciowe, zarządzanie gospodarstwem domowym, praca nieodpłatna.

JEL: D10, D13.

INTRODUCTION

Households play an irreplaceable societal role, receiving substantial academic attention from various perspectives aimed at understanding internal dynamics and external environmental interactions. However, given the private nature of households, it is often difficult for researchers to fully “penetrate” this sphere. Consequently, empirical insights into household behaviour – either of individuals or the household as a unit – are limited and therefore particularly valuable. This paper seeks to offer a less conventional, yet highly relevant and socially desirable, perspective on household functioning. While still relatively rare in Slovakia and many other European countries, this perspective applies theoretical concepts from management science to the household context.

The daily decisions and processes within households are unlikely to be entirely spontaneous or intuitive. In many cases, it can be assumed that household members rely on coordinated procedures closely aligned with the traditional functions of

management as known from business practice. The aim of this paper is to provide a theoretical framework for understanding household management in the context of unpaid labour. It also presents methodological approaches and international experiences in household research, while suggesting how these may be adapted to the Slovak context. Our conceptual foundation is grounded in existing approaches to household management that seek to explain its mechanisms and provide pathways for empirical investigation. These approaches, when appropriately modified, offer numerous insights applicable to real-world research.

Although international studies provide valuable insights into household management and unpaid labour, the Slovak context remains relatively underexplored. Existing research shows that Slovak households demonstrate distinctive features, especially in the volume and gendered distribution of unpaid work. These features reveal both similarities and differences compared to households in other countries, which will be discussed in later sections of this article. Emphasizing these characteristics highlights the need to adapt international theoretical and methodological approaches to the Slovak environment, where systematic empirical research remains scarce. In line with the above, the aim of this article is to describe a theoretical framework of household management in the context of unpaid labour, specifically in the case of dual-earner couples, based on the analysis of theoretical foundations and research from various countries. Although our article is primarily theoretical, the methodological approach to processing this article is based on its theoretical focus and is adapted to the aim of describing a theoretical framework of household management in the context of unpaid labour. The article is based on a qualitative analysis of secondary scientific sources from various countries that reflect the management of everyday life in the household. The analysis of these sources allowed us to identify experiences with primary survey methodology, which may be beneficial in the next phase of research under the conditions of the Slovak Republic, as these findings are rare for Slovak households and socially desirable.

THEORETICAL CONCEPTS OF HOME MANAGEMENT AND HOUSEHOLD MANAGEMENT

Home management consists of a series of decisions that together form the overall process of utilizing family or household resources. In this context, family goals are of primary importance, as all managerial activities are directed toward their fulfilment, which in turn provides maximum satisfaction for the family. Home management is considered an essential component of family life, contributing to the health, well-being, and development of all its members (Varghese, 1985). Hill and McFarland (1971) define home management as the mental coordination of all individuals one must collaborate with, as well as the selection of goals one

aims to achieve. In addition to goal-setting, home management also involves managing financial resources. It is a joint effort by spouses or partners to handle their household economically and emotionally (Jain, 2019). In contrast, Medina (1991) presents a more traditional perspective, where the husband is viewed as the primary breadwinner, reflecting the family's social and economic status in society, while the wife assumes full responsibility for childcare and home management. Beyond motherhood, this domain encompasses home economics components including familial relationships, safety, child development, and resource allocation. The administrative dimension emphasizes planning, integration, and evaluation of household resources to optimize quality of life for all members (AwadAllah, 2019; Amin, Akhter, 2011).

Theoretical concepts of “household management” identify specific cognitive and organizational tasks facilitating family and household care, defined as the amount of time spent considering family and housework throughout the day (Ciciolla, Luthar, 2019). The concept may thus be viewed as a key responsibility, as decisions related to family and household matters are inherently tied to financial resources. When resources are scarce, household management becomes a burden. In contrast, when financial resources are sufficient, decision-making is significantly easier. Indeed, household income directly influences nearly all household-related activities (Yovcheva, 2012; Treas, Tai, 2012; Srinivasan, Athuru, 2005). Activities associated with household management include time allocated to meal planning and preparation, organizing daily routines, scheduling appointments for household members, managing services and repairs, and making financial decisions (Mederer, 1993; Winkler, Ireland, 2009). The distribution of these tasks is often influenced by gender, the employment status of spouses, the presence of children, or even the number of cars the family owns (Srinivasan, Athuru, 2005). Nosheen, Ali, and Ahmad (2011) argue that household management is predominantly associated with women, who assume this responsibility alongside motherhood.

Household management and unpaid labour demonstrate significant interdependence through the coordination of finite resources including human capital, financial assets, time allocation, and energy distribution for essential domestic task completion. Effective household management functions optimize task distribution, facilitate equitable responsibility allocation, and mitigate interpersonal conflict among household members. Technological advances and artificial intelligence integration present potential efficiency improvements through reduced temporal burdens and enhanced coordination mechanisms via digital applications and smart systems, thereby contributing to domestic harmony – an essential goal of household management. Theoretical approaches to household management in the context of unpaid labour offer valuable tools for empirical research, helping to enhance our understanding of current dynamics in this area, which is undoubtedly influenced by external societal trends.

The concepts of home management and household management are often used interchangeably; however, based on an analysis of the scholarly literature, we have identified several differences. Home management is perceived as a more complex concept, oriented toward family goals. We understand it as a part of household life, emphasizing health, well-being, and the development of family members. On the other hand, household management is more specific, focusing on concrete everyday tasks and their implementation. Home management often has an emotional dimension, as many publications mention the joint efforts of partners, while household management is characterized by pragmatism, with an emphasis on efficiency and time management.

UNPAID WORK IN THE HOUSEHOLD

Increased academic attention to unpaid work in economics and sociology began during the 1960s and 1970s (Swiebel, 1999). Unpaid work is one of the most important sources of comfort in individuals' everyday lives and constitutes a key component of the economy, contributing to overall societal well-being at the macroeconomic level (Zachorowska-Mazurkiewicz, 2016; Hirway, 2015). Miranda (2011) highlighted the significance of unpaid work in the context of well-being, asserting that it contributes substantially to both present and future well-being within households and communities. The paradox lies in the fact that while unpaid work promotes well-being, it can simultaneously hinder women's economic status, thus reducing their independence and life satisfaction. This is not due to unpaid work itself, but rather to its unequal distribution and mismanaged household organization (Bruyn-Hundt, 1996). Measuring unpaid domestic work is important mainly to inform policies that promote a fairer division of paid and unpaid work between women and men (Bednárík, 2024).

Despite the existence of many definitions in the literature, the core understanding of unpaid work – as deliberate, productive activity carried out within households, outside the official labour market, for which no financial compensation is received – remains largely intact (Považanová, 2016). According to Harvey and Taylor (2000), unpaid work encompasses the minimum amount of time required for the household operation and maintenance, including raw materials transformation into consumable goods and ensuring a healthy, clean living environment. It also includes cooking, gardening, shopping, managing social and personal relationships, and providing auxiliary services accessed through the public or private sectors. Products of unpaid labour may also benefit individuals outside the household, such as assisting an elderly relative with gardening (Picchio, 2003; Miranda, 2011). Antonopoulos (2008) argues that unpaid work lacks societal recognition, and that numerous factors – age, gender,

household composition, geographic location, social class, and the presence or absence of children – influence the division of time between paid and unpaid labour. Measuring its volume highlights inequalities in time distribution, specific responsibilities, economic resources, and social accountability, while underscoring its essential role as a dynamic component of the economic system (Picchio, 2003).

Households typically devote a comparable amount of time to unpaid work as to paid employment. Since the home represents a vital setting for daily life, research is increasingly focusing on household technologies, seen as tools capable of transforming lifestyles and improving quality of life (Aldrich, 2003; Lehdonvirta, Shi, Hertog, Nagase, Ohta, 2023). According to Hertog, Fukuda, Matsukura, Nagase, and Lehdonvirta (2023), unpaid tasks – particularly those related to domestic labour – are highly susceptible to automation. Smart home technologies can significantly reduce gender disparities in household responsibilities, decrease time on undesirable tasks, increase leisure time, and enhance personal autonomy in aging. These technologies must recognize household habits and preferences to maximize quality of life improvements. Simultaneously, privacy protection and misuse prevention are essential, which contradicts the above assumption (Friedewald, Da Costa, Punie, Alahuhta, Heinonen, 2005).

DUAL-INCOME COUPLES AND CONCEPTS INFLUENCING THEIR DECISION-MAKING

A couple consists of two individuals who are in a marriage, romantic, or sexual relationship, or are together for a specific purpose (Cambridge Dictionary, [http](http://)). Dual-income couples have begun to challenge traditional gender stereotypes, as women are increasingly the ones contributing to the family economy, while men contribute emotionally (Harrington, VanDeusen, Humberd, 2011; Howe, 2012). Rahman, Jan, Bibi, and Ahmad (2021) point out that marriages with two income earners are a source of mutual moral and emotional support for both partners. There are several typologies of couples that help to highlight the variability and understanding of differences within and between dual-income couples (Masterson, Hoobler, 2015). Raley, Mattingly, and Bianchi (2006) examined typologies based on the contributions of each member of the marriage to the overall family income. They identified couples in which the husband was the primary income provider, equal-income providers, and couples where women were the dominant earners. Through an alternative approach, researchers have identified three types of dual-income couples: the high-status couple, associated with high job prestige and the importance of work in their lives; the low-stress couple, marked by lower prestige and lower job overload; and the primary-secondary provider couple, characterized by a large disparity in the working hours of the spouses (Crouter, Manke, 1997).

Clarkberg and Moen (2001) did not focus on the prestige or status of couples, but instead examined each partner's working time. They categorized couples into nontraditional full-time, nontraditional long hours, dual-career full-time, dual-career long hours, and husband part-time. A different perspective is offered by Moe and Shandy (2010), who introduce the concept of "100-hour couple," where partners collectively work more than 100 hours per week as a household.

The first theoretical concept that deals with the division of unpaid domestic labour between men and women is the perspective of relative resources. This approach assumes that power relations influence unpaid work distribution, with household members' relative socio-economic resources creating negotiating power over time allocation to unpaid labour (McElory, Horney, 1981). The income level of individual household members directly influences responsibility allocation, with economically dependent women or those experiencing constrained employment access demonstrating diminished bargaining power and subsequently undertaking the majority of unpaid domestic labour (Raley, Bianchi, Wang, 2012; Altuzarra, Gálvez-Gálvez, González-Flores, 2020). The author Schneider (2011) confirms theory that income functions as bargaining power-until spousal parity is reached. When women earns more than a men, thus violating the breadwinner norm, they paradoxically increase their share of unpaid work. Apart from this approach, power is also addressed by Sprey (1979) in the theory of conflicts, where he assumes that people in a marital union compete for power with each other. The theory of human capital takes into account access to time and its subsequent distribution by household members or the couple between the labour market and household work. In this case, the division of labour is the result of the couple's rationality, who seek to maximizes the welfare and utility of the household (Becker, 1993; Oinas, 2018). According to this approach, paid and unpaid work division reflects comparative advantages between men and women, determined by education and income levels. Higher comparative advantage correlates with reduced time spent on unpaid household work (Becker, 1993; Altuzarra, Gálvez-Gálvez, González-Flores, 2020). Oinas (2018) asserts that studies examining income's impact on household labour division consistently demonstrate relatively equitable unpaid work distribution when spousal income disparities are minimal. However, Sevilla-Sanz, Gimenez-Nadal, and Fernández (2010) reject the comparative advantage and income hypotheses, instead supporting gender behaviour theory and masculinity/femininity influences.

From a gender perspective, paid work is considered masculine and more valuable, whereas unpaid domestic work is regarded as feminine and less valuable (Downing, Goldberg, 2010). Freudenthaler and Mikula (1998) argue that the unequal division of household labour stems from societal expectations defining gender-specific work roles. The presence of traditional roles leads women to

feel responsible for unpaid household labour, which increases their share of domestic duties regardless of their income level (Zimmerman, 1987). Due to social roles and gender stereotypes, women have adopted instrumental tasks such as cooking and laundry, quiet managerial tasks like household scheduling and time management, administrative duties such as planning, and significantly, they are assigned responsibility for mental labour (Moulton-Tetlock, Ahn, Haines, Mason, 2019; Hessing, 1994; Lee, 2005). Women who endorse traditional gender stereotypes do not perceive the unequal division of unpaid domestic work as a barrier or injustice; rather, from their perspective, they see themselves as primarily responsible for household and family work. It is generally observed that women's satisfaction also rises if their husbands perform more domestic work compared to other husbands in their social circle (Greenstein, 1996; Himsel, Goldberg, 2003).

Given that the aim of this paper is to provide a theoretical framework for understanding household management in the context of unpaid labour, in the introductory part we worked with secondary sources of scholarly literature. Primarily, we drew on books, publications, academic articles, research studies, and databases. The following section of this paper compares multiple studies addressing unpaid work management in dual-income households. To ensure diversity, several scientific studies from different parts of the world were selected for comparison. The focus will be on research methodologies, the implementation of surveys in real conditions, and the comparison of the results achieved. From the methods of scientific inquiry, we primarily employ comparison, analysis, and synthesis in the concluding part of the paper.

COMPARISON OF METHODOLOGIES FOR RESEARCHING THE MANAGEMENT OF UNPAID WORK IN HOUSEHOLDS

To understand the management of unpaid work in dual-earner households, we examined several empirical studies from different socio-cultural contexts. Studies were selected based on systematic search using terms “dual-earner couples” and “unpaid work,” with selection criteria including: 1) thematic relevance and direct alignment with the research focus, and 2) geographical diversification with emphasis on proportional representation of different national contexts. These studies differ in sampling methods, data collection techniques, and research objectives, but collectively contribute to a nuanced understanding of domestic unpaid work. In this section, we introduce a comparative analytical framework along five key dimensions: 1) data collection method; 2) sample composition; 3) country and context; 4) main analytical focus; 5) notes on tools or limitations.

Table 1. Methodological Overview of Selected Studies

Study	Data Collection Method	Sample Composition	Country/ Context	Main Analytical Focus	Tools/ Limitations
Stevens, Kiger, Riley (2001)	Structured survey, separate questionnaires for each partner	156 dual-earner heterosexual couples	USA (Rocky Mountains)	Marital satisfaction, domestic chores division, gender ideology	Spanier's 7-item scale, strong emphasis on spousal satisfaction
Bartley, Blanton, Gilliard (2005)	Survey via workplace channels	233 participants from female-dominated workplaces	USA (Southern states)	Gender ideology, decision-making, equity perception	Multi-step distribution, Likert scales, potential selection bias
Alby, Fatigante, Zuccheromaglio (2014)	Focus group interviews, daily activity charts, video recordings	15 working mothers + 8 families	Italy (Rome)	Mental load, managerial responsibility, real-time behavior	Rich qualitative data; small, non-generalizable sample
Altuzarra, Gálvez-Gálvez, González-Flores (2020)	Time-use diaries, secondary data	1,269 dual-earner households from larger sample	Spain	Time spent on childcare and housework vs. income levels	Eurostat activity codes, 24-hour time logs, OLS regressions
Craig, Churchill (2020)	Online survey	1,536 dual-earner couples with children	Australia	Pre/post-COVID changes in household labour and care roles	Longitudinal (retrospective) design, Likert items, pandemic context
Zaman, Shadid (2023)	Survey using Likert scale and Dual-Career Parenting Scale	50 couples employed in the formal economy	Pakistan (Islamabad, Rawalpindi)	Emotional strain, work-life balance, gender roles	Small sample, extensive psychometric tools (e.g. Cron Cronbach's alpha)

Source: own elaboration.

This structured comparison highlights several patterns:

1. Quantitative vs. qualitative designs. While most studies employed structured surveys that enabled broad generalizability and statistical analysis, Alby, Fatigante, and Zuccheromaglio (2014) introduced a qualitative dimension through in-depth interviews, activity charts, and video recordings. This approach allowed for deeper insight into intangible aspects such as emotional labour,

mental load, and tacit managerial responsibility often overlooked in standard surveys. Their study offers a fine-grained perspective on how women structure and manage domestic routines in real-time.

2. Focus on gender roles. All studies acknowledged gendered patterns in unpaid work and confirmed a disproportionate domestic burden on women. Theories of relative resources, gender ideology, and symbolic gender roles were consistently applied as interpretive frameworks. Several studies found that even when women earned more than their partners, they continued to perform the bulk of domestic work – reflecting the endurance of traditional gender expectations and compensatory behaviours.
3. Cultural and economics contexts. Studies spanned diverse geographical and cultural settings, allowing for a rich comparative understanding of unpaid work. For example, the Spanish study examined economic variables such as income and employment in relation to unpaid work, while the Pakistani study highlighted the burden of societal gender norms and their effects on emotional strain and time pressure. The Italian and American studies focused more heavily on family dynamics, religious beliefs, and role negotiation within households. These contextual differences reveal how unpaid work is shaped not only by income and employment but also by cultural expectations and institutional support structures.
4. Pre-pandemic vs. pandemic dynamics. Craig and Churchill's research (2020), conducted during the COVID-19 pandemic, provided valuable insights into how crisis contexts alter domestic unpaid work patterns. Their findings revealed a temporary increase in men's caregiving involvement; however, this was accompanied by a simultaneous and greater increase in women's unpaid workload. The study illustrates the fragility of progress toward gender equality in household work under crisis conditions and the importance of structural supports for sustainable change.
5. Use of tools and scales. Most quantitative studies utilized validated instruments, such as Likert-type scales, time-use diaries, and equity perception tools, to measure attitudes, behaviours, and workloads. Zaman and Shadid (2023) also used the dual-career parenting scale to assess emotional strain in dual-earner couples. In contrast, qualitative research focused more on discursive strategies, narrative structures, and situational analysis. The variety of tools and indicators across studies demonstrates the multidimensional nature of unpaid work and suggests that mixed-method approaches may be particularly valuable in future research.

In summary, despite differing methodologies, all reviewed studies confirm persistent gender disparities in household labour. They collectively underline the need for further context-sensitive empirical inquiry – especially in under-researched regions such as Central and Eastern Europe.

COMPARISON OF RESULTS IN THE MANAGEMENT OF UNPAID WORK
IN DUAL-EARNER HOUSEHOLDS

In each of the studies reviewed, the authors paid particular attention to the time couples allocated to unpaid (domestic) labour. Stevens, Kiger, and Riley (2001) found that women spent approximately 15 hours per week on household tasks, while men spent only 6.8 hours per week. Bartley, Blanton, and Gilliard (2005) examined the division of domestic labour in more detail, distinguishing between low-control and high-control tasks. They found that wives spent more time performing low-control tasks, whereas men tended to handle those with higher control. Unlike the aforementioned authors, Alby et al. (2014) did not quantify the time spent on unpaid work. Instead, working mothers were characterized as family life managers, bearing the “mental load” of household responsibilities through efficiency planning, detail monitoring, routine management, and family decision-making organization. Altuzarra, Gálvez-Gálvez, and González-Flores (2020) demonstrated that women’s domestic labour allocation diminishes until achieving income parity. Interestingly, when women’s earnings surpass their partners’, domestic labour increases, replicating patterns observed among lower-earning women. This model supports the claim that women may compensate for higher earnings by devoting more time to housework. Craig and Churchill (2020) tracked unpaid work changes during COVID-19, finding women spent 1.7 more daily hours than men on housework, household management, and childcare pre-pandemic, increasing to 2.3 hours during the pandemic. Zaman and Shadid (2023) confirmed this pattern, with women averaging 24.36 weekly hours on domestic tasks versus men’s 16.56 hours.

A distinct component of unpaid work is childcare. While Stevens, Kiger, and Riley (2001), as well as Bartley, Blanton, and Gilliard (2005), did not focus specifically on this type of labour, Alby et al. (2014) did. They found that mothers constantly monitored their children’s needs and, even when the father was actively involved, the mother remained responsible for envisioning, planning, and executing the activity. Altuzarra et al. (2020) examined the relationship between income and time devoted to childcare. They concluded that earnings did not significantly affect men’s and women’s time devoted to childcare. Before COVID-19 restrictions, the gender gap in active childcare was 54%. Craig and Churchill (2020) observed that this gap narrowed to 40% during the pandemic. Zaman and Shadid (2023) identified a strong link between work-family balance and financial strain.

Regarding partner satisfaction with the division of domestic labour, Stevens et al. (2001) found that women were less satisfied than men. Women’s satisfaction increased with the number of hours their partners spent on housework and was

positively associated with their gender ideology. Conversely, the more time women spent on domestic chores themselves, the less satisfied they were. Bartley et al. (2005) did not explore this particular aspect, but Alby et al. (2014) indirectly indicated dissatisfaction among women, describing the unequal burden as a source of fatigue. While Altuzarra et al. (2020) did not address this issue directly, Craig and Churchill (2020) explored subjective experiences of time allocation during the pandemic, finding that many mothers experienced reduced time constraints, enhancing perceptions of parental equity. However, one-third reported bearing disproportionate unpaid labour responsibilities. The perceived gender gap in fairness increased from 18% to 28%. Zaman and Shadid (2023) did not address partner satisfaction with the division of unpaid work.

From the perspective of gender ideology, Stevens et al. (2001) argued that gender ideology indirectly affects women's marital satisfaction through domestic work engagement. Women identifying with traditional gender ideologies perform more housework yet feel more satisfied with the labour division. Bartley et al. (2005) reached similar conclusions, stating that gender ideology has a direct impact on how labour is divided between men and women. Alby et al. (2014) consistently highlighted gender inequality in labour division, emphasizing how gender ideology shapes planning, organization, and task allocation in households. Altuzarra et al. (2020) also noted the influence of gender ideology in relation to income – based task division. Although Craig and Churchill (2020) did not directly study gender ideology, their findings relate to gender equality in households. They noted that fathers were forced to increase their caregiving time during the pandemic, but mothers' unpaid workload also increased – indicating mixed outcomes regarding gender equality. Zaman and Shadid (2023) confirmed that women bear the majority of household responsibilities due to harmful gender stereotypes.

CONCLUSION

Exploring unpaid work's multidimensional contexts provides valuable insights into household functioning. This paper examined theoretical aspects of unpaid work management in dual-earner households – a relatively unconventional perspective offering deeper understanding of household processes before and during unpaid work performance. Drawing on theoretical knowledge and existing studies enabled several key conclusions. From a theoretical perspective, unpaid work and household management constitute interconnected constructs, with management functioning as an inherent component of household operations, particularly concerning unpaid work coordination. Unpaid work performance necessitates deliberative choices regarding task allocation, scope, quality parameters, and beneficiary designation. These aspects represent only a selection

of the everyday “dilemmas” households must resolve in light of the many activities that comprise unpaid work. The identified aspects are influenced in real-life settings by factors such as household size, household income, the educational attainment of household members, and the time household members spend on paid work. Dual-earner households exemplify contexts where both partners participate in the labour market, creating complex constraints for unpaid labour organization. The findings we have reached indicate that the methodology for examining the chosen dimensions is not standardized, leaving ample room and potential for researchers or research teams focused on the management of unpaid labour. Most of the studies reviewed relied on questionnaires as their primary data collection method. This approach enables large sample sizes that facilitate generalization of findings, provided the questionnaire is well-structured and clearly understood by respondents to ensure valid responses. With appropriate structuring, this method can ensure a degree of comparability of information and data, allowing for partial comparison of results within a country as well as across countries. Such comparisons can be useful, for example, in explaining cultural differences and customs among households in different contexts. In Slovakia, the area of unpaid labour has already been partially explored, which creates a significant opportunity for continuing and deepening research to reflect current social and economic realities. The insights we gained through this study have confirmed the necessity of researching unpaid labour, as it remains an integral and inseparable part of household life. Its organization adapts to technological advancements and the evolving labour market, which increasingly includes remote work arrangements. Based on the review of available literature and the synthesis of findings from real-world studies across different contexts, our next ambition and challenge is to design and conduct a survey in Slovakia that focuses on selected aspects of unpaid labour management. Acknowledging the current state of knowledge, as well as the benefits and limitations of surveys and research in this area, has led us to the conclusion that focusing on specific types of households is beneficial. Such a targeted approach enhances the generalizability of conclusions within defined household types. However, given the vast and heterogeneous nature of household populations, full generation remains unfeasible due to their inherent diversity and complexity.

When examining the specifics of Slovak households in the area of unpaid work in comparison with the studied regions – the USA, Italy, Australia, and Pakistan – we observe several similarities as well as differences. In terms of the amount of time spent on unpaid work, women in Slovak households devote approximately 31 hours per week (Kika, Martinkovičová, 2015), while in Pakistan it is 24.34 hours per week (Zaman, Shadid, 2023), and in the USA it is about half as much as in Slovakia, according to Stevens et al. (2001). For men in Slovak households, it is approximately 17 hours per week (Kika, Martinkovičová, 2015), in Pakistan very

similarly 16.56 hours per week, and in the USA only 6.8 hours per week. On the basis of the selected studies, we can therefore claim that, at least among these three countries, the extent of unpaid work performed weekly is the highest in Slovakia. Australia, Italy, and all the other countries under review were characterized, from the perspective of gender ideology related to the division of unpaid work, by the persistence of stereotypes, and in all cases, women performed more of this type of work than men. The situation is no different in Slovakia, where many specific tasks are even categorized as “women’s” and “men’s” work (Kika, Martinkovičová, 2015). In Italian households, Alba et al. (2014) mentioned in many cases the presence of the mental load of women, described as managers of family life, routine organization, and decision-making. A similar feature can be observed in Slovakia, where decision-making is often delegated primarily to women. On the other hand, the authors emphasize that many of these arrangements also arise from mutual agreement among household members, aimed at maximizing utility (Kika, Kollár, 2020).

The theoretical concept of this article helped us to better understand and penetrate the essence of household management in the context of unpaid labour among dual-earner couples. At the same time, we identified methodological approaches for collecting primary data in this field from various countries, which is inspiring for the next phase of our research. The information obtained from Slovak households is essential not only for economic and political decision-making in family and social policy but can also provide valuable insights for private sector employers, who can gain a better understanding of the internal processes within households – an environment that is difficult to access and comprehend. Given the current lack of knowledge in this area, future research can provide information and facts that will serve as a useful complement to the existing secondary data from various publicly available sources.

The aim of this paper was to provide a theoretical framework for understanding household management in the context of unpaid labour. In line with the above, the aim of this article was to describe a theoretical framework of household management in the context of unpaid labour, specifically in the case of dual-earner couples, based on the analysis of theoretical foundations and research from various countries. The article offers important insights into the management and gendered organization of unpaid work within dual-earner couples, a topic with strong relevance for both social inequality research and economic development studies. While it does not aim to measure or explain gender inequalities directly, it acknowledges their presence as an important contextual factor shaping household dynamics. The findings suggest that understanding how unpaid work is managed can help promote more equitable sharing of responsibilities, improve work-life balance, and support the well-being of all household members. From a policy perspective, the article underscores the need for measures that encourage shared

caregiving, challenge traditional gender roles, and recognize the value of unpaid work. Finally, the paper calls for future empirical research in Central and Eastern Europe to generate context-specific evidence that can inform both scholarly debate and policy interventions. However, we aim to highlight questions for future research, particularly from theoretical and methodological perspectives in the Slovak context. What factors influence the redistribution of unpaid work in dual-income households in Slovakia? Which data collection methods are most optimal for examining the scope and structure of unpaid work in dual-income households in Slovakia? What challenges are associated with research focused on the scope and structure of unpaid work in dual-income households in Slovakia?

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*Mgr Ivana Lovětínská, MBA*¹ 

University of Jan Evangelista Purkyně in Ústí nad Labem, Czech Republic

*Mgr Jan Neugebauer Ph.D., MBA*² 

University of Jan Evangelista Purkyně in Ústí nad Labem, Czech Republic

*Ing. Marek Vokoun, Ph.D.*³ 

University of Jan Evangelista Purkyně in Ústí nad Labem, Czech Republic

Economic barriers of African students arriving in the Czech Republic⁴

Abstract

International students coming to the Czech Republic for education, experience, and potential future employment opportunities encounter a variety of challenges. While each student's experience is unique, shaped by personal background, financial situation, chosen university, and community support, specific challenges are common to most students.

The primary objective of this study is to identify and analyse the economic and social barriers faced by African students, particularly those from Nigeria. To establish a strong theoretical foundation, the PRISMA–PICOT approach was applied, followed by a qualitative research design. Semi-structured interviews were conducted to validate or challenge the theoretical assumptions. The study focuses on two key phases of the international student experience: pre-arrival and post-arrival.

The findings indicate that the most significant barrier in the pre-arrival phase is the visa application process, which involves difficulties in securing embassy appointments and fulfilling complex administrative requirements. In the post-arrival phase, financial insecurity becomes a major obstacle, as many students struggle to cover both initial and ongoing living expenses. The

¹ Correspondence address: University of Jan Evangelista Purkyně, Pasteurova 3544/1, 400 96 Ústí nad Labem; e-mail: lovetinskaivana2@gmail.com. ORCID: 0009-0006-7203-5415.

² Correspondence address: University of Jan Evangelista Purkyně, Pasteurova 3544/1, 400 96 Ústí nad Labem; e-mail: jan.neugebauer@students.ujep.cz. ORCID: 0000-0001-5216-1015.

³ Correspondence address: University of Jan Evangelista Purkyně, Pasteurova 3544/1, 400 96 Ústí nad Labem; e-mail: marekvokoun@gmail.com. ORCID: 0000-0001-5659-3085.

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combination of these barriers creates a substantial burden, making the transition process more challenging and stressful for African students studying in the Czech Republic.

Keywords: abroad, African, Czech Republic, international, students.

Ekonomiczne bariery przyjazdu afrykańskich studentów do Republiki Czeskiej

Abstrakt

Studenci zagraniczni przyjeżdżający do Czech w celu zdobycia wykształcenia, doświadczenia i potencjalnych możliwości zatrudnienia napotykają szereg wyzwań. Chociaż doświadczenia każdego studenta są wyjątkowe, kształtowane przez osobiste pochodzenie, sytuację finansową, wybraną uczelnię i wsparcie społeczności, specyficzne wyzwania są wspólne dla większości studentów.

Głównym celem niniejszego badania jest identyfikacja i analiza barier ekonomicznych i społecznych, z jakimi borykają się studenci z Afryki, a zwłaszcza z Nigerii. Aby zbudować solidne podstawy teoretyczne, zastosowano metodę PRISMA–PICOT, a następnie jakościowy projekt badawczy. Przeprowadzono półstrukturyzowane wywiady w celu weryfikacji lub zakwestionowania założeń teoretycznych. Badanie koncentruje się na dwóch kluczowych fazach doświadczenia studentów zagranicznych: przed przyjazdem i po przyjeździe.

Wyniki badań wskazują, że najważniejszą barierą w fazie przed przyjazdem jest proces ubiegania się o wizę, który wiąże się z trudnościami w uzyskaniu wizyt w ambasadzie i spełnieniu złożonych wymogów administracyjnych. W fazie po przyjeździe niepewność finansowa staje się główną przeszkodą, ponieważ wielu studentów ma trudności z pokryciem zarówno początkowych, jak i bieżących kosztów utrzymania. Połączenie tych barier stanowi poważne obciążenie, przez co proces adaptacji staje się trudniejszy i bardziej stresujący dla afrykańskich studentów studiujących w Czechach.

Słowa kluczowe: zagranica, afrykańscy, Republika Czeska, międzynarodowy, studenci.

JEL: F22, I23, J15, K37.

INTRODUCTION

In recent years, the number of African students pursuing higher education abroad has increased significantly. This trend is driven by a complex interplay of academic, professional, and socio-economic motivations, as students seek to improve educational quality, expand career opportunities, and foster personal development in international contexts. Countries across Europe, including the Czech Republic, have become attractive destinations due to their affordable education systems, relatively safe environments, and growing internationalization efforts.

Despite these advantages, African students – particularly those from Nigeria – face numerous challenges that shape both their decision-making processes and their experiences before and after arrival. These challenges are not merely

individual in nature but reflect broader institutional, economic, and structural barriers embedded within international education and migration systems.

AIM OF THE STUDY

This study aims to identify, analyse, and explain the key economic and social barriers faced by African students, particularly those from Nigeria, during both the pre-arrival and post-arrival phases of their higher education experience in the Czech Republic. By combining a systematic literature review based on the PRISMA–PICOT framework with qualitative evidence from semi-structured interviews, the study seeks to deepen understanding of how institutional, financial, and socio-cultural factors influence students' access to Czech higher education and their academic and social integration.

BENEFITS AND PERSPECTIVES OF STUDYING ABROAD

Many African students are increasingly motivated to study abroad due to a combination of academic, professional, and personal development goals. Access to quality education and research facilities is a significant driving factor (Magbondé, 2021), as many foreign institutions offer advanced curricula, cutting-edge laboratories, and internationally recognized faculty that may not be readily available in their home countries (Liu, Froese, Peltokorpi, Feng, 2024). Research on macroeconomic and institutional factors has shown that the quality of domestic educational institutions also significantly motivates students to pursue education abroad rather than study in their home country (Lovětínská, Vokoun, 2024).

Additionally, career opportunities associated with international degrees represent a strong incentive, as studying abroad often opens doors to global job markets, internships, and skill development that can significantly enhance future employability (Banda, Zungu, 2024; Okunola, Ikuomola, 2009; Johanson, Priode, 2023). Personal development also plays a key role (Di Michele, Tørris, Gunn, Johansen, 2024; Schneider, Grau, Ariaratnam, 2023), as living and studying in a different cultural environment fosters independence, adaptability, and a broader worldview (Azram, Hong, Ahmad, Sohail, 2024). Furthermore, international study provides valuable networking opportunities, allowing African students to build academic, professional, and cross-cultural relationships (Michno, Lozano-Alonso, 2024) that can support their long-term goals. Together, these motivations contribute to the growing trend of African students pursuing education abroad.

THE CZECH REPUBLIC, A COUNTRY OF CHOICE
FOR NIGERIAN STUDENTS

During the pre-arrival phase, Nigerian students face significant challenges with university admissions and visa procedures when seeking to study in the Czech Republic. Gaining admission often involves navigating guidelines on entrance requirements, document authentication, and language proficiency standards in Czech or English (Lovětínská, 2023).

Even after securing admission, the visa application process through the Czech Embassy in Abuja represents a major obstacle. Students commonly experience long waiting times for appointments, lengthy visa processing periods, and strict documentation requirements, including proof of sufficient financial resources and legalized academic records (Lovětínská, 2023). Moreover, the embassy's limited capacity to handle the growing volume of student applications leads to delays and uncertainty, potentially resulting in missed academic deadlines.

A student mode is a concept designed to facilitate the visa process for a specific group of students from third countries. Nigeria was among the selected countries until January 1, 2024. Following its removal from this list, obtaining an appointment at the embassy became even more difficult for applicants (Ministerstvo školství, mládeže a tělovýchovy, 2025). These procedural hurdles not only cause stress and financial strain but also contribute to the broader perception that studying in the Czech Republic is difficult for Nigerian students to access.

After arriving in the Czech Republic, African students often face multiple challenges that affect their academic and personal experiences (Urban, Kallová, Avilés, Jang, Urban, 2025). One of the most significant is the language barrier (Tan et al., 2022), as Czech is the primary language used in daily life and many administrative processes. This makes it difficult for students without sufficient language proficiency to navigate essential services, socialize, or complete specific university procedures (Tajvar, Ahmadizadeh, Sajadi, Shaqura, 2024).

Financial difficulties also persist post-arrival, with living costs, unexpected fees, and limited access to part-time employment (Fichtnerova, Vackova, Nathan, 2022) or scholarships placing pressure on students, especially those from modest economic backgrounds. Cultural adaptation can also be a struggle, as differences in social norms, communication styles, and educational expectations may lead to feelings of isolation or misunderstanding (Alasmari, 2023; O'Dea, Stern, 2022). Cultural differences and language barriers further complicate social integration, making proactive engagement essential (Wijbenga et al., 2024). If left unaddressed, these barriers can significantly affect students' academic performance, mental well-being, and overall success in the host country.

MATERIALS AND METHODS

We adopted the PRISMA-PICOT framework to establish the theoretical foundation of our study. Subsequently, we employed a qualitative research design, utilizing semi-structured interviews to examine and refine our theoretical assumptions. The overall study design integrates established theoretical concepts with standardized search strategies to ensure a comprehensive approach. Accordingly, the initial phase focused on outlining and grounding key theoretical concepts, which were then explored in greater depth through qualitative semi-structured interviews in the following phase.

The PRISMA research question was defined as follows: *What are the key economic and social barriers faced by African (particularly Nigerian) students before and after arriving in the Czech Republic for higher education?*

The primary objective of the case study was to conduct a comprehensive literature review of barriers using the PICOT approach in the Web of Science (WoS) database. Searches were conducted using keywords such as *African, students, Czech Republic*, and terms characterizing international students (*abroad, foreign, global*). However, when limiting the search to scholarly articles and literature reviews in the fields of economics and politics, a sufficient number of relevant publications specifically addressing the Czech context was not identified.

Initially, 224 results were found. After restricting the publication period to 2021–2025, 151 publications were excluded, leaving 73 records. Further limitation to articles only reduced the sample to 65. After narrowing the scope to education, educational research, and interdisciplinary social sciences, 25 results remained. Following screening based on titles and abstracts, the final number of articles was reduced to six. Given this limited number, the search was extended beyond the WoS database to identify additional relevant sources.

Students from Nigeria at the University of South Bohemia were approached for semi-structured interviews using the snowball sampling method, facilitated by the author's existing connections. Initially, students of both sexes and at different levels of study were approached. Nine interviews were conducted, comprising three women and six men. The interview focused on identifying general, economic, and socio-cultural barriers faced by African students who have chosen to study in the Czech Republic before and after their arrival. Nigerian students were selected because they represent the largest group of students from African countries in the Czech Republic, according to data from the Czech Statistical Office.

RESULTS

The research focused on two phases: pre-arrival and post-arrival. The results are presented accordingly.

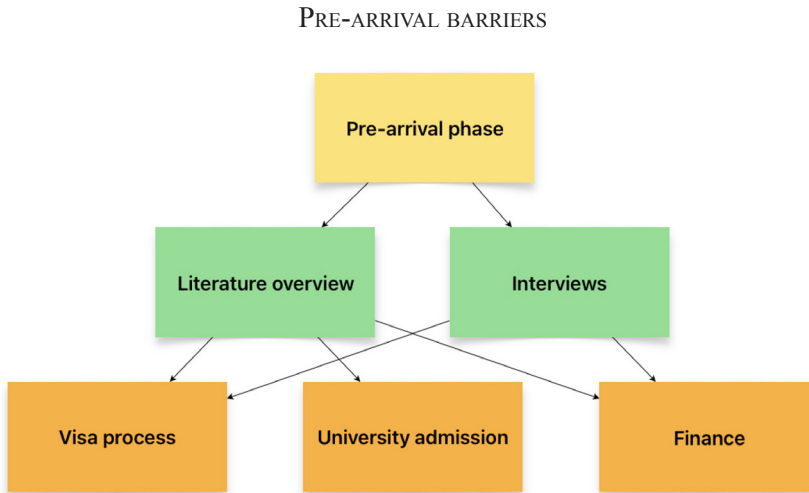


Figure 1. Pre-arrival barriers

Source: own research.

Interviews with Nigerian students confirmed that the visa process is widely perceived as the most significant pre-arrival barrier to studying in the Czech Republic. Many students described the process as time-consuming: *“It took time to get dates because you have to apply for dates for super legalization, you need to apply for dates for biometrics, you need to apply for dates for interviews.”* The process was also described as costly, particularly due to repeated travel and document legalization requirements: *“I had to take a flight three different times, and it was expensive because I had to go for like super legalization, then biometrics, then an interview, which was expensive.”*

A commonly cited issue was the difficulty in obtaining an appointment for a visa interview at the Czech Embassy in Abuja. Limited appointment slots and long waiting times frequently resulted in delays that jeopardized students’ ability to meet academic deadlines: *“I got my admission in July. I finished all the processes at the end of July, so I waited until August, September, and October. I finally received my interview dates for November, and then I obtained my visa in January of last year. Hence, it was like a six-month waiting period.”*

Students also emphasized that the cancellation of the student mode significantly worsened access to embassy appointments: *“It was faster before my turn, it was like six months, and now it’s harder for other people because lots of people are trying to come in.”* Another student compared the process to chance: *“It’s like something I would compare to a lottery. It’s like trying your luck.”*

Even after submitting all required documentation, uncertainty regarding the outcome remained high. Visa approvals are not guaranteed, and rejections are

sometimes issued without clear explanations. This unpredictability, combined with financial and emotional strain, makes the visa process a significant deterrent for prospective Nigerian students.

POST-ARRIVAL BARRIERS

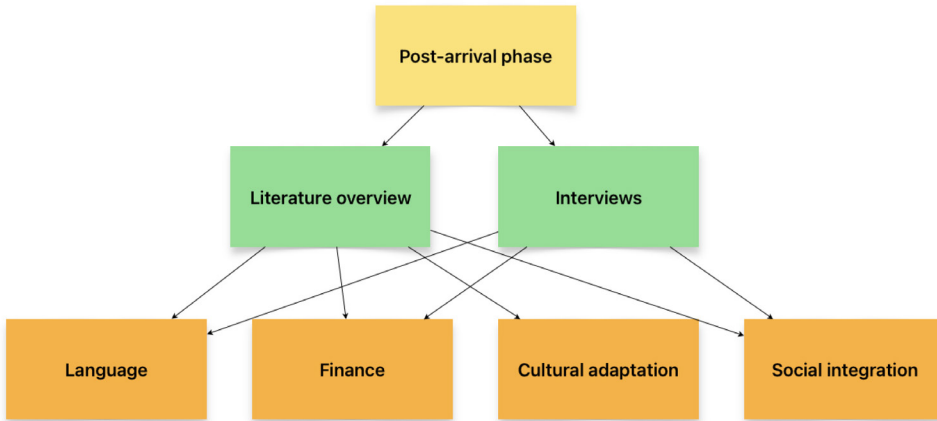


Figure 2. Post-arrival barriers

Source: own research.

Interviews revealed that financial constraints represent a significant economic barrier both upon arrival and throughout students’ academic trajectories if they are not sufficiently prepared. Upon arrival, students face substantial upfront expenses, including accommodation deposits, transportation costs, and basic living necessities: *“I was prepared for five to six months for accommodation and maybe a little bit of feeding as well. But I knew that as soon as I arrived, I needed to start looking for a job.”*

These costs follow already significant expenditures related to tuition, visa processing, and document legalization, placing considerable strain on students and their families: *“My parents and my fiancée help me.”* These costs follow already significant expenditures related to tuition, visa processing, and document legalization, placing considerable strain on students and their families: *“Because it’s just like you have the intellectual, you know this job, but you can’t get the job because of the language.”*

The inability to communicate effectively in Czech restricts access to many local job markets, leaving students dependent on irregular or low-income work: *“It’s like a minimum wage, so it’s not life-changing, but it helps,”* if available at all. *“There are lots of job sites that I apply to. And I could see that I might stand a chance, but because I don’t speak the language.”* This ongoing financial

insecurity not only affects students' academic performance and well-being but also limits their social engagement and overall integration into Czech society. *"I'm having a financial issue, so I'll be able to have more food to care for my family."*

The language barrier also restricts social integration and access to support: *"Affects you mentally because you might be in a place where you need help and even if the person walking by might speak English you're just like scared to ask them because you don't know if they speak the English."* Without sufficient Czech language skills, students often struggle to form meaningful connections with local peers, participate in campus activities, or access social support systems: *"The language has prevented a whole lot of opportunities."* This isolation can hinder their sense of belonging and overall well-being: *"First few months it was a bit tough time for me because I didn't have any friends and I got to used to the life that you how do I say right you mind your business that's how we live here so it's not something that I'm used to I'm used to having people around me."* As a result, many students remain within small, familiar cultural circles, thereby reducing their opportunities to engage with the broader academic and local communities: *"We only have our group amongst the Africans, yeah, we're on WhatsApp, so that's all."*

This ongoing financial insecurity, compounded by social isolation, affects students' academic performance and mental health and restricts their long-term integration into Czech society. These findings highlight the structural and linguistic barriers that exacerbate the financial burdens faced by Nigerian students, both at the point of entry and during their stay, and underscore the need for more targeted institutional and policy-level support.

DISCUSSION

This paper examines the motivations, pre-arrival barriers (focusing on university admissions and visa processes), and post-arrival challenges (such as language, finances, and cultural integration) that Nigerian and other African students encounter when pursuing higher education in the Czech Republic. Drawing on interview data and policy analysis, the study highlights how these factors interact to shape the educational trajectories of African students, and identifies areas where targeted support and policy reform are urgently needed.

PRE-ARRIVAL PHASE: INSTITUTIONAL AND ADMINISTRATIVE BARRIERS

One of the most prominent barriers identified by international students is the visa application process. In line with previous findings (Lovětínská, 2023), respondents reported significant delays, bureaucratic obstacles, and substantial financial burdens

in securing appointments and meeting documentation requirements. A particularly striking example is the recent removal of Nigeria from the Czech Republic's "student mode" list. This policy shift has intensified difficulties for Nigerian applicants, rendering the visa process akin to a lottery. These challenges point to broader systemic issues within the Czech immigration framework, which appears ill-equipped to handle the growing interest from third-country nationals, particularly those from Africa.

Beyond these procedural difficulties, visa policy also functions as a strategic tool through which host countries can influence the number and origin of incoming students. As Liu (2024) observes, governments often use visa regulations to shape the demographic composition of their international student populations in line with national interests. Some countries adopt more flexible and inclusive policies to attract students from specific regions or academic backgrounds, offering streamlined application processes or post-study employment opportunities. In contrast, others impose stricter requirements to limit access for applicants from regions deemed less desirable, citing economic, political, or security-related concerns (Akhrova, 2024; Poojary, Roy, 2024). In this way, visa policy serves not only as a logistical barrier but also as a selective mechanism that filters student mobility according to geopolitical and institutional priorities.

POST-ARRIVAL PHASE: FINANCIAL STRAIN AND SOCIO-CULTURAL CHALLENGES

Post-arrival, financial insecurity remains a significant burden. Students frequently arrive with minimal financial cushioning and face immediate expenses such as housing deposits, daily living costs, and transportation. Limited part-time job opportunities, combined with the pervasive language barrier, exacerbate these challenges. While the Czech Republic offers relatively affordable education compared to its Western European counterparts, living costs remain a significant issue, especially in cities where student jobs are scarce or require fluency in the Czech language.

Language emerged as a dual barrier, both economic and social. As Tan et al. (2022) and Tajvar, Ahmadizadeh, Sajadi, and Shaqura (2024) suggest, the inability to speak the local language not only limits job prospects but also impedes students' ability to navigate everyday systems and build meaningful relationships within the local community. This aligns with Wijbenga et al. (2024), who emphasize the need for proactive integration strategies for international students. Bacon (2002) recommends creating study materials or lessons for potential students to prepare them for what comes after arrival, and to make university or work life more attractive. Behind all this, we must keep students connected to their roots in their hometown. Lu, Tamayo-Verleene, Söderberg, Puffer, and Meschke (2025) described the connection with language and how people can suffer during

cultural and language changes. It should be essential knowledge we provide to help students adapt to a foreign country, making them wiser, smarter, and better prepared to study and work.

Additionally, cultural adjustment remains a subtle yet powerful factor affecting students' sense of belonging. Feelings of isolation, misunderstanding, and frustration stem from differing communication styles and social norms, echoing the findings of Alasmari (2023) and O'Dea, Stern (2022). The same opinion is held by numerous authors worldwide (Abdulai, Roosalu, Wagoner, 2021; Gong, Gao, Li, Lai, 2020; Lu, Tamayo-Verleene, Søderberg, Puffer, Meschke, 2024; Wawrosz, Jurásek, 2022). Bacon (2002) reveals that more than 20 years ago, research showed dramatic changes in language proficiency during the learning of different "rules" in other societies. Ward and Kennedy (1993) presented older results on socio-cultural adjustment, revealing mental deficits. Some levels of anxiety and depression will appear after the cultural shock disappears, and they are related to various feelings about the home cultural preferences remaining and the new cultural values in the new country. The same results are also presented in Gong, Gao, Li, and Lai (2020), a study that focuses on the challenges of cultural adaptation. The optional strategy to satisfy all students is to design a study program that prepares them to protect their cultural preferences, adapt to new situations, and, more importantly, maintain mental focus, health, and resilience.

The limited visibility of African students within the Czech social and academic landscape also contributes to a sense of marginalization, further complicating integration efforts.

CONCLUSION

In conclusion, while the Czech Republic offers valuable academic opportunities that continue to attract African students, particularly from Nigeria, the reality of their experience is shaped by a range of barriers that extend across both pre-arrival and post-arrival phases. The findings highlight that although motivations such as access to quality education, career advancement, and personal growth drive students to study abroad, these aspirations are often challenged by bureaucratic visa processes, financial strain, language barriers, and difficulties in social integration. The removal of Nigeria from the student visa facilitation program has further complicated access to higher education in the Czech Republic for many prospective students. Post-arrival, persistent economic insecurity and limited integration support continue to affect students' well-being and academic performance. These issues highlight the need for more inclusive, student-centered policies that address the specific needs of non-EU international students. Greater institutional transparency, expanded financial aid, targeted language support, and intercultural programming are essential

steps toward creating an equitable and supportive environment for African students. Without such measures, the Czech Republic risks undermining its own goals of internationalization and academic excellence by failing to fully include and support one of its growing student populations.

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