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ul. Jana Heweliusza 14, 10-718 Olsztyn
phone: 89 523 36 61, fax 89 523 34 38
www.uwm.edu.pl/wydawnictwo/
e-mail: wydawca@uwm.edu.pl

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ORIGINAL PAPER

STRESS AT WORK AND EMPLOYEE MOTIVATION

Adam Rudzewicz
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
ORCID: https://orcid.org/0000-0002-7807-9375
e-mail: adam.rudzewicz@uwm.edu.pl

JEL Classification: L3, M12, M14, M54.

K e y w o r d s: stress, motivation, employee, city hall.

A b s t r a c t

Today's work environment poses many challenges for organisations in terms of stress management and motivation. The main objective of this research is to determine the relationship between workplace stress and employee motivation levels. The research investigation was conducted on the example of employees of a local government institution (city hall) in north-eastern Poland, exploring their experiences of occupational stress (stress) and declared motivation. An online survey questionnaire was used in the study. The research sample consisted of 90 people (100% of staff). The main finding of the research is that few people do not experience stress in the workplace. This is an important observation that highlights the prevalence of this phenomenon. Of course, it is not always at a dysfunctional level. However, it should be noted that one in five employees is severely affected by it. Respondents showed a moderate level of their professional motivation. The majority of staff are focused on their job duties and recognise their commitment, but work is not their passion. A negative correlation was found between stress levels and professional motivation. There is also variation in the way stress affects motivation. Depending on employees' gender, age, income and occupational position, the relationship is clearly different. Men show a greater susceptibility to decreased motivation in stressful situations compared to women. In addition, those in managerial positions show a weaker correlation between stress and motivation, i.e. their motivation is not as strongly linked to stress as for employees in lower positions. Similarly, the relationship is for older versus younger people and higher earners versus lower earners.

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STRES W PRACY A MOTYWACJA PRACOWNIKÓW

Adam Rudzewicz
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Kody JEL: L3, M12, M14, M54.

Słowa kluczowe: stres, motywacja, pracownik, urząd miasta.

Abstrakt

Współczesne środowisko pracy stawia przed organizacjami wiele wyzwań związanych z zarządzaniem stresem i motywacją. Głównym celem przeprowadzonych badań jest określenie relacji między stresem występującym w miejscu pracy a poziomem motywacji pracowników. Postępowanie badawcze przeprowadzono na przykładzie pracowników instytucji samorządowej (urząd miasta) w Polsce północno-wschodniej, zgłębiając ich doświadczenia związane z napięciem zawodowym (stresem) i deklarowaną motywacją. W badaniu wykorzystano kwestionariusz ankiety internetowej. Próba badawcza składała się z 90 osób (100% kadry pracowniczej). Głównym wnioskiem wynikającym z badań jest to, że mało kto nie doświadcza stresu w miejscu pracy. Jest to istotne spostrzeżenie, które podkreśla powszechność występowania tego zjawiska. Oczywiście nie zawsze jest to poziom dysfunkcyjny. Zauważyć jednak należy, że co piaty pracownik jest nim dotknięty w sposób poważny. Badani wykazali umiarkowany poziom swojej motywacji zawodowej. Większość personelu koncentruje się na obowiązkach zawodowych i dostrzega swoje zaangażowanie, ale praca nie jest ich pasją. Stwierdzono negatywną korelację między poziomem stresu a motywacją zawodową. Istnieje także różnorodność w sposobie, w jaki stres wpływa na motywację. Zależnie od płci, wieku, dochodów i pozycji zawodowej pracowników relacja ta jest wyraźnie odmienna. Mężczyźni wykazują większą podatność na spadek motywacji w sytuacjach stresowych w porównaniu z kobietami. Ponadto osoby na stanowiskach kierowniczych wykazują słabszą korelację między stresem a motywacją, czyli ich motywacja nie jest tak mocno powiązana ze stresem, jak w przypadku pracowników na niższych stanowiskach. Podobnie relacja ta kształtuje się w przypadku osób starszych w stosunku do osób młodszych oraz lepiej zarabiających w stosunku do osób gorzej wynagradzanych.

Introduction

Today's working environment poses many challenges for organisations in terms of stress management and employee motivation. Understanding the relationship between these aspects is key to effective human resource management.

Stress is experienced by employees, regardless of their job or position. People affected by stress often feel a lack of job satisfaction, do not enjoy performing their duties and, over time, may become dismissive of their work. The symptoms of stress and the reactions to them are highly individual. Stress reactions vary in intensity between people due to a number of factors, such as life experiences, lifestyle, personality or social interactions (Liszkova, 2020, p. 287, 288). Occupations characterised by high levels of occupational stress often involve

intensive intellectual work, require frequent interpersonal interactions, high levels of responsibility and are emotionally engaging (Humeniuk, 2017, p. 293-295).

The main objective of this article is to present the complexity of phenomena such as workplace stress and employee motivation and to identify the relationship between these variables. The sources of data are the literature on the subject and the primary research conducted on a sample of employees of a public institution, operating in the local government sector, such as a town hall.

It is primarily a review article summarizing the current state of knowledge in a given research area, supported to a small extent by empirical research including a case study.

Literature Review

Stress

Stress is a set of specific and unspecified reactions to situations that disrupt the body's equilibrium and pose serious challenges, often exceeding the individual's ability to cope with stress (Szczygieł, 2020, p. 313; Skoczek *et al.*, 2020, p. 94; Gajda & Biskupek-Wanot, 2020, p. 84). Basket (2018, p. 42) understands stress as an ambivalent mental state or 'emotional reaction' that arises from negative stimuli, called stressors. Stress arises from situations or events that conflict with the need to survive (Hobfoll, 2006, p. 43, 44).

Occupational stress is one of its specific varieties. Occupational stress results from the interaction between the employee and the work environment and consists of both social and physical factors. The social aspects of this stress include the climate among employees, the way work is organised and the amount of pay the employer offers. From a physical perspective, working conditions such as noise levels, ambient temperature and the availability and quality of workplace equipment also contribute to occupational stress levels (Piernikowska & Podsiadły, 2019, p. 3). Stress can result from a variety of factors, such as excessive pressure, interpersonal conflicts or workload.

Psychosocial risks and work-related stress are among the main challenges in the field of occupational health and safety, as they have a significant impact on the health of individuals and the health of enterprises. A good working environment makes it possible to promote improved productivity, personal development and the physical and mental wellbeing of employees. A certain amount of stress is required to motivate an individual to perform or to help maintain productivity and challenge at work (Setyo *et al.*, 2020, p. 924).

Around half of European workers believe that stress is common in the workplace and is responsible for almost half of all lost working days. Stress and mental health problems are the most serious health problems experienced in the workplace for about one fifth of workers in the European Union. About two-thirds

of them are exposed to serious psychosocial problems (Ostrowska & Michcik, 2014, p. 89). In addition to mental health problems, workers exposed to prolonged stress may develop serious physical health problems such as cardiovascular disease or musculoskeletal disorders (Michantez *et al.*, 2015, p. 99). Businesses are also not well served by stress. For businesses, the negative effects can be low overall profitability, increased absenteeism and increased accidents and injuries. Work-related stress can contribute to higher rates of early retirement. Long-term job stress and poor quality of life, can lead to the development of job burnout. Lack of effective methods to manage stress at work can cause the problem to become chronic and increase the risk of disease (Vidotti *et al.*, 2019, p. 367, 368).

By adopting the right approach, psychosocial risks and work-related stress can be effectively prevented and managed, regardless of the characteristics or size of the workplace, and addressed with the same logic and systematic approach as other health and safety issues (Harasim, 2018, p. 66).

Motivation

Motivation is the process that is responsible for an individual's intensity and persistence in pursuing a goal (Neta & Haas, 2019, p. 1). Employee motivation is a concept that refers to the factors that stimulate employees to perform better and perform their duties in a more efficient and committed manner (Hysa & Grabowska, 2014, p. 326). Motivation encompasses the biological, emotional, social and cognitive forces that activate behaviour. It is the driving force behind human actions (although it is rarely directly observable). It is often necessary to infer the reasons why people do what they do from observable behaviour (Knap-Stefaniuk *et al.*, 2018, p. 188-192). The literature portrays motivation as a concept deeply rooted in the human psyche and a key factor influencing people's decisions and actions (Baka & Basinska, 2016, p. 17).

Motivation plays an extremely important role in the dynamic functioning of businesses, being a key factor influencing efficiency, creativity and innovation in the workplace. A high level of employee motivation translates directly into employee commitment and a willingness to put in extra effort for the good of the organisation. Employees who experience strong motivation not only present a higher level of performance on assigned tasks, but also show a greater willingness to take on new challenges. Their enthusiasm translates into active involvement in the company's development processes. Strong motivation stimulates the search for new solutions and process improvement. In addition, employees with a high level of motivation are more likely to cooperate, form effective teams and exchange ideas. Creating an atmosphere of cooperation, mutual understanding and support can contribute significantly to job satisfaction. Employees who experience positive team relationships are more likely to share knowledge, help each other and collaborate effectively (Rudzewicz, 2017, p. 293-296). Motivated

individuals see every new initiative as an opportunity for personal growth. Therefore, taking care of effective employee motivation becomes a strategic element of personnel management, influencing the long-term development of the company (Kozłowski, 2020, p. 205-213; Michalik, 2009, p. 376). In turn, a lack of motivation can lead to a decline in morale, increased absenteeism and lower productivity (Snopko, 2014, p. 103).

Methodological Assumptions of the Study

The subject of this research focuses on the analysis of tension levels and employee motivation. The research proceedings were conducted on the example of employees of a local government institution (city hall) in north-eastern Poland. The town hall was purposively selected and is located in north-eastern Poland. This office is headed by a mayor. The subjectively selected sample unit in a non--probabilistic manner involved obtaining consent to the study from both the mayor and the office staff. The analysis is based on a case study without the possibility of generalising the results obtained.

The main objective of the research is to determine the relationship between stress at work and motivation in the work environment (specificity of the municipal office). In pursuit of the main objective, the following research procedure was adopted:

1. Identifying stress levels in the workplace.
2. Determining the level of employee motivation.
3. Identify the relationship between stress and employee motivation (taking into account the variation in these).

A seven-point Likert scale was used to measure stress and motivation. The results were then subjected to correlation analysis to verify any potential relationship between them. Additionally, as part of a deeper understanding of the stress and motivation phenomenon, attention was paid to the most stressful situations at work and symptoms of experienced stress and manifestations of motivation.

The survey was conducted in July 2023 among all employees of the selected city hall. Each employee received a card with a link to the survey, also in the form of a unique QR code. Transcribing the link or scanning the code with a mobile device automatically took the surveyed employees to the actual survey posted online. There were 90 employees in the surveyed office and it appears that each of them answered the questionnaire. The procedure adopted ensured anonymity.

Analysing the data, it is noted that 34% of the respondents were aged 20-30, indicating a significant presence of the younger generation among the workers surveyed (Tab. 1). In addition, 27% of the respondents were between 31-40 years old, another 27% were workers between 41-50 years old and 12% were over

Table 1

Characteristics of respondents

Criterion	Variables	Percentage share [%]
Gender	woman	84
	man	16
Age [years]	under 30	34
	31-40	27
	41-50	27
	over 50	12
Earnings [PLN]	under 3,000	21
	3001-4000	50
	over 4,000	29
Position	clerk (specialist)	86
	manager	14

Source: own elaboration.

50 years old. In the survey, the majority were women with an impressive percentage of 84%. Among the employees, those in clerical (specialist) positions predominated with 86%. Managerial positions were held by 14% of respondents. Respondents' incomes varied, with a dominant range between 3,000 and 4,000 PLN net per month (50%).

Research Findings – Relationship between Stress and Motivation

Measurement of stress

Respondents were asked to identify the most stressful situations or tasks in their work. The rating scale ranged from 1 to 7 points, where 1 meant that the situation was not stressful at all and 7 meant that it was very stressful. Participants were given the opportunity to express a subjective evaluation regarding various aspects of their work.

The study found that one of the most stressful factors is the short time available to complete specific tasks, which was rated at 3.73 points. Not having enough time can limit the ability to focus on tasks and result in a lower quality of work completed. Next, a bad team atmosphere was listed as another stressful factor, rated at 3.48 points, which can lead to conflicts between employees, lack of cooperation and a decrease in work motivation. Another important aspect is the need to carry out many tasks at the same time (3.54 points), which leads to an excessive workload and difficulties in maintaining concentration. Taking work

home is also an unpleasant element. Other circumstances rated below 3 points are already more acceptable, although they are not entirely comfortable, such as public speaking or employee appraisal. However, they are accompanied by a not very high level of stress. The presented scores show that even the most stressful circumstances are not a stressful problem. The highest scores are roughly around the middle of the adopted scale. All these data are presented in Figure 1.

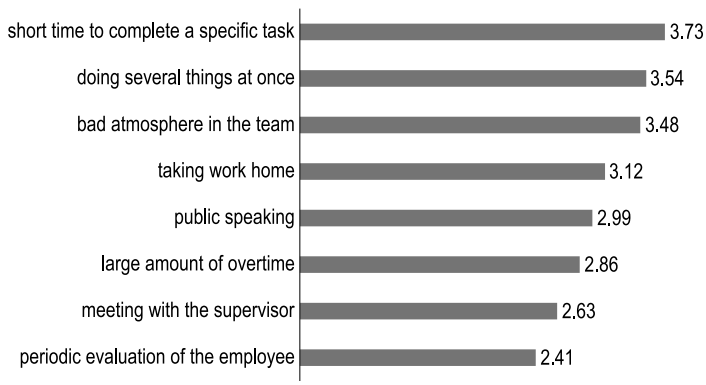

Fig. 1. The most stressful situations at work

Source: own survey.

Analysis of stress symptoms among respondents shows that stress can have a variety of mental and physical health consequences. Irritability and nervousness were the most frequently reported symptoms, affecting up to 67% of survey participants (Fig. 2). These are typical reactions to stress, which can lead to increased emotional tension. Headache is experienced by 60% of respondents, sleep problems are reported by 43% of study participants. Difficulty concentrating is experienced by 38% of respondents. Bad mood is reported by 36% of participants. The impact of stress is multidimensional, manifesting itself in both the mental and physical spheres. It is noted that two thirds of employees experience various ailments often related to stress. This confirms that stress in the workplace is not just a theoretical phenomenon.

An analysis of the respondents' stress levels revealed wide variations in how they felt. Several percent (16%) of respondents described their stress level as very low at 1 and 2 points. (Fig. 3).

Next, 57% of respondents rated their experience of stress at 3-5 points, indicating moderate stress. They experience some degree of stress, but it is not yet very intense or dangerous. A group of 27% of respondents estimated their stress at a high level (6-7 points). This suggests that one in four employees experience quite high or even very high stress in the workplace. For them, stress

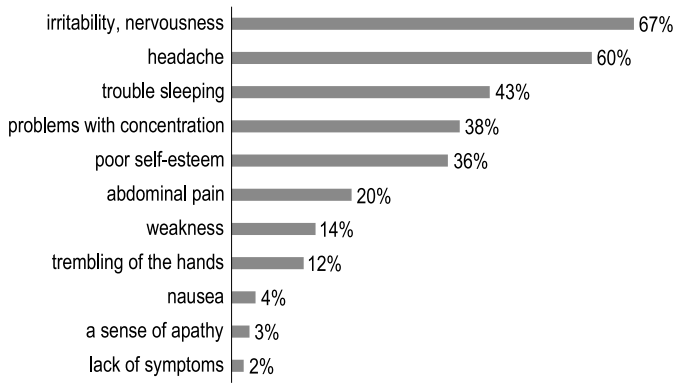

Fig. 2. Main symptoms of perceived stress
Source: own survey.

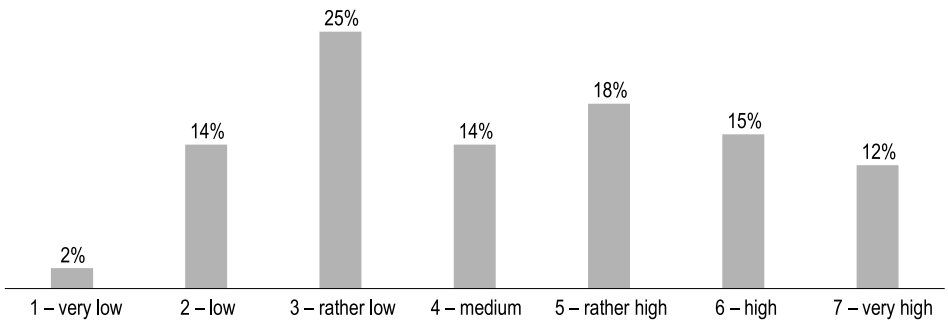

Fig. 3. Declared stress level
Source: own survey.

can be strongly felt, as well as being a significant factor affecting their daily functioning and wellbeing both inside and outside of work.

Representing the problem in terms of central tendency, the arithmetic mean of 4.23 points in the stress assessment suggests a moderate level of stress.

Measuring motivation

Motivation was also rated on a seven-point scale, as was stress. The employees surveyed showed a high level of focus on the performance of their daily job duties, as evidenced by a score of 4.12 (Fig. 4). It is noteworthy that the respondents express a certain degree of dedication to their work (3.74 points). An interesting observation is the respondents' perception that time at work passes quickly (3.51 points), which may mean that they are preoccupied with their tasks and are additionally accompanied by job satisfaction (3.21 points). The other variables with scores below 3 points are unlikely to be manifestations of clear commitment

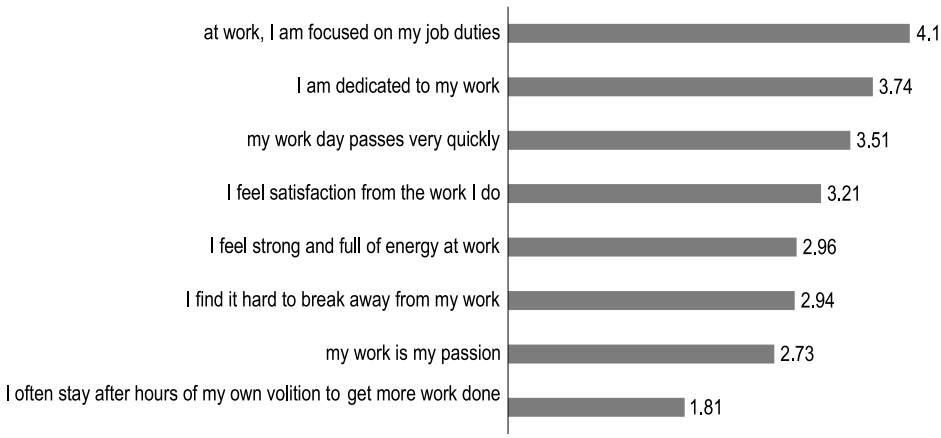

Fig. 4. The manifestation of motivation at work

Source: own survey.

to work. Respondents declare their feeling of involvement of strength and energy in their work at an average level (2.96 points). Working at the office is not a passion and it seems that employees are reluctant to stay at work after hours of their own accord. Apart from one criterion describing motivation, the other scores are at most around the middle of the possible scale.

The results of the survey show the respondents' varying attitudes towards their motivation at work (Fig. 5). Almost one fifth of the respondents, i.e. 19%, rated their level of work motivation as high or very high (6-7 points). On the other hand, there is also a group of people (14% in total) who rate their level of motivation as low or very low (1-2 points). It is worth noting that 67% of respondents rate their level of motivation as average (3-5 pts). Using the central measure, the arithmetic mean of the assessment of the level of motivation ranks at 4.19 points. Such a result suggests a moderate approach to motivation.

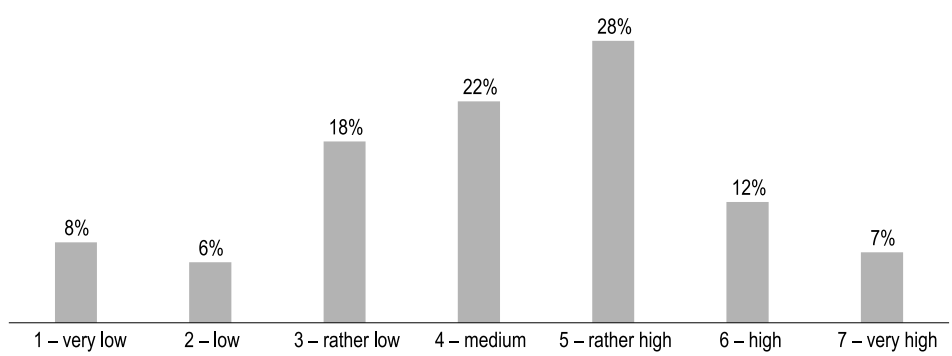

Fig. 5. Declared level of motivation

Source: own survey.

Relationship between stress and motivation

A correlation coefficient was used to examine the relationship between the assessment of stress levels and the assessment of motivation levels among employees. The result of -0.27 among all employees suggests that there is a negative relationship between stress levels and motivation levels among employees. This means that an increase in stress levels is associated with a decrease in motivation levels.

It is worth looking at this relationship by different employee groups. The correlation coefficient values show a weak relationship for women (-0.21) and a moderate one among men (-0.52), suggesting that gender may be an important factor in the relationship between stress and motivation (Tab. 2). When faced with stress, men experience a decrease in work motivation to a greater extent than women.

Turning to the issue of age, what stands out is that young workers (up to 30 years old) react to stress with a decrease in motivation to a greater extent (-0.44) than older workers. In contrast, among the oldest workers (over 50 years), the relationship between stress and motivation was only -0.18 (correlation).

An examination of the correlation between stress ratings and motivation levels in different occupational contexts, revealed that for managers the coefficient was -0.07, while for desk officers it was -0.31 (Tab. 2). The difference is again marked. The values obtained suggest a weak unfavourable correlation between stress level and motivation among managers and a moderate unfavourable correlation for clerks. Consequently, for clerks, escalating stress levels are more associated with a decrease in motivation levels compared to those in managerial positions.

Table 2

Correlation coefficients between stress and employee motivation

Employees		Correlation value
Overall		-0.27
Gender	women	-0.21
	men	-0.52
Age [years]	under 30	-0.44
	31-40	-0.22
	41-50	-0.32
	over 50	-0.18
Earnings [PLN]	under 3,000	-0.44
	3,001-4,000	-0.30
	over 4,000	-0.06
Position	managers	-0.07
	references	-0.31

Source: own research.

The final area of analysis concerned net monthly earnings. Those with the highest incomes (over 4,000 PLN) do not show an excessive decrease in motivation due to stress (correlation -0.06). The situation is different in the group of the lowest paid employees (under 3,000 PLN), where the correlation studied is moderately high (-0.44).

There seems to be some convergence in the results obtained. Older, better paid people in higher positions who have reached a strong professional position do not easily succumb to stress and it does not shape their motivation. Less experienced people may be more sensitive to stressful situations, which translates into their degree of motivation or discouragement.

Summary and Final Conclusions

Stress is an intrinsic part of every person's life, representing the body's response to a variety of situations that require adaptation or coping with difficulties. The essence of stress is its dynamic nature, which mobilises the body to respond actively to challenges and to adapt in the face of a changing environment. In practice, this means that stress can occur both in positive situations, which stimulate action, and in negative situations, which cause tension and discomfort. The essence of stress also lies in its potential effects on an individual's mental and physical health, which can manifest in a variety of ways, from muscle tension and difficulty concentrating to problems with sleep or negative emotions.

The results of research on motivation and stress in the work environment shed light on a number of important aspects of staff functioning. The main finding of the research is that, few people do not experience stress in the workplace. This is an important observation that highlights the prevalence of this phenomenon in the workplace. Of course, it is not always at a dysfunctional level.

An analysis of staff motivation levels suggests that the majority of staff are focused on their job duties and recognise their commitment. However, there is a group of staff who rate their level of motivation as low or very low. Perhaps these are individuals who are accompanied by excessive stress.

A negative correlation was found between stress levels and occupational motivation. There is also variation in the way stress affects motivation. Depending on the gender, age, income and occupational position of employees, the relationship is clearly different. Men show a greater susceptibility to decreased motivation in stressful situations compared to women. Furthermore, the results confirm that those in managerial positions show a weaker correlation between stress and motivation, i.e. their motivation is not as strongly linked to stress as employees in lower positions. Similarly, the relationship is for older versus younger people and higher earners versus lower earners.

The relationship between stress and motivation is complex and multidimensional. When stress levels are moderate, it can act as a motivational stimulus, spurring employed staff to perform and achieve their goals. However, when it becomes chronic or excessive, it can negatively affect the employee's level of engagement by increasing feelings of fatigue, helplessness or loss of interest in their work.

In conclusion, the study found that there is a weak but clearly negative correlation between stress and motivation in the workplace, suggesting that stress reduction has a positive impact on staff motivation. The introduction of stress reduction programmes and the regular monitoring and effective management of staff stress and motivation levels may be key to maintaining a positive workplace atmosphere and ensuring staff satisfaction, which will certainly benefit the organisation.

The limitation of the article is that there is only one research subject (city hall) and a limited number of staff. The results obtained should be regarded as a pilot study that needs to be expanded to include a larger number of entities, including commercial ones. The collected material should be subjected to in-depth statistical analysis.

Translated by Author

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ORIGINAL PAPER

ANALYSIS OF ROAD INFRASTRUCTURE IN TERMS OF ITS ADAPTATION TO SERVE PEOPLE WITH DISABILITIES (CASE STUDY FROM POLAND)

Piotr Gorzelańczyk
Department of Transport
Stanisław Staszic State University of Applied Sciences in Piła
ORCID: https://orcid.org/0000-0001-9662-400X
e-mail: piotr.gorzelanczyk@ans.pila.pl

Alicja Herudaj
Department of Transport
Stanisław Staszic State University of Applied Sciences in Piła
ORCID: https://orcid.org/0000-0003-1414-8631
e-mail: herudaj.alicja@gmail.com

JEL Classification: R42, R41.

Key words: transport, people with disabilities, transport infrastructure.

Abstract

The problem of disability affects more and more people every year. One of the problems in their proper functioning is problems related to their movement. The main purpose of this study is to analyze the road transport system in terms of its adaptation for people with disabilities in Wielkopolskie voivodeship. For this purpose the existing public infrastructure was reviewed in terms of its adaptation to the needs of people with disabilities. On the basis of the research carried out, it was found that the best adapted facilities for disabled people are newly built public buildings. A hospital, as an object that should be the most comfortable for people with disabilities, comes out very poorly and requires mainly surface modernization.

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ANALIZA INFRASTRUKTURY DROGOWEJ POD KĄTEM JEJ PRZYSTOSOWANIA DO OBSŁUGI OSÓB Z NIEPEŁNOSPRAWNOŚCIAMI (STUDIUM PRZYPADKU Z POLSKI)

Piotr Gorzelańczyk
Katedra Transportu
Akademia Nauk Stosowanych im. Stanisława Staszica w Pile

Alicja Herudaj
Katedra Transportu
Akademia Nauk Stosowanych im. Stanisława Staszica w Pile

Kody JEL: R42, R41.

S ł o w a k l u c z o w e: transport, osoby z niepełnosprawnościami, infrastruktura transportowa.

A b s t r a k t

Problem niepełnosprawności z roku na rok dotyczy coraz większej liczby osób. Jednym z problemów w ich prawidłowym funkcjonowaniu są trudności z przemieszczaniem. Głównym celem artykułu jest analiza systemu transportu drogowego w aspekcie jego przystosowania dla osób z niepełnosprawnościami w województwie wielkopolskim. W tym celu dokonano przeglądu istniejącej infrastruktury publicznej w odniesieniu do jej dostosowania dla osób z niepełnosprawnościami. Na podstawie przeprowadzonych badań stwierdzono, że najlepiej przystosowanymi obiektami dla osób z niepełnosprawnościami są nowo wybudowane budynki użytku publicznego. Szpital jako obiekt, który powinien być najlepiej przystosowany dla osób z niepełnosprawnościami, wypada bardzo słabo i wymaga przede wszystkim modernizacji nawierzchni.

Introduction

According to Polish law, a disabled person is defined as a person who, as a result of a long-term or permanent inability to fulfil social roles, causing, in particular, inability to work, is temporarily or permanently unable to fulfil social roles. Ensuring the accessibility of the public transport system for people with disabilities means having, among other things, adapted rolling stock of railroads, long-distance trains, buses and city buses. In addition, the road and communication infrastructure on which people with disabilities travel should be adapted to their needs. For example, the adaptation for people with disabilities of urban public transport is mainly the replacement of rolling stock with low-floor vehicles and the provision of correct audio and visual information for passengers both inside and outside the vehicle (Raczyńska-Buława, 2017a; 2017b).

It has always been believed that people with disabilities have mobility difficulties that limit them in their daily lives (Lucas, 2004; Dodson *et al*., 2004). These limitations are considered as accessibility barriers to the use

of transportation systems services (Evans & White, 1998). Very many authors deal with the accessibility of adaptations of buildings, public transport or public infrastructure for people with disabilities (Mace *et al.*, 1991; Donnelly, 2003; Czarnecki & Siemiński, 2004; Wysocki, 2009) as well as the movement of people with disabilities and movement in public spaces (Heiser, 1995; *Improving…*, 1999; Campion *et al.*, 2003; Taylor & Józefowicz, 2012a; 2012b; 2012c; 2012d).

People with disabilities make up 15% of the population and there are more than one billion people worldwide (*Disability Inclusion*, 2021). In Poland, people with disabilities officially constitute more than 3 million, while in reality their number can vary from 4 to almost 7 million (*How Many People…*, 2021). The number of studies referring to people with disabilities on a geographical basis is increasing year by year (Cormode, 1997). This occurs systematically, which is related to population changes and the increasing number of people with disabilities (Skalska, 2004; 2010; Zajadacz, 2015). A large number of studies link people with dysfunctions to the geographical environment (Ostrowska, 1994; Gaines, 2004; Józefowicz, 2014). A very good example is the research on accessible tourism for people with disabilities, where moving is an integral part of the trip (Kaganek, 2009; Midura & Żbikowski, 2005; Buhalis *et al.*, 2006). Facilitated access to transportation services influences the quality of life and, in the case of people with disabilities, additionally contributes to their self-esteem and social participation (Zadrożny, 2009; Furmanek, 2014).

The problem of usability of road infrastructure for people with mobility disabilities was considered by Nwachi and his team (2023). In a similar vein are the following works (Stafford & Baldwin, 2018; Fasina *et al.*, 2020; Ross *et al.*, 2020). They show that there are still barriers among children, the elderly and people with disabilities, limiting their opportunities for mobility and social interaction. It should be remembered that many people with disabilities get around on foot or in a wheelchair (Mogaji *et al.*, 2021; Mogaji & Nguyen, 2021). This does not depend on road infrastructure. Some researchers believe that road infrastructure causes significant exclusion of mobility and difficulties for people with disabilities (Mogaji *et al.*, 2022; Igomy, 2021; Jirgba *et al.*, 2020).

Purpose and Scope of Study

Among communities, a small number pay attention to the conditions for adapting road infrastructure for the disabled. The purpose of the article is to analyze the road infrastructure in terms of adaptation for people with disabilities. For this purpose, the existing traffic infrastructure was reviewed. Road infrastructure is all elements of the transportation network that are used by means of transport both while they are moving and at rest. Road infrastructure

for people with disabilities refers to the system of roads, sidewalks, pedestrian crossings and other elements that are designed to be accessible and safe for people with different types of disabilities.

Methodology of the Study

The study was conducted in 2021 in northern Greater Poland, using two cities of different sizes as examples: Piła, which has about 74 thousand inhabitants, and Złotów, which has about 18 thousand inhabitants (*Population*, 2021). The study analyzed the road infrastructure in the vicinity of ten public places, which are most often used by people with disabilities. These places include: hospital, pharmacy, shopping center, supermarket, railroad station, swimming pool, bank, post office, gas station and Social Security Office. The following criteria were taken into consideration when adapting the sites for people with disabilities: curb adjustments and roadway surface quality ratings. Parking amenities for persons with disabilities in terms of signage for parking spaces and distance from the building were also considered. The site was also checked for ramps, access ramps, platforms, outdoor elevators to allow a person with a disability to get into the building and an overall rating of the accessibility of the site for persons with disabilities. In the study, the authors analyzed road infrastructure and its adaptation to persons with disabilities.

Sites were rated on the following scale from 0-1, where 0 means not adapted and 1 means adapted. Stanislaw Staszic Specialist Hospital in Pila and Alfred Sokolowski County Hospital in Zlotow were selected for evaluation. The next facilities were pharmacies: Sokal Pharmacy at the Stanislaw Staszic Specialist Hospital in Piła and at 8 Norwida Street in Zlotow. Next object was bank PKO at Aleja Piastów 2 in Piła and bank PKO in Złotów at Norwida 5 St. Next post office at Aleja Wojska Polskiego 36 in Piła and post office at Aleja Piasta 4 in Złotów. The next object of the study for infrastructure assessment was a supermarket in Piła at 4 Doctor Drygas Street and a supermarket in Zlotow at Norwida Street. A supermarket in Piła at 4 Artura Grottgera St. and a swimming pool in Zlotow at 4 A Norwida St. were also included in the study. Petrol stations were chosen as those located at 102 Powstańców Wielkopolskich Street in Piła and the petrol station in Złotów at 2 Szpitalna Street. The next objects examined were ZUS in Piła and ZUS in Złotów. The last study sites were Galeria Kasztanowa in Piła and Galeria Aura Park in Złotów as well as the railway station in Piła and the railway station in Złotów. The sites most frequently used by people with disabilities were considered when selecting sites for the study.

Results of the Study

The evaluation of accessibility of public infrastructure for people with disabilities in Złotów and Piła in the selected 10 facilities most frequently used by the community is quite good. The worst adapted object in Złotów is the railroad station. As a public facility used for public transport it should provide special conditions for the disabled. The Alfred Sokolowski County Hospital is also very poor in the assessment of the adaptation of the facility in Zlotow. As the facility most frequently visited, especially by disabled people, it should be adjusted and meet all the evaluation criteria. In Piła, the worst adapted facility is Sokal Pharmacy at Stanisław Staszic Specialist Hospital. The infrastructure at the hospital is in very poor condition, the surface is cracked, which makes it difficult to enter the facility. The best adapted facilities for disabled people both in Złotów and in Piła are supermarkets, shopping malls, swimming pools and petrol stations. These facilities meet all the evaluation criteria and allow people with disabilities to freely get to and move around the facilities. The assessment of facilities for people with disabilities is presented in the tables 1 and 2. Recorded in the table 0 means no adaptation 1 object adapted.

Table 1

Assessment of accommodations for people with disabilities

Criteria	Hospital		Pharmacy		Bank		Post Office		Supermarket	
	Piła	Złotów	Piła	Złotów	Piła	Złotów	Piła	Złotów	Piła	Złotów
Adjusting curbs	1	0	0	1	1	1	0	1	1	1
Assessment of road surface quality	0	0	0	1	1	1	1	1	1	1
Adaptation of the parking lot for persons with disabilities in terms of:										
a – marking of parking stalls	1	0	1	1	1	0	1	1	1	1
b – distance from the facility	1	0	0	1	1	0	1	1	1	1
Slopes, ramps, ramps, platforms, external elevators allowing access to the building for disabled people	1	1	1	1	1	0	1	0	1	1
Accessibility of facility adaptations for persons with disabilities	1	1	1	1	1	0	1	1	1	1
Total	5	2	3	6	6	2	5	5	6	6

Source*:* own study.

Table 2

Assessment of accessibility of facilities for people with disabilities – continued

Criteria	Swimming pool		Gas station		Social security office		Shopping mall		Railway station	
	Piła	Złotów	Piła	Złotów	Piła	Złotów	Piła	Złotów	Piła	Złotów
Adjusting curbs	1	1	1	1	1	1	1	1	1	0
Assessment of road surface quality	1	1	1	1	1	1	1	1	1	0
Adaptation of the parking lot for persons with disabilities in terms of:										
a – marking of parking stalls	1	1	1	1	1	1	1	1	1	0
b – distance from the facility	1	1	1	1	0	1	1	1	1	0
Slopes, ramps, ramps, platforms, external elevators allowing access to the building for disabled people	1	1	1	1	1	1	1	1	1	1
Accessibility of facility adaptations for persons with disabilities	1	1	1	1	1	1	1	1	1	1
Total	6	6	6	6	5	6	6	6	6	2

Source: own study.

Summary

On the basis of the conducted research, in selected places in Złotów and Piła there is a high availability of parking spaces for the disabled, which, however, still requires improvement due to poor signposting or their location at a considerable distance from the destination. The best accessible infrastructure is found near supermarkets, swimming pools, gas stations and shopping malls. The least accessible are hospitals, banks and railroad stations, especially in smaller towns, such as Złotów.

The biggest problem for people with disabilities are unadopted curbs and poor road surface, especially potholes that a wheelchair must navigate. People with disabilities also have problems finding an adapted parking space for them and driving from the parking lot onto the sidewalk. In addition, it is very common for parking lots to be located far from public places.

Implementing changes in infrastructure requires long-term actions, which involves not only improving the existing infrastructure but also changes

in legislation, so that in the long run the infrastructure is adapted to the needs of people with disabilities and does not have architectural barriers preventing people in wheelchairs and with mobility problems from reaching the bus stop safely.

Translated by the Authors

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ORIGINAL PAPER

KNOWLEDGE OF MOTOR INSURANCE AMONG THE POLISH POPULATION

Justyna Witkowska
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
ORCID: https://orcid.org/0000-0001-8478-0769
e-mail: justyna.witkowska@uwm.edu.pl

JEL Classification: G22, F3.

Key words: motor insurance, Third-party liability insurance, Autocasco insurance, Assistance insurance, Accident insurance, Green Card.

Abstract

The article addresses the state of knowledge of motor insurance types and the possession of related policies among the population of Poles. The study was conducted in March 2024 on a group of 800 respondents by means of an original survey questionnaire deploying the CAWI technique.

Based on the conducted survey, it was established that over 8 out of 10 respondents declared having the knowledge of Autocasco insurance (AC) and Accident insurance (NNW). The three most recognizable types of motor insurance included AC insurance, Accident insurance (NNW) and Assistance insurance. These types of insurance policies were also most frequently purchased by the surveyed. In addition to the mandatory liability insurance (OC), 95.0% of the respondents declared possession of the Accident insurance policy (NNW), 92.4% – Assistance insurance policy and 82.6% – Autocasco insurance policy.

ZNAJOMOŚĆ UBEZPIECZEŃ KOMUNIKACYJNYCH WŚRÓD POLSKIEGO SPOŁECZEŃSTWA

Justyna Witkowska
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Kody JEL: G22, F3.

Słowa kluczowe: ubezpieczenia komunikacyjne, OC p.p.m., AC, assistance, NNW, zielona karta.

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Abstrakt

W artykule poruszono kwestię znajomości rodzajów ubezpieczeń komunikacyjnych i ich stan posiadania wśród polskiego społeczeństwa. Badanie przeprowadzono w marcu 2024 r. na grupie 800 respondentów, z wykorzystaniem autorskiego kwestionariusza ankiety, techniką CAWI.

Na podstawie przeprowadzanego badania ustalono, że ponad 8 na 10 ankietowanych deklarowało znajomość ubezpieczenia autocasco (AC) oraz ubezpieczenia od następstw nieszczęśliwych wypadków (NNW). W trójce najbardziej rozpoznawalnych rodzajów ubezpieczeń komunikacyjnych znalazło się ubezpieczenie AC, ubezpieczenie NNW oraz ubezpieczenie assistance. Również te rodzaje ubezpieczeń najczęściej mają badane osoby. Oprócz ubezpieczenia OC p.p.m., respondenci w 95,0% mają ubezpieczenie NNW, ubezpieczenie assistance (92,4%) oraz autocasco (82,6%).

Introduction

The motor insurance market has continued to experience significant growth over the past decades due to increasing car sales worldwide. Global car sales have increased from 63.8 million in 2020 to 66.7 million in 2021, with electric car sales doubling to 6.7 million in 2021. This growth has led to an increase in demand for motor insurance (Kajwang, 2021).

The number of vehicles has been observed to increase every year also in Poland. A report issued by The Polish Automotive Industry Association (PZPM) indicates that the number of vehicles in Poland in 2022 was 34,970.8 units, including 26,501.5 passenger cars (*Automotive Industry Report 2023/2024*, 2024), which is almost 15% more than five years earlier. According to data from the European Statistical Office, the number of vehicles registered in 2022 per 1,000 inhabitants in the European Union Member States was 560 units, while in Poland it was as many as 584 cars (*Passenger cars – per thousand inhabitants*, 2024).

Despite the increasing number of vehicles, there are fewer and fewer road accidents. In 2023, there were 20,936 road accidents (41.6% less than ten years ago), with 1,983 death casualties (43.6% less than in 2013) (*Wypadki drogowe w Polsce…*, 2024).

Every car owner is at risk of a collision on the road and other related hazards that can occur both when the vehicle is in motion or parked. Motor insurance helps compensate for the effects of accidents, with some types of policies being compulsory and others (most) voluntary.

There are different types of motor vehicle insurance policies, each with a different set of risks covered and a different set of guiding legal principles (Atkinson, 2020). Consumer protection in terms of sales and risk management is governed by the European Parliament and Council (EU) Directive (Directive… 2016) on the distribution of insurance (Fras *et al.*, 2024), drawing attention to providing customers with products that meet their needs.

Motor insurance is a viable tool allowing to properly manage the driver's liability towards other road users. It is dedicated to owners of road vehicles

such as: passenger cars, buses, trucks, delivery vehicles, motorcycles and any other motorized road vehicles, and enables transferring the costs related to an accident or theft from the culprit to the insurance company.

Third-party liability insurance for motor vehicle owners (OC p.p.m.) is a compulsory insurance in Poland (and in many other countries) by operation of law[1]. The Act on Compulsory Insurance for Motor Vehicle Owners covers compulsory insurance for motor vehicle owners in a broad context, emphasizing the basic principles specific to this type of insurance, its functioning in connection with general principles of law and EU directives (Gürses, 2020).

In the event of death or bodily injury to a third party or a third party's vehicle, the insurer will pay compensation or benefits to the injured parties from the third party liability insurance policy. Additionally, this policy also protects against the effects of events caused by other persons, family members, who were driving the vehicle. The Green Card insurance operates on the same principle, which is mandatory when traveling outside Poland to countries not covered by third-party liability insurance (see Witkowska, 2020, p. 45, 46).

In addition to the compulsory motor insurance, voluntary insurance policies are also available: Autocasco (AC); Accident insurance (NNW); Assistance insurance; as well as luggage, car window and car tyre insurance policies, which are expected to protect the car and its owner against the effects of man-made events or natural disasters, such as terrorist attacks, theft, riots, earthquakes, hurricanes. There are many benefits from having motor insurance, which include (Omoghie *et al.*, 2021):

– providing benefits to injured parties;

– covering costs related to court actions in the event of compensation to third parties;

– covering vehicle repair bills due to accident-caused damage;

– covering the costs of damage caused by factors other than accidents, such as theft, fire, etc.;

– additional discounts – motor insurance policies enable obtaining discounts on subsequent policies for various insurance policies with the same insurer and discounts for no claims in a given year of insurance coverage.

The Polish Chamber of Insurance reports that at the end of 2023, 28.1 million Poles had a third-party liability insurance policy and almost 7.4 million had AC insurance policy. Insurers collected over PLN 28 billion in premiums for third-party liability insurance (PLN 15.7 billion) and Autocasco insurance (PLN 12.6 billion). In turn, the compensation and benefits paid in this years from these types of insurance policies amounted to PLN 18 billion (*Ubezpieczenia w liczbach 2023…*, 2024).

[1] In Poland, the applicable act is: Ustawa z dnia 22 maja 2003 r. o ubezpieczeniach obowiązkowych, Ubezpieczeniowym Funduszu Gwarancyjnym i Polskim Biurze Ubezpieczycieli Komunikacyjnych, Dz.U. z 2003 r., nr 124, poz. 1152.

Methodology

The aim of this article is to present the state of knowledge of motor insurance types and the number of related policies purchased by the Polish population. The study was conducted in March 2024 on a group of 800 respondents by means of an original survey questionnaire deploying the CAWI technique. Its main assumption was that all respondents possessed the compulsory third-party liability insurance for motor vehicle owners and at least one voluntary motor insurance.

This article inscribes into the research trend of analyzing the situation on the motor insurance market, allowing to extend the current state of knowledge in this area. The results of the conducted research may provide a practical clue for insurers in the matter of tailoring the product offer to the needs of customers.

Results

The survey results show that over 8 out of 10 respondents declared having the knowledge of Autocasco Insurance (AC) and Accident Insurance (NNW). The most recognizable types of motor insurance turned out to be (Fig. 1): AC insurance (693 respondents declared to know this product, which is 86.6% of all respondents), Accident insurance (NNW) (657 respondents) and Assistance insurance (564 respondents). The lowest number of respondents were familiar with border insurance – 319 surveyed (24.8% of the respondents). To sum up, it should be noted that the individual types of insurance were quite well recognizable by the respondents.

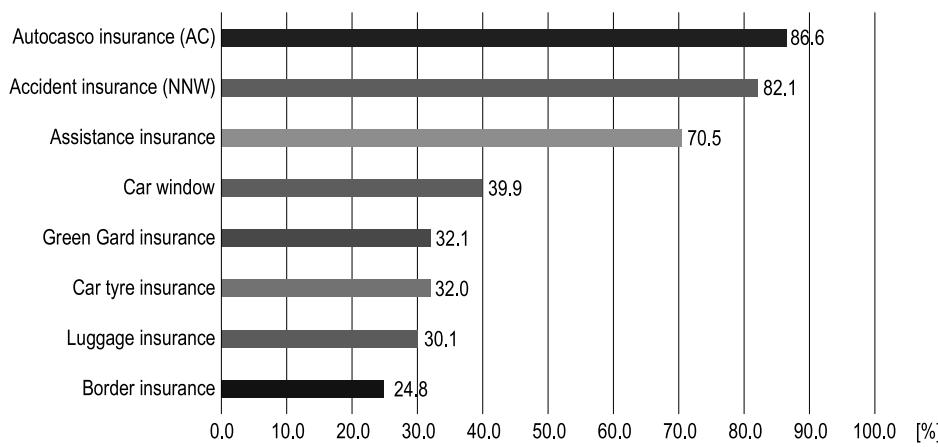

Fig. 1. Knowledge of the types of motor insurance policies (in %)
Source: own work based on own research.

Additionally, the knowledge of the types of motor insurance was analyzed taking into account gender, education and income level of the respondents. The survey results show that more men than women knew and were interested in motor insurance (Tab. 1). The greatest difference (by 9.8 percentage points) was observed in the case of Green Card and Assistance insurance policies (6.4 percentage points), while the smallest one in the case of the Accident insurance (NNW).

Table 1

Knowledge of types of motor insurance policies depending on gender

Type of insurance	*N*	Total [%]	Female [%]	Male [%]
Autocasco insurance (AC)	693	86.6	86.3	87.2
Accident insurance (NNW)	657	82.1	82.1	82.2
Assistance insurance	564	70.5	68.1	74.5
Green Card insurance	257	32.1	28.5	38.3
Border insurance	198	24.8	24.1	25.8
Luggage insurance	241	30.1	29.1	31.9
Car tyre insurance	256	32.0	31.3	33.2
Car window insurance	319	39.9	38.6	41.9

Source: own work based on own research.

The greatest knowledge of AC insurance was observed among the respondents with higher education (Tab. 2). Those with vocational/industry education had extensive knowledge of Accident insurance (NNW), Green Card, border insurance and car tyre insurance. The surveyed with primary education were not familiar with the following insurances: Green Card, border insurance, luggage insurance, and car tyre insurance. In turn, the respondents with lower secondary education were not familiar with border insurance and car window insurance.

Table 2

Knowledge of types of motor insurance policies depending on educational level (in %)

Type of insurance	Primary	Secondary and post-secondary	Lower secondary	Basic vocational/ professional	Higher
Autocasco insurance (AC)	75.0	33.3	83.8	86.3	87.5
Accident insurance (NNW)	75.0	66.7	86.5	80.5	82.9
Assistance insurance	75.0	66.7	67.6	68.3	72.1
Green Card insurance	-	33.3	37.8	31.7	32.2
Border insurance	-	-	27.0	24.6	25.1
Luggage insurance	-	33.3	27.0	29.0	31.3
Car tyre insurance	-	33.3	35.1	33.1	31.3
Car window insurance	50.0	-	43.2	38.6	40.6

Source: own work based on own research.

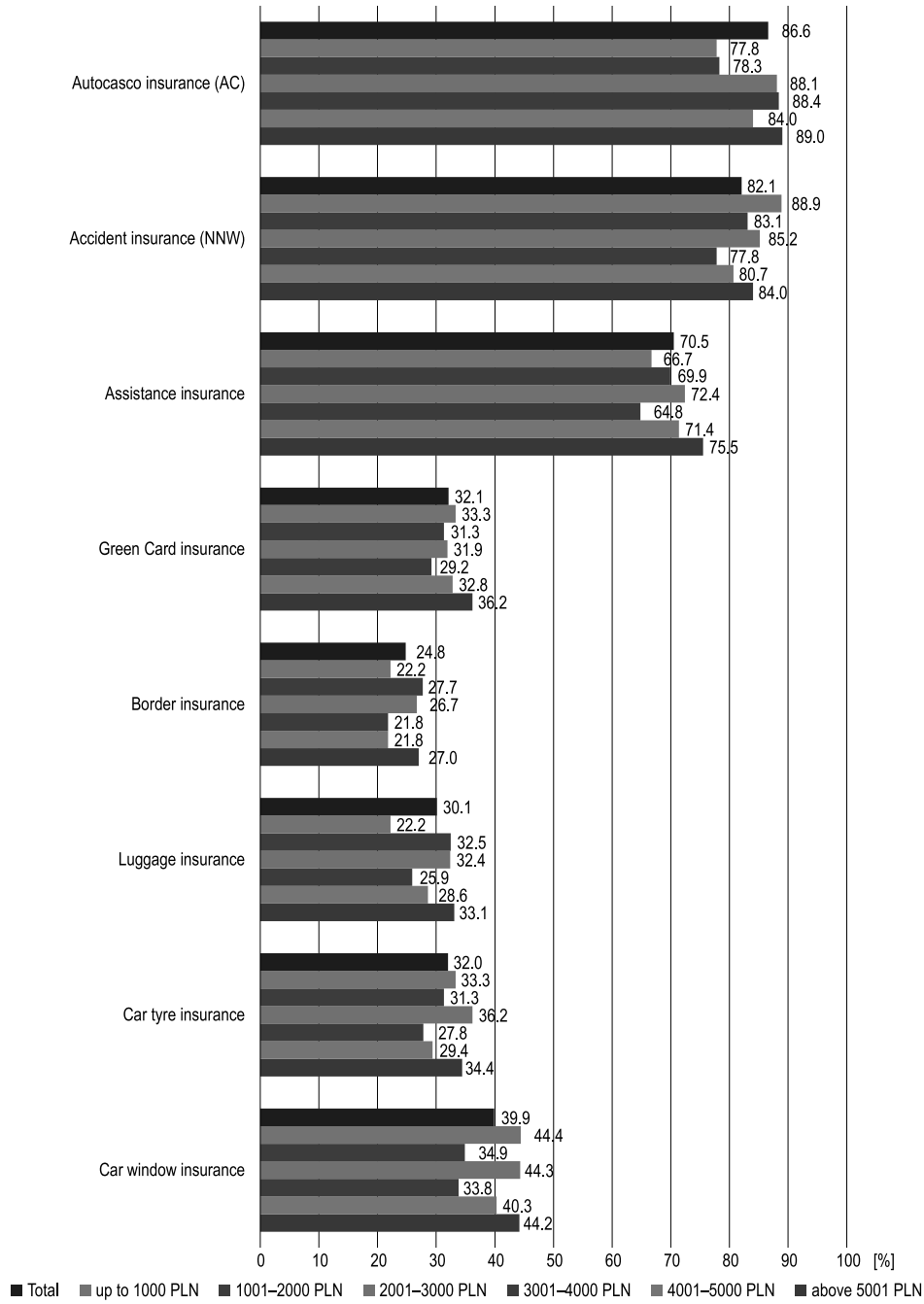

Fig. 2. Knowledge of types of motor insurance policies depending on income (in %)
Source: own work based on own research.

In the case of Autocasco insurance, persons with incomes exceeding PLN 5,000 net per capita in a household demonstrated the greatest knowledge of this type of insurance (89.0% of the respondents). In turn, the least knowledge of this insurance was observed among the respondents whose incomes did not exceed PLN 1,000 per capita. On the other hand, the Accident insurance (NNW) was most often known among the respondents with incomes up to PLN 1,000 (88.9%), and the least known among those whose incomes ranging from PLN 3,001 to 4,000. Analyzing the knowledge of Assistance insurance and Green Card insurance, it was noticed that the greatest knowledge was shown by the respondents with incomes exceeding PLN 5,000 net, and the least one by those whose incomes ranging from PLN 3,001 to 4,000. The greatest knowledge of border insurance was shown by the persons whose incomes were in the range of PLN 1,001 to 2,000, and the lowest by those with incomes ranging from PLN 3,001 to 5,000. Travel luggage insurance was most familiar to the respondents with incomes above PLN 5,000, and least familiar to those with incomes below PLN 1,000. Car tyre insurance was most known among the surveyed with incomes ranging from PLN 2,001 to PLN 3,001, while car window insurance to the respondents with incomes up to PLN 1,000 (Fig. 2).

In the next stage of the survey, the respondents who declared having the knowledge of a given type of insurance were asked to indicate whether they had purchased a respective insurance policy (Fig. 3).

In the case of Accident insurance (NNW), out of 657 respondents who recognized this insurance type, 624 declared to possess a respective policy (which is 95.0% of the surveyed who knew this type of insurance). In the case of AC insurance, out of 693 respondents who knew it, 642 were holders of such an insurance policy (92.6%). In turn, out of 564 respondents who knew Assistance

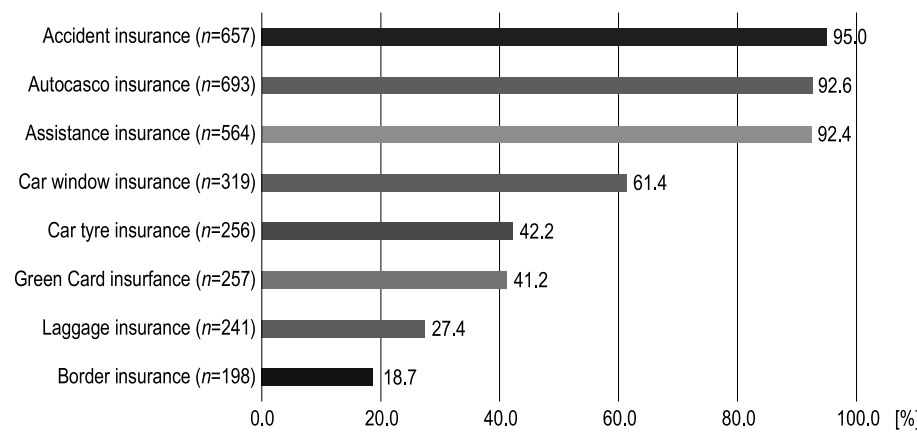

Fig. 3. Type of motor insurance possessed (in %)

Source: own work based on own research.

insurance, 521 declared that they had such a policy (92.4%). In the research conducted by M. Borda and A. Jędrzychowska, respondents also indicated that in addition to the compulsory insurance, they most often possessed Accident insurance (NNW), AC insurance and Assistance insurance policies (Borda & Jędrzychowska, 2012).

Border insurance, which was the least recognizable type of insurance, was also the least frequently chosen in the study group, with only 37 respondents (18.7%) declaring to possess such a policy out of 198 respondents who knew about this type of insurance.

Next, the type of insurance held was verified depending on gender, education and the amount of monthly net income per capita in the household. As in the case of the knowledge of motor insurance types, men prevailed in the number of purchased policies (Tab. 3). A very large difference was observed in the case of Green Card insurance (by 18.9 percentage points), travel luggage insurance (by 10.4 percentage points), car tyre insurance (by 10.3 percentage points), as well as border insurance (by 9.8 percentage points).

Table 3

Type of motor insurance possessed depending on sex

Type of insurance	*N*	Total [%]	Female [%]	Male [%]
Autocasco insurance (AC)	624	95.0	94.9	95.1
Accident insurance (NNW)	642	92.6	92.4	93.1
Assistance insurance	521	92.4	90.6	95.0
Green Card insurance	106	41.2	32.9	51.8
Border insurance	37	18.7	14.9	24.7
Luggage insurance	66	27.4	23.3	33.7
Car tyre insurance	108	42.2	38.2	48.5
Car window insurance	196	61.4	60.8	62.4

Source: own work based on own research.

Furthermore, 100% of the surveyed with primary and lower secondary education declared possessing the AC, Accident and Assistance insurance policies (Tab. 4). Additionally, all respondents with lower secondary education also declared to have luggage and car tyre insurance, and all the surveyed with primary education to have car window insurance. Different observations were made for the respondents with vocational, secondary and higher education. AC, Green Card, and luggage insurance policies were most often purchased by those with secondary and post-secondary education. In turn, the respondents with higher education were the largest group of customers protected by Assistance and border insurance.

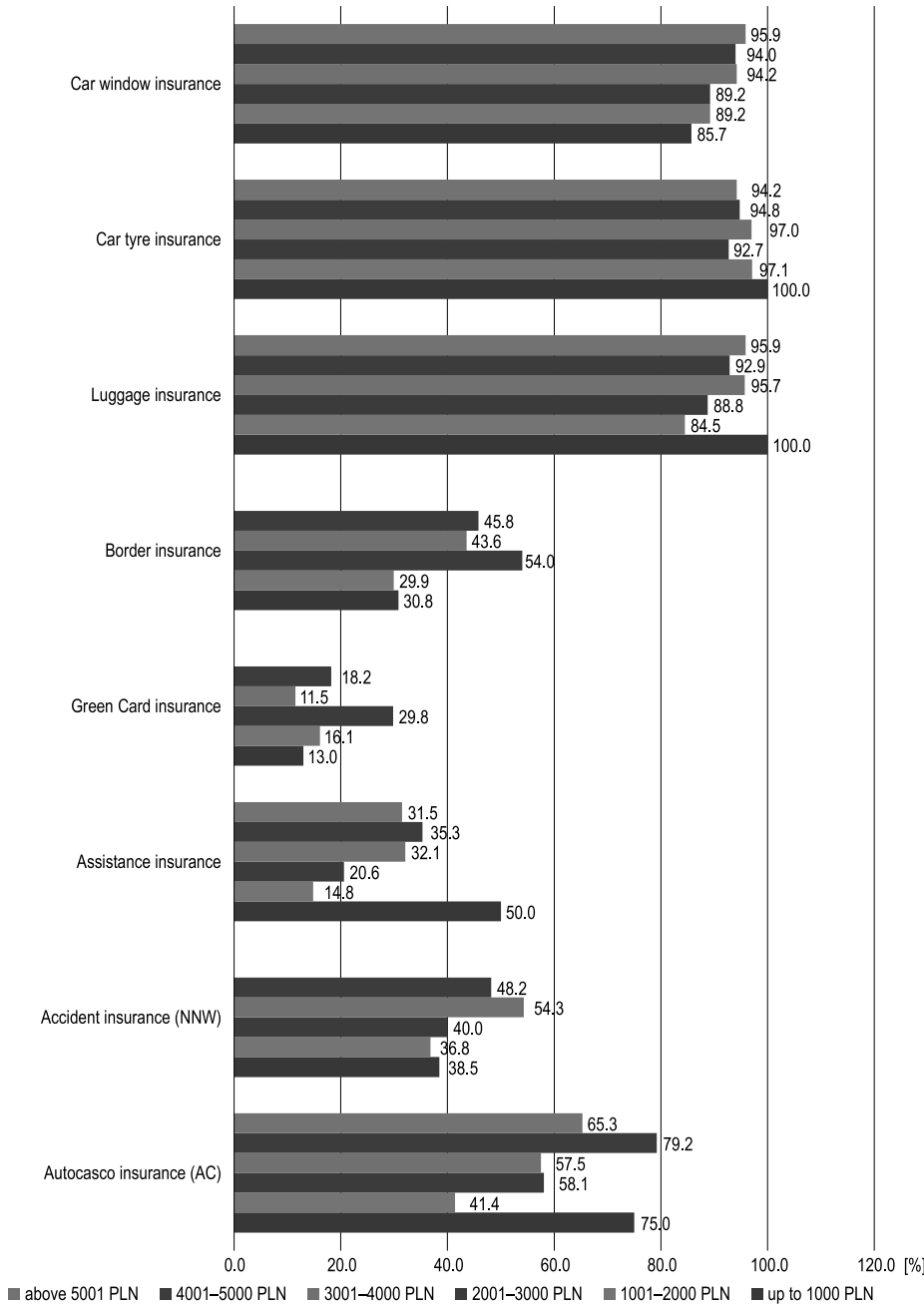

Fig. 4. Type of motor insurance possessed depending on income (in %)
Source: own work based on own research.

Table 4

Type of motor insurance possessed depending on educational level (in %)

Type of insurance	Primary	Secondary and post-secondary	Lower secondary	Basic vocational/ professional	Higher
Autocasco insurance (AC)	100.0	100.0	90.3	92.9	92.6
Accident insurance (NNW)	100.0	100.0	93.8	96.6	94.0
Assistance insurance	100.0	100.0	88.0	90.0	94.0
Green Card insurance	-	-	35.7	45.2	39.6
Border insurance	-	-	-	18.1	20.7
Luggage insurance	-	100.0	10.0	28.2	27.6
Car tyre insurance	-	100.0	46.2	41.2	42.1
Car window insurance	100.0	-	68.8	57.5	62.8

Source: own work based on own research.

The survey results also show that 100% of the respondents who earned up to PLN 1,000 per capita in a household possessed the Accident (NNW) and Assistance insurance policies, and as many as half of them had travel luggage insurance (Fig. 4). Almost 96% of the respondents whose monthly income exceeded PLN 5,001 per capita declared to have the AC insurance, while over half (54.0%) of the respondents earning from PLN 3,001 to 4,000 to have the Green Card insurance, and almost 30% of them to have the border insurance. The car tyre and car window insurance policies were most often purchased by the respondents whose monthly income oscillated between PLN 4,001 and 5,000.

Summary

Understanding consumer behavior and decision-making, which is largely influenced by the approach to risk in the insurance market, is very important (Graminha & Afonso, 2022). On the other hand, access to information and the ability to exploit it are drivers of actions undertaken by insurers and customers themselves. Information asymmetry in the insurance market causes uncertainty. "The lack of complete knowledge of the existing state of affairs urges the need to make choices" (Kurek, 2012). Very often, customers who are aware of the possibility of protecting themselves against certain negative events with insurance have insufficient financial resources to purchase it.

The motor insurance market features high development potential and competitiveness and is also full of dependencies (Kowalska, 2016). Motor insurance is very common among the Poles; with its share in the gross written premium accounting for 51.3%, and in the paid compensations and benefits – for as much as 67.0%.

The conducted survey results show that the knowledge of motor insurance types among Poles is extensive. However, their use depends on the type of risk being insured. The respondents most often (apart from the mandatory civil liability insurance for owners of motor vehicles) possessed the Accident (NNW), AC and Assistance insurance, i.e., insurance types that protect the driver and passenger (NNW), secure destruction and damage to the car due to accident and car theft (AC) and provide assistance in the event of vehicle damage or immobilization (Assistance).

Men were more familiar with and possessed more policies of motor insurance than women. Income played an important role in the case of AC insurance and car window and tyre insurance (which can be insured separately or in AC insurance package).

Translated by Joanna Molga

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ORIGINAL PAPER

ACTUAL AND DECLARED ATTITUDES TOWARDS FINANCIAL RISK AMONG STUDENTS OF THE UNIVERSITY OF WARMIA AND MAZURY IN OLSZTYN

Justyna Brzezicka
Department of Real Estate and Investment Process
Cracow University of Economics
ORCID: https://orcid.org/0000-0001-9500-1054
e-mail: brzezicj@uek.krakow.pl

Katarzyna Pirożek, Paweł Grabowski
Graduates of the Faculty of Geoengineering
University of Warmia and Mazury in Olsztyn

JEL Classification: D81, D90, D91.

K e y w o r d s: behavioral economics, prospect theory, risk aversion, risk seeking.

A b s t r a c t

The article is dedicated to the issue of actual and declared attitudes toward risk among students of the University of Warmia and Mazury in Olsztyn. The research was carried out using a survey (100 questionnaires) in December 2022 as an extension of the work carried out by the students in their thesis. The survey asked respondents to identify their self-reported attitude towards risk (risk averse, risk seeker, risk neutral attitude) and then assessed their actual attitude towards risk using the certainty equivalent method, known from behavioral economics. The study had specific objectives to identify risk attitudes among students and to identify differences between their actual and declared risk attitudes. The most significant conclusions of the study are as follows. Students are not aware of their own attitudes towards risk – only about 30% of the survey sample shows a match between actual and declared attitudes. According to the actual data, risk averters respondents are 41%, those with a risk-neutral attitude 21% and risk-seekers 38%. In the case of the declared data it was respectively: 50%, 6% and 34%.

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RZECZYWISTE I DEKLAROWANE POSTAWY WOBEC RYZYKA FINANSOWEGO WŚRÓD STUDENTÓW UNIWERSYTETU WARMIŃSKO-MAZURSKIEGO W OLSZTYNIE

Justyna Brzezicka
Katedra Ekonomiki Nieruchomości i Procesu Inwestycyjnego
Uniwersytet Ekonomiczny w Krakowie

Katarzyna Pirożek, Paweł Grabowski
Absolwenci Wydziału Geoinżynierii
Uniwersytet Warmińsko-Mazurski w Olsztynie

Kody JEL: D81, D90, D91.

Słowa kluczowe: ekonomia behawioralna, teoria perspektywy, awersja do ryzyka, poszukiwanie ryzyka.

Abstrakt

Artykuł poświęcono zagadnieniu rzeczywistych i deklarowanych postaw wobec ryzyka wśród studentów Uniwersytetu Warmińsko-Mazurskiego w Olsztynie. Badania przeprowadzono z wykorzystaniem formularza ankiety (100 kwestionariuszy) w grudniu 2022 r. jako rozszerzenie pracy realizowanej przez studentów w ramach pracy dyplomowej. W ankiecie poproszono respondentów o zidentyfikowanie własnej postawy wobec ryzyka (awersja do ryzyka, poszukiwanie ryzyka, postawa neutralna wobec ryzyka), a następnie oceniono ich rzeczywistą postawę wobec ryzyka za pomocą metody ekwiwalentu pewności, znanego na gruncie ekonomii behawioralnej. Badanie miało na celu identyfikację postaw wobec ryzyka wśród studentów oraz zidentyfikowanie różnic między ich rzeczywistymi a deklarowanymi postawami wobec ryzyka. Najważniejsze wnioski z badania są następujące. Studenci nie są świadomi własnych postaw wobec ryzyka – tylko ok. 30% studentów wykazuje zgodność między rzeczywistymi a deklarowanymi postawami. Zgodnie z rzeczywistymi danymi respondenci unikający ryzyka stanowią 41%, osoby o postawie neutralnej wobec ryzyka 21%, a osoby poszukujące ryzyka 38%. W przypadku danych deklarowanych było to odpowiednio: 50%, 6% i 34%.

Intruduction

For young people, studying is a developmental leap, both in terms of acquiring specialized knowledge in line with the fields of study they are taking, as well as their first experience with adulthood, independent financial decisions, investments, and the risks of managing money on their own. However, their awareness of financial markets, risks, and their own attitudes toward risk are still in the process of forming, and they are just gaining knowledge about these topics. For this reason, the students are an extremely interesting research group. Upon graduation, they will form a group of young adults, active market participants, making much larger financial decisions.

The purpose of this study was to determine attitudes towards risk among students at the University of Warmia and Mazury in Olsztyn and then to determine the differences between actual and declared attitudes toward risk. A questionnaire was used to conduct the investigation. The respondent's actual attitude was determined using the theory of the certainty equivalent of a lottery, known in the field of behavioral economics, which makes it possible to determine whether the respondent manifests a risk-seeking attitude, risk-averse attitude, or risk-neutral attitude. The responses to actual attitudes were then compared with the responses from students who self-identified their attitude toward risk, declaring which attitude they thought best described their behavior.

The remainder of the paper is organized as follows. The next chapter introduces the issue of the equivalent certainty and describes attitudes toward risk on the basis of behavioral economic theory. A detailed description of the research methodology is presented in the section 'Data and methods'. The main part of the paper is a presentation of the research results, and the whole is completed with conclusions.

Literature Review

Behavioral economics is one of the younger and fastest growing fields of economics. It focuses on analyzing the decision-making process and describing the behavior of market participants by appealing to the psychological basis of human nature (Camerer & Loewenstein, 2004, p. 3; Pesendorfer, 2006, p. 712), the limited cognitive capabilities of humans and the tendency to indulge in emotions and temptations (e.g., Tyszka, 2000; Kahneman, 2012). Behavioral economics departs from the fully rational model of homo-oeconomicus behavior (Thaler, 2000; Brzezicka & Wiśniewski, 2014), also taking into account the informational deficiencies of decision-makers or issues related to the learning process.

Behavioral economics also addresses the issues of bounded rationality and decision-making process under conditions of risk and uncertainty. In this area, the best known theory is prospect theory, developed by Kahneman and Tverskye (1979) and its more advanced form (Tversky & Kahneman, 1992). Prospect theory is one of the most important and interesting achievements of contemporary experimental research on psychological issues related to economic theory. This model is an alternative to the classical expected utility model (von Neumann & Morgenstern, 1944), which was criticized for mismatching theoretical assumptions with the actual behavior of market actors. According to its assumptions, decisions under risk conditions are made by an individual in two stages: the editing phase and the evaluation phase (McDermott, 2001, p. 1, 20; Zaleśkiewicz, 2011, p. 104). In the editing phase, decision-makers recognize the situation. They 'record' the results as gains and losses based on a reference

point. The reference point may be a current or desired state of possession; may be known a priori; me by shaped by preferences; and it also may be revealed from behavior (Werner & Zank, 2019). In the evaluation phase, values are established for each decision prospect.

The prospect theory described above explains how individuals make decisions under risk. Through numerous experimental studies, Kahneman and Tversky analyzed the behavior and preferences of market participants. These studies confirmed the existence of numerous deviations from the classical theory of rationality. The willingness to take risks is also an individual characteristic of decision makers. Depending on the decision-making situation and the individually determined level of risk acceptance, three attitudes towards risk can be distinguished: risk seeking, risk neutrality, and risk aversion (Tyszka & Domurat, 2004; Tyszka, 2010, p. 202). Jajuga (2018, p. 19) explains these attitudes as follows: risk aversion occurs when a decision maker is willing to incur additional expenditures in order to make a higher-risk decision; risk neutrality occurs when the magnitude of the risk does not matter when making a decision; risk aversion occurs when a decision maker takes risks when he or she expects to be compensated with a risk premium.

The study of attitudes toward risk is possible using thethe certainty equivalent method. Certainty equivalent is used in practice to determine the utility function for money. According to Tyszka's definition (2010, p. 202), the certainty equivalent is "such a reward value for which the decision maker is indifferent (neutral) as to whether he receives this value with certainty or a given risky option". A similar definition is given by Zaleśkiewicz (2011, p. 245), according to whom the certainty equivalent is 'the amount that is still the smallest amount acceptable to balance participation in a lottery with a risky option.' Certainty equivalent means a certain utility, determined in a similar way to the expected value from a game with a risk option (Guyse, 2001, p. 83). It is important to note that the value of the certainty equivalent varies depending on what attitude toward risk the individuals have.

The certainty equivalent method has been used in prospect theory (Kahneman & Tversky, 1979), in the cumulative prospect theory of Tversky, Kahneman (1992) and in other studies to determine the parameters of this function (Rieger *et al.*, 2017). It also has many other applications, such as determining the minimum sale price, maximum purchase price (Guyse, 2001, p. 83); asset pricing (Zhang, 2023); risk assessment in the real estate market (Brzezicka & Tomal, 2023; Tomal & Brzezicka, 2023).

Data and Methods

To achieve the research goals, surveys were conducted. It was held in December 2022 and was attended by 100 people (57 women, 43 men). The respondents were students at the University of Warmia and Mazury in Olsztyn studying spatial management, geodesy and construction. The study group consisted of approximately 80% first-degree engineering students (3rd and fourth year of study), while the remaining 20% were students in supplementary master's studies (5th year of study). The distribution of the research sample is shown in Figure 1.

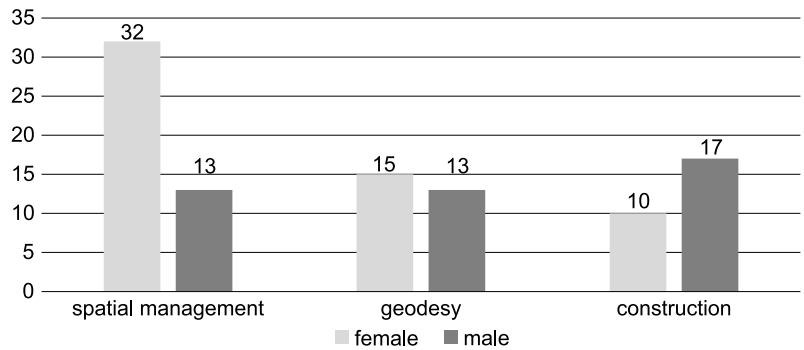

Fig. 1. Share of women and men of each field of study in the survey
Source: own study.

The questionnaire consisted of more than a dozen questions, some of which were used to achieve the research objectives presented above. It included metric questions, questions to determine actual attitudes toward risk, and questions on students' self-definition of their own attitudes toward risk.

In the part to determine actual attitudes toward risk, students were asked about their attitudes toward the amount of PLN 500 (Question 1), PLN 5,000 (Question 2) and PLN 500,000 (Question 3). However, Question 2 was chosen for further study due to the fact that it is a medium-sized amount (not too extreme to be too abstract and not too small to disregard the survey). The content of the question is shown in Figure 2. The questions include a risk variant due to the 50% probability of winning. This means that the expected value of this game is equal to PLN 2,500. On the other hand, the amount indicated as X is precisely the certainty equivalent of a lottery, since it is a guaranteed amount (100% probable). By comparing the expected value from the game and the value of the surety equivalent, it is possible to determine the respondent's attitude toward risk, according to the following interpretation (Tomal & Brzezicka, 2022, p. 2):

– if the amount X is equal to the expected value – risk neutrality;
– if the amount X is less than the expected value – risk aversion;
– if the amount of X is greater than the expected value – risk seeking.

Question 2

You have been invited to participate in a gain lottery with two possible outcomes:
option *A* – participating in the lottery and option *B* – receiving money.

A: 5000 PLN (50% chance) or 0 PLN (50% chance).
B: amount of money X (100% chance).

Indicate what amount of money *X* would have to be for you to be neutral about whether you participate in the lottery (variant *A*) or receive a payout (variant *B*).

X = ...

Fig. 2. Question about the actual attitude toward risk
Source: own study.

In the section to determine declared attitudes toward risk, the survey requested two questions presented in Figure 3. The first asked respondents to identify whether they were risk averse, risk seeker, or risk neutral. The second question was more specific, asking students to indicate on a 7-point Likert scale their attitude.

Question 17

Do you consider yourself to be:

a) risk-averse?
b) risk-seeking?
c) neutral to risk.

Question 18

Indicate on a 7-grade scale your attitude towards risk where:
1 – risk aversion, 4 – risk neutrality, 7 – risk seeking

1 – high risk aversion	2 – medium risk aversion	3 – low risk aversion	4 – risk neutrality	5 – low risk seeking	6 – medium risk seeking	7 – high risk seeking
□	□	□	□	□	□	□

Fig. 3. Question about the declared attitude toward risk
Source: own study.

By comparing the responses to the questions presented in Figure 1 and Figure 2, we were able to:

– determine the attitudes of students toward risk;
– identify the differences in the actual and stated attitudes;
– determine the scale of these differences.

For the analysis of actual attitudes, the answers provided in Question 2 of the survey were used. To analyze the differences between actual and declared attitudes, the answers given in Questions 2 and 17 were used. Furthermore, taking into account the answers given to question 18, it was possible to determine the scale of these differences. Question 18 makes it possible to classify students' declared responses into one of 7 ranges of attitudes toward risk, and therefore, the responses given in question 2 also required classification into one of the 7 ranges, this time prepared on actual data. The scale of students' answers regarding the level of the certainty equivalent could take values from a closed range of 0 to 5,000 PLN, with an expected value of 2,500 PLN. Using these criteria, the equivalent value was divided into seven possible ranges, each PLN 714, as shown in Table 1.

Table 1

Ranges of the value of the certainty equivalent (amount *X*)

Ranges	Range CE	lower bounds	upper bounds	Range of values
I	R. 1	0	714	<0;714)
II	R. 2	714	1,428	<714;1,428)
III	R. 3	1,428	2,143	<1,428;2,143)
IV	R. 4	2,143	2,858	<2,143;2,858>
V	R. 5	2,858	3,572	(2,858;3,572>
VI	R. 6	3,572	4,286	(3,572;4,286>
VII	R. 7	4,286	5,000	(4,286;5,000>

Source: own study.

The research procedure was to check for each individual answer what relationship exists between actual and declared attitudes. For this purpose, the students' answers given in Question 2 were ordered from smallest to largest, and then it was determined in which range from Table 1 they were (actual attitude determination divided on a 7-degree scale). Then the actual answers were compared with the answers declared in Question 18 (the declared attitude term expressed on a 7-degree scale). In this way, two streams of scores recorded on a scale from 1 to 7 were obtained – actual and declared. The actual answers were placed in a table with the coding (Tab. 2) of the results by numbers and the declared answers by an asterisk '*'.

For example, a respondent who indicated in Question 2 an amount *X* worth PLN 2,500, specified in Question 17 that he is risk neutral, and indicated 4 in Question 18, will present a declared attitude consistent with reality (*C* compatible). On the other hand, a respondent who indicated in Question 2 an amount *X* of PLN 500, specified in Question 17 that he was risk neutral,

and indicated 4 in Question 18, would present a declared attitude incompatible with reality (INC – incompatible). The scale of differences between actual and declared responses was calculated as the difference in the scores between these responses in absolute value. The interpretation of the results was adopted as follows:

– 0 – no differences in actual and declared attitudes;

– 1-2 points – small differences in actual and declared attitudes (mean that the actual and declared answers differ by 1 to 2 points);

– 3-4 points – large differences in actual and declared attitude attitudes (mean that the actual and declared answers differ by 3 to 4 points);

– 5-6 points. – very large differences in actual and declared attitudes attitudes (mean that the actual and declared answers differ by 5 to 6 points).

An example of coding responses in the summary table is presented in Table 2 based on 14 sample responses, 2 respondents from each actual attitude range.

Table 2

Coding of responses

ID	Q2	Rate (Q2)	Rate (Q2)	Opinion (Q17)	C vs. INC	Opinion (Q18)	R. 1	R. 2	R. 3	R. 4	R 5	R. 6	R. 7	Scale of these differences
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
11	100	1	A	A	C	3	100		*					2
19	400	1	A	N	INC	5	400				*			4
97	1,000	2	A	A	C	3		1,000	*					1
90	1,000	2	A	S	INC	5		1,000			*			3
16	2,000	3	A	A	INC	4			2,000	*				1
58	2,000	3	A	S	INC	5			2,000		*			2
94	2,500	4	N	S	INC	3			*	2,500				1
31	2,500	4	N	S	INC	5				2,500	*			1
93	3,000	5	S	S	INC	5					3,000 *			0
52	3,000	5	S	S	C	6					3,000	*		1
3	4,000	6	S	A	INC	2				*		4,000		4
18	4,000	6	S	A	C	2					*	4,000		4
92	4,800	7	S	S	C	4					*		4,800	3
32	5,000	7	S	S	INC	3			*				5,000	4

A – risk averse attitude, S – risk seeker attitude, N – risk neutral attitude
Source: own study.

Results and Discussion

First, the students' responses regarding their actual attitude toward risk were analyzed. The answers given to Question 2, regarding the expected value from the lottery of 2,500 PLN, revealed that the surveyed group was 41% risk averse, 21% risk neutral and 38% risk seekers. These results were in line with expectations. The belief that students are risk-oriented is a common opinion, but scientific research indicates that students mostly take risky actions when it is a necessity and not a choice, one in 4 students take risks rarely, and only a few percent of respondents involve themselves more strongly in risky situations according to their personality characteristics (Saran, 2019, p. 110). The results obtained in terms of the distribution of individual attitudes in the research group are partially consistent with the literature. Tomal and Brzezicka (2023) analyzed attitudes towards risk on the gain lottery in questions about money and obtained the following results: 67% risk aversion attitude, 12% neutral attitude and 21% risk seeking attitude. The mentioned study was carried out in a group of people aged 25-40, while this study was carried out in a group of students. A comparison of the results obtained from both research groups indicates that older people are more risk averse, which may result from the fact that with age they develop knowledge and experience in this area. Furthermore, as the expected value of the lottery increases, the number of risk-averse attitudes increases, and at the same time, the number of respondents who take a risk-seeking attitude decreases (see Fig. 4). These results are also consistent with those reported in the literature. Prospect theory (Kahneman & Tversky, 1979) clearly indicates that decision-makers change their attitude toward risk depending on gains and losses and whether the situation involves a small or large amount. When the lotery gains, risk aversion is observed, and many studies in various fields confirm this observation (e.g., Barberis *et al.*, 2021; Pawlonka, 2021). However, when declaring their attitudes, the students indicated a risk-averse attitude in 45% of the cases, a neutral attitude in 37%, and risk seeking in 18%. Therefore,

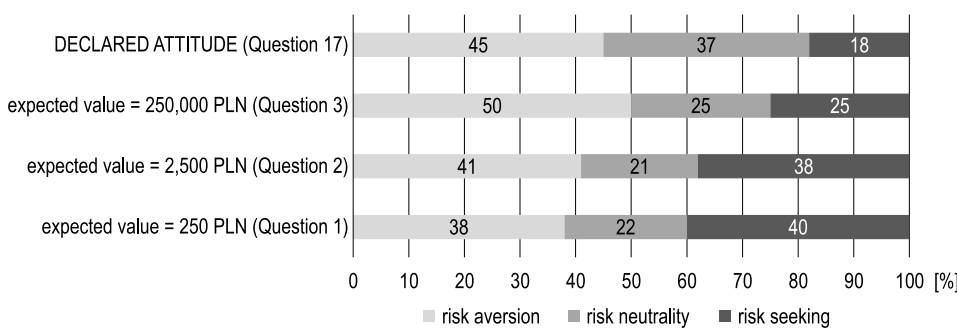

Fig. 4. Question about the declared attitude toward risk

Source: own study.

declared attitudes underestimate the number of risk-taker and overestimate the number of neutral attitudes.

Unfortunately, when students determine their own attitudes toward risk, only 35% determined them in accordance with actual attitudes, and up to 65% of respondents are characterized by the incompatibility of actual and declared attitudes. In the group of risk-averse respondents, only about 38% determine that they are risk-averse, in the group of risk-neutral respondents, only 30% of them indicated this attitude, and in the group of risk-takers, only 39% considered themselves risk-takers (see Tab. 3). This means that only one in three students correctly identified their attitude towards risk. According to the literature, risk-seeking varies into different spheres of life – taking high risks when doing extreme sports does not mean being willing to take risks when investing one's own money (Tyszka & Zaleśkiewicz, 2001). Risk taking preferences can also change as a result of experience obtained, as well as with increased competence acquired in the educational process (Adamczyk, 2018). So here we have an isolated research situation at a specific point in the life cycle – this may partially justify students who are unaware of their actual attitudes. Their knowledge of this is not yet established, and they are also still forming and acquiring their knowledge of themselves.

Table 3

Declared vs. actual attitudes of students toward risk (in percentage points)

Declared attitudes		Risk aversion	Risk neutrality	Risk seeking
Actual attitudes	risk aversion	17 (38% in grup)	14	10
	risk neutrality	9	11 (29 % in grup)	1
	risk seeking	19	12	7 (39% in grup)
Sum		45	37	18%

Source: own study.

The next stage of the study was to determine the scale of differences between declared and actual attitudes. These differences were calculated based on differences in the number of scores determined on a 7-degree scale. The results of this investigation were presented in a histogram (Fig. 5). The study shows that about 20% of the respondents do not show differences in actual and declared attitudes towards risk (0 points), almost half (49%) of the respondents show small differences (1-2 points), and the remaining 30% show large and very large differences (3-6 points). This means that despite the fact that students mostly misjudge their overall attitude toward risk, the assessment using a detailed difference scale shows that about half of the respondents make small errors in this assessment.

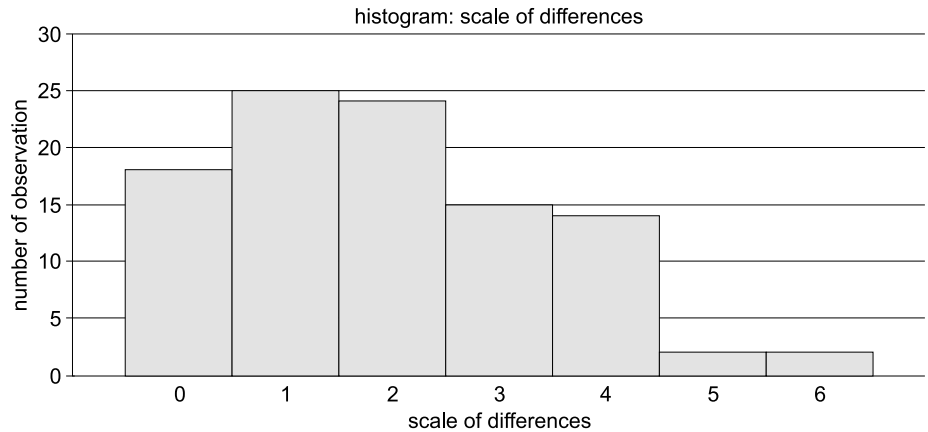

Fig. 5. Scale of differences in actual and declared attitudes

Source: own study.

In the next step, statistical texts of differences were also performed to see if there were statistically significant differences between actual and declared attitudes towards risk. First, a test was performed to see if the answers revealed in questions 2 and 17 were statistically different. The answers were recorded on a nominal scale (1 – risk averse attitude, 2 – neutral attitude, 3 – risk seeking attitude). A nonparametric chi-square test was used here, in which the distribution of the two answers was compared. Question 2 – that is, the actual responses – revealed that there are 41 risk averse, 21 neutral, and 38 risk takers in the population. This distribution was taken as the expected distribution and declared attitudes were checked to see if there was a concordance between the distribution and the expected distribution. A test value of $\chi^2 = 23.107$, $df = 2$, $p < 0.001$ was obtained, which means that the differences between the actual and declared responses should be considered statistically significant.

In the next step, a test was performed to see if the answers revealed in Questions 2 and 18 were statistically different. Responses were recorded on an ordinal scale (from 1 to 7 respectively to the ranges of values shown in Table 1). Since the variables did not have a normal distribution, were described on an ordinal scale and the samples were dependent – a nonparametric Wilcoxon signed rank test was performed. The null hypothesis of this test is that the median difference between the variables is equal to zero. The p-value for this test was $p = 0.666$, the test statistic $T = 1609$, the standardized statistic $Z = 0.431$, which means that the null hypothesis should be accepted – there are no differences between the medians of the two variables. Calculations of both tests were performed in SPSS software.

The results obtained confirm the above observations. When it comes to the overall assessment of their attitudes, the students mostly incorrectly assess their

attitudes toward risk (significant differences in population distributions according to the chi-square test). However, in the case of detailed analysis of attitudes toward risk, they make small errors, which is reflected in the results of the Wilcoxon test, which shows that the differences between declared and actual attitudes are not statistically significant.

Conclusions

The article was dedicated to the issue of financial risks taken by students. Research distinguished students' attitudes toward risk according to prospect theory: risk aversion, risk seeking, and risk neutrality. The research confirmed observations in the literature that students are not risk-takers. In addition, observations from perspective theory were also confirmed: gain lotteries cause the risk aversion attitude. This attitude in the study group was prevalent and, in addition, the attitude towards risk changed depending on the size of the lottery amounts. The study also revealed that there is a large overall difference in actual and declared attitudes, but after examining these differences in detail and placing them on a scale, it turned out that about half of the students make a small error in assessing their attitudes.

The most important research limitation for the present study is the small sample size – only 100 survey responses collected, which may affect the applicability of the results presented. Therefore, further research directions should include conducting research on a larger study group. In addition, the discussion carried out with the results indicates that students' attitudes may differ among students studying in different fields of study and in different years of study, so such research should be carried out in the future to be able to determine with a greater degree of detail not only the scale of differences in declared and actual attitudes, but also the reasons for these differences.

Translated by the Author

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ORIGINAL PAPER

HOUSING TRANSACTIONS DATA PORTAL (DOM): THEORETICAL ASPECTS AND POSSIBILITIES FOR PRACTICAL IMPLEMENTATION

Ewa Gorlecka-Łabiak
Department of Real Estate and Investment Process
Cracow University of Economics
ORCID: http://orcid.org/0000-0002-7571-5188
e-mail: gorlecke@uek.krakow.pl

JEL Classification: K20, R30, R38.

Key words: homebuyer protection, transaction residential price statistics, housing market, databases, real estate prices.

Abstract

This study aims to describe the government's concept for creating the Housing Transactions Data Portal (DOM), designed to present statistics on transaction prices in the housing market. The Ministry of Development and Technology proposed the portal, which is to be operated by the Insurance Guarantee Fund through an IT system. This is an innovative solution in the national housing market, with a nationwide scope, that will expand the bargaining power of homebuyers (thus aligning with the broader protection of financial consumer services and acting as a tool for safeguarding homebuyers). At the same time, this database will enable public authorities to conduct real-time analyses of the housing market, including assessing the impact of housing support instruments on the market. The considerations in this article focus on analyzing the potential benefits and possible problematic areas related to the implementation of the DOM portal.

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PORTAL DANYCH O OBROCIE MIESZKANIAMI (DOM): ASPEKTY TEORETYCZNE I MOŻLIWOŚCI PRAKTYCZNEGO WDROŻENIA

Ewa Gorlecka-Łabiak
Katedra Ekonomiki Nieruchomości i Procesu Inwestycyjnego
Uniwersytet Ekonomiczny w Krakowie

Kody JEL: K20, R30, R38.

Słowa kluczowe: ochrona nabywcy nieruchomości mieszkaniowej, statystyki cen transakcyjnych mieszkań, rynek mieszkaniowy, bazy danych, ceny nieruchomości mieszkaniowych.

Abstrakt

W opracowaniu opisano rządową koncepcję utworzenia portalu danych o transakcjach mieszkaniowych (DOM), mającego prezentować statystyki dotyczące cen transakcyjnych na rynku mieszkaniowym. Ministerstwo Rozwoju i Technologii zaproponowało portal, który ma być obsługiwany przez Ubezpieczeniowy Fundusz Gwarancyjny za pośrednictwem systemu informatycznego. Jest to innowacyjne rozwiązanie na krajowym rynku mieszkaniowym, o zasięgu ogólnopolskim, które zwiększy siłę przetargową nabywców mieszkań (wpisując się tym samym w szerszą ochronę finansowych usług konsumenckich i działając jako narzędzie ochrony nabywców mieszkań). Jednocześnie baza ta umożliwi organom publicznym przeprowadzanie analiz rynku mieszkaniowego w czasie rzeczywistym, w tym ocenę wpływu instrumentów wsparcia mieszkaniowego na rynek. Rozważania w artykule koncentrują się na analizie potencjalnych korzyści i obszarów problematycznych związanych z wdrożeniem portalu DOM.

List of Abbreviations

CSO – Central Statistical Office
DFG – Developer Guarantee Fund
DOM – Housing Transactions Data Portal
EPC – Electronic Property Card
FSC – Financial Supervision Commission
IGF – Insurance Guarantee Fund
MDT – Ministry of Development and Technology
NBP – National Bank of Poland
NTA – National Tax Administration
OCCP – Office of Competition and Consumer Protection
PBA – Polish Bank Association
Record – Developer Guarantee Fund Registry
REPR – Real Estate Price Register
SIM – Social Housing Initiative

Introduction

For most Poles, purchasing residential property is one of the most important financial decisions they make in their lives. The real estate market in Poland struggles with persistent imbalances (Kucharska-Stasiak, 2016), cyclical price increases (Główka, 2018), and the absence of publicly accessible databases providing information on the market's condition. Access to information in the housing real estate market is one of the key factors determining its development, influencing market equilibrium and price levels. As J. Brzezicka notes, the real estate market is characterized by insufficient availability of information, information asymmetry, and difficulties in data accessibility (Brzezicka, 2021).

In response to these problems, the Ministry of Development and Technology (MDT) developed the concept for creating the nationwide Housing Transactions Data Portal (DOM). The portal will be launched based on an amendment to the Act of May 20, 2021, on the Protection of Homebuyers of Residential Units or Single-Family Homes and the Developer Guarantee Fund (Journal of Laws 2024, item 695). The amendment draft has already been submitted for public consultations, reviews, and inter-ministerial agreements, and it has been published on the Government Legislation Centre website (Projekt ustawy o zmianie ustawy o ochronie praw…, 2024). This portal will present transaction price statistics for the housing market. The primary solutions included in the legislative draft involve establishing the DOM portal, defining the catalog of data and information collected for the portal, determining the processing of this information, and specifying the principles for accessing the statistics.

The primary objective of this article is to present the assumptions behind the operation of the Housing Transactions Data Portal (DOM) as an innovation in the national housing real estate market. The considerations focus on analyzing potential benefits and identifying possible problematic areas related to the implementation of the DOM portal. The article sets out the following specific goals:

1. What is the purpose of the DOM portal, its basic conceptual assumptions, and its target groups?
2. Determining the sources of information feeding the database and defining the functionality of the data.
3. Assessing the opportunities, threats, and risks associated with the operation of the discussed instrument, along with an attempt to estimate the effectiveness of government actions in housing policy after the project's implementation.

The research methodology used in this study includes a review of the subject literature and national legislation, including documents in the legislative pipeline, such as the draft and explanatory memorandum to the Act on the Protection of Homebuyers of Residential Units or Single-Family Homes.

Legal Foundations for the Creation of the DOM Portal

The Housing Transactions Data Portal (DOM) will be launched based on the amendment to the Act of May 20, 2021, on the Protection of Homebuyers of Residential Units or Single-Family Homes, the Developer Guarantee Fund, and Certain Other Acts (Journal of Laws 2024, item 695)[1]. The provisions will enter into force, with exceptions, 20 months after the amendment's publication. Currently, the draft act is undergoing external consultations.

The concept of universal and free access to the Housing Transactions Data Portal (DOM) fits into the broader idea of protecting homebuyers of residential real estate, initiated with the enactment of the Developer Act (Act of May 21, 2022, on the Protection of Homebuyers of Residential Units or Single-Family Homes and the Developer Guarantee Fund, consolidated text: Journal of Laws 2024, item 695). Additionally, it aligns with constitutional provisions and citizens' rights to satisfy housing needs and consumer protection against unfair market practices.

In accordance with Article 75(1) of the Constitution of the Republic of Poland, public authorities conduct policies aimed at meeting citizens' housing needs, particularly combating homelessness, supporting the development of social housing, and promoting citizen initiatives to acquire their own housing. Furthermore, Article 76 of the Constitution stipulates that public authorities protect consumers, users, and tenants from actions threatening their health, privacy, and safety, as well as from unfair market practices (Constitution of the Republic of Poland of 2 April 1997).

The concept of implementing the DOM portal increases the protection of residential real estate buyers and complements earlier measures undertaken by the national legislator. Notably, since July 1, 2022, thanks to the Developer Guarantee Fund (DGF)[2], buyers of homes and apartments in the primary market have gained effective protection of their interests. The DGF guarantees the reimbursement of all invested funds, both in cases of developer bankruptcy and bank insolvency regarding the escrow accounts where clients' funds are deposited. The legal changes leading to the establishment of the DGF were

[1] This Act amends the following legal acts: the Act of 6 July 1982 on land and mortgage registers, the Act of 14 February 1991 – Notary Public Law, the Act of 29 August 1997 – Tax Ordinance, the Act of 22 May 2003 on compulsory insurance, the Insurance Guarantee Fund and the Polish Motor Insurers' Bureau, and the Act of 1 March 2018 on the prevention of money laundering and the financing of terrorism.

[2] The DGF was established by the Act of 20 May 2021 on the protection of the rights of the purchaser of a dwelling or a detached house and the Developer Guarantee Fund, Journal of Laws, i.e. 2024, item 695. The DFG collects and processes a range of data provided by banks and developers on concluded development contracts, the related housing trust accounts (MRPs), payments and withdrawals from these accounts and the history of changes made to the contracts. From 1 July, full protection for buyers of houses and flats from the primary market (mb, aleBank.pl, 2022).

initiated by the Office of Competition and Consumer Protection (OCCP), with the fund being managed by the Insurance Guarantee Fund (IGF).

As B. Gliniecki (2022) emphasizes, the Developer Act extended the scope of protection for homebuyers in the primary residential real estate market and culminated years of OCCP's efforts to strengthen the rights of buyers of residential units and single-family homes. It is worth noting that legal issues related to developer agreements had been of interest to the OCCP President since at least 2003 and to the Commissioner for Human Rights since at least 2007 (Jurczyński, 2022).

Considering the above, the DOM portal thus fulfills the state's constitutional obligations to its citizens and meets OCCP's requirements while strengthening the bargaining position and ensuring the protection of homebuyers in Poland.

Objectives, Conceptual Assumptions, and Target Groups of the DOM Portal

As envisioned by its proponent, the Ministry of Development and Technology (MDT), the main purpose of the Housing Transactions Data Portal (DOM) is to strengthen the bargaining position of individuals purchasing residential properties. Additionally, the portal is intended to serve as a tool to assist public institutions responsible for supporting housing policy.

It is worth emphasizing that the operation of the DOM Portal has been entrusted to the Insurance Guarantee Fund (IGF) due to its existing management of another instrument for protecting homebuyers – the Developer Guarantee Fund Registry (hereinafter referred to as the "Record")[3]. This entity already has established automated communication channels with professional entities (developers, banks) reporting transaction data. Expanding the range of data collected for the Registry will be quicker and more cost-effective than building a new system from scratch (Krupa-Dąbrowska, 2024). Data and information collected within the Record will partially support the DOM portal, which will disclose average transaction prices of residential units and single-family homes. Developers, the primary source of information on transactions in the primary market, already have automated communication channels for feeding the Record. To cover the entire primary market, data obtained from the Record will be supplemented by information provided by other professional entities. Additional data from both the primary and secondary markets will be supplied by the National Tax Administration (NTA), which collects transaction data for tax

[3] On the basis of the amended Act of 20 May 2021 on the protection of the rights of the purchaser of a dwelling or a detached house and the Developer Guarantee Fund.

purposes and for combating money laundering and terrorist financing. Utilizing existing structures and databases is considered a reasonable approach[4].

The legislative draft specifies central institutions exclusively as the entities responsible for housing policy. According to the draft law, the IGF will generate or process information and make it available to the following entities: The Prime Minister, The Minister responsible for construction, planning, spatial development, and housing, The Minister responsible for internal affairs, The Minister responsible for public finances, The Head of the National Tax Administration, Heads of regional tax chambers, heads of tax offices, or customs-tax offices, The President of the Office of Competition and Consumer Protection (OCCP), The President of the National Bank of Poland (NBP), and The President of the Central Statistical Office (CSO).

These entities will use the information to fulfil their statutory duties within housing policy frameworks (Article 1, point 6 of the draft amendment, Article 56d, point 1). According to the draft law, information will be generated or processed and provided in a format that prevents the identification of individuals or specific properties. As noted above, the data passed to CSO and NBP will already be anonymized and statistically processed, which may complicate integration with existing statistics and analyses prepared by these entities.

Of greater concern is the exclusion of municipalities and cities from the list of entities that may access data, reports, or analyses. Local governments are also responsible for meeting the housing needs of their communities and may take actions such as building homes within SIM (Social Housing Initiative) frameworks or implementing spatial policies if they identify problems with meeting local demand. Legislative measures are only one aspect of housing policy implemented by local governments, often in collaboration with central institutions. If the DOM Portal is intended to monitor housing policy instruments, local governments should also have access to the analyses.

The division proposed in this draft, where central offices rely on data from one source while local governments, courts, and the banking system rely on different data, does not contribute to greater transparency in the housing market.

Additionally, the regulation does not foresee access to data, even anonymized for specific research purposes, for scientific studies, analyses, and comparisons at various levels, including international ones. Scientific research often serves as the first step in introducing housing policy instruments. Collaborating with research institutions on the DOM Portal, not only at the level of publicly available reports but also through access to underlying data, could be invaluable for housing policy at both central and local levels. The scientific purposes are mentioned in the explanatory memorandum to the draft law.

[4] Explanatory Memorandum to the Draft Law on Amendments to the Law on the Protection of the Rights of the Purchaser of a Dwelling or Single-Family House and the Developer Guarantee Fund and Certain Other Laws, Ministry of Development and Technology, Draft of 9 September 2024, p. 4.

Improving housing monitoring in Poland is in the public interest and thus benefits the government, local governments, non-governmental organizations, scientific and market communities, and all citizens who wish to base their housing decisions on reliable information sources (Milewska-Wilk & Nowak, 2022).

The real estate market functions with the active participation of many stakeholders, all of whom play equally important roles. One such stakeholder is the notary, whose involvement is indispensable for real estate transactions (Gołąbeska (ed.), 2024). Notaries, as public officials overseeing the execution of real estate purchase and sale transactions, will be a key element in feeding the database. This raises the question of whether notaries in Poland are prepared for such detailed descriptions of transactions and the daily feeding of the database with completed transactions.

In this context, it is worth considering the Polish Bank Association's (PBA) repeatedly proposed introduction of the Electronic Property Card (EPC). PBA submitted this proposal in early August 2024, in the context of the public consultation on the DOM Portal project, to three ministries – the Ministry of Development and Technology, the Ministry of Digital Affairs, and the Ministry of Justice.

According to PBA, creating the DOM Portal to present actual property prices is a step toward greater transparency in the real estate market. Unfortunately, the DOM Portal is designed for individual buyers, who purchase residential properties relatively infrequently. The project targets no more than 200,000 potential individual buyers per year. Given the significant effort and financial resources invested, it seems reasonable to enable the banking sector to utilize data collected in the DOM Portal, for instance, through an external (interbank) real estate database, as referenced in Recommendation by the Financial Supervision Commission on the principles of gathering and processing real estate data by banks. The AMRON system is an example of such a database, used by over 600 entities active in the real estate market, including 25 major commercial banks, 391 cooperative banks, as well as the National Bank of Poland, the Financial Supervision Authority, the National Prosecutor's Office, and the police. Establishing a framework for cooperation with banks to access data (e.g., via API connections) should be considered, especially given that banks are expected to contribute data to the system.

Utilizing existing information sources, such as data from the DFG and information collected by the NTA (via forms completed by notaries), is a good solution. However, a significant breakthrough would be the standardization of data describing properties involved in purchase transactions. As previously noted, PBA recommends revisiting discussions on implementing the EPC, which should be annexed to notarial deeds for real estate purchases. The scope of data collected in the EPC would significantly expand the list of characteristics and attributes of the property, allowing for transaction price verification, including technical condition and energy efficiency attributes.

By implementing the EPC, notarial deeds submitted to tax offices, county geodetic and cartographic documentation centers, and the land registry divisions of district courts could include a standardized and unified set of basic information about the properties involved in transactions. This would enable complete identification of transactions in the real estate market and eliminate the risk of errors in public registries caused by manual data entry in various public administration units.

Considering the above, introducing the EPC into the Polish legal framework should be deemed both necessary and fully justified.

It is worth pointing out at this point that there are other property databases in Poland. These include, among others, a few land registers, geoportals and all kinds of records, registers and lists, which are maintained by both public and private sector entities. Access to these is often difficult or chargeable.

The primary source of information holding data on the legal status of real estate is the Land and Mortgage Register[5]. Land and mortgage registers are maintained to ensure the security of property transactions. It is an established register to establish the rights in rem in real property. Land and Mortgage Registers are maintained for individual real properties regardless of any changes concerning the owner (Zaremba, 2009).

The Land and Building Register[6] is maintained by starosties, which means that, in effect, there are 380 units in Poland responsible for maintaining this database. The data, and in particular the data on registered parcels, are the basic reference data for the presentation of various other objects collected in spatial databases.

It should be noted that the above-mentioned sources of property data are detailed as to the property, not publicly available and intended for a different purpose as in the DOM Data Portal.

Mention should also be made of the operation in Poland of the Register of Real Estate Prices and Values[7], maintained by the Land and Building Register Departments in the county offices. This is a public register which contains data on real estate prices specified in notarial deeds and on real estate values specified by property valuers in appraisal reports, extracts of which are submitted to the Land and Building Register. These registers are appropriate for market analysis, but their main disadvantage is that they are chargeable and the database is incomplete (e.g. cooperative ownership of premises is not shown).

J. Zyga (2018) pointed out a number of flaws in the functioning of the Polish Register of Real Estate Prices and Values. In his research, he has shown that the contents of the real estate price and value register currently operating in

[5] In polish: Księgi Wieczyste.
[6] In polish: Ewidencja gruntów i budynków.
[7] In polish: Polski Rejestr Cen i Wartości Nieruchomości.

Poland cannot be used as an independent information basis for property valuation in accordance with the requirements of the Real Estate Management Act.

In addition, there are public real estate databases, run by the National Bank of Poland and the Central Statistical Office. Their disadvantage, however, is the fact that the data they obtain are general and the data they contain are aggregated and averaged.

In response to the lack of access to a public and free register of residential property transaction prices in Poland, real estate listing data is used. There are a number of advertising portals, e.g. nieruchomości-online, otodom, morizon, operating as databases of residential property prices, which present data subject to errors that reduce the transparency of the residential property market. All of these databases contain price data, but present either a different type of data, or the acquisition of this data is paid for, or the data is averaged, or scattered, or outdated. This justifies the creation of the DOM portal in Poland, given the lack of free access to the public to a portal of transaction price data on a micro level (to a specific property and not to an average value).

The analysis of shortcomings in the existing system of collecting, acquiring and presenting institutional information on transactional prices of residential real estate in Poland predestines the implementation of the DOM portal to be recommended.

Sources of Information Feeding the Database

The DOM Portal will be based on the following data and information sources derived from notarial deeds: primary market data on agreements for residential units and single-family homes subject to the requirement of maintaining housing escrow accounts, obtained from professional entities obligated to report data to the Developer Guarantee Fund Registry (hereinafter referred to as the "Record"); primary market data on sales agreements for residential properties not subject to the housing escrow account requirement, obtained from professional entities not obligated to report data to the Registry; and primary and secondary market data provided by the Head of the National Tax Administration (NTA) based on information from notarial deeds submitted by notaries[8].

The operation of the DOM Portal aims to increase the transparency of the housing real estate market and provide essential information for implementing state housing policy and parameterizing housing support instruments. It should be noted that, to date, Poland has lacked tools to verify the effectiveness

[8] Regulatory Impact Assessment of the draft Act on amending the Act on the protection of the rights of the purchaser of a dwelling or a single-family house and the Developer Guarantee Fund and some other acts, Ministry of Development and Technology.09.09.2024, No. in the list of legislative and programme works of the Council of Ministers: UD110.

of government housing programs. Furthermore, the absence of universal and free access to up-to-date and reliable information on transaction prices in the housing market makes it challenging for individuals intending to purchase a home or single-family house to understand actual market prices.

The collected data and information will enable the presentation of statistical data in territorial, temporal, and categorical dimensions, allowing individuals interested in purchasing a residential property to evaluate housing prices in a specific area and time frame. This will facilitate selecting the most advantageous offer among those available to them[9].

This issue is particularly significant from the perspective of real estate market practices. Given current economic conditions, it seems that this aspect has not yet been thoroughly examined from the perspective of residential unit or single-family home buyers.

This issue also corresponds to the broader challenge of accessing universal and free data on the housing market in selected EU countries. It is worth noting that such information, reflecting the state of the housing market, including transaction volumes and real (transactional) property prices, is publicly available in countries with developed real estate markets. Spain, for instance, provides very detailed market analyses. Another example is Ireland's Residential Property Price Register, maintained by the Property Services Regulatory Authority (PSRA) under Section 86 of the Property Services (Regulation) Act of 2011. This register includes the date of sale, price, and address of all residential properties sold in Ireland since January 1, 2010, as reported to the Revenue Commissioners for stamp duty purposes.

It is important to emphasize that the Residential Property Price Register should not be considered a "Property Price Index" (Explanatory Memorandum to the Draft Amendment, 2024). A key argument for implementing the DOM Portal is the need to present transactional property prices rather than asking prices. As R. Trojanek (2007) highlights, transactional property prices are the most reliable indicator of the market value of a property, and in countries with advanced real estate market monitoring systems, this data is readily accessible.

I. Dittmann (2013) conducted research on the formation of transactional and asking prices in the primary and secondary housing markets of selected Polish cities. According to her findings, average transactional prices were generally lower than asking prices, and average prices in the secondary market were lower than in the primary market. However, there were cities where these relationships were reversed.

[9] Detailed Explanatory Memorandum of the proposed solutions – Draft Act on amending the Act on the protection of the rights of the purchaser of a dwelling or a detached house and the Developer Guarantee Fund and certain other acts, Ministry of Development and Technology, Draft of 9 September 2024, p. 12.

Assessment of Opportunities, Threats, and Risks Associated with the Functioning of the Proposed Instrument

The proposal to establish the DOM Portal constitutes a significant innovation in the national housing real estate market. On one hand, it will expand the negotiation opportunities for homebuyers, contributing to broader financial consumer protection. On the other hand, it will enable public authorities to conduct ongoing analyses of the housing market, including evaluating the impact of housing support instruments on this market. The portal is intended to provide essential information for state housing policy and the parameterization of housing support measures.

Attention must be drawn to the increasing requirements of supervisory authorities in Poland regarding data collection, particularly the necessity for banks to supply real estate data. The growing importance of mortgage loans and the increasing share of these products in banks' portfolios highlight the clear need for reliable information to conduct analyses, ensure high-quality collateral, and address other critical credit parameters. Over the years, successive versions of Recommendation J have emphasized the importance of banks contributing to high-quality interbank databases alongside their internal systems. The DOM database is expected to meet the banking sector's needs in this regard.

A significant conceptual flaw of the DOM Portal, however, is its omission of data on the technical condition of properties, including key details such as:

– the date the building was commissioned for use. Data in the Developer Guarantee Fund Registry predominantly relates to newly built investments. As data is sourced more broadly from other professional entities and the Head of the National Tax Administration (NTA), the properties in question will become increasingly diverse. This will complicate the distinction between primary and secondary markets, which in CSO statistics currently relies on whether the seller is a private individual (secondary market) or another entity (primary market). A more effective solution would be to record the building's commissioning date, linked to applicable technical standards, as this significantly impacts property prices, especially for homes requiring substantial renovation. This information is particularly critical for real estate insurers;

– another key omission is the lack of integration with energy performance certificates. These documents are mandatory for real estate transactions, and since April 28, 2023, digital versions are stored in a dedicated registry, which also includes the building's commissioning date. Linking this registry to the DOM database could fill gaps regarding the age and technical condition of buildings. This is especially relevant for properties subject to heritage protection. The connection between building standards and price often hinges on energy efficiency, with the need for improvements translating into measurable costs.

From a housing policy perspective, the IGF, as the administrator of the DOM database, generates or processes information and makes it available to specific entities for the execution of statutory tasks aimed at meeting citizens' housing needs. These entities include the Prime Minister, the minister responsible for construction, planning, spatial development, and housing; the minister responsible for internal affairs; the minister responsible for public finances; the Head of the National Tax Administration; heads of regional tax chambers; tax and customs office directors; the President of the Office of Competition and Consumer Protection (OCCP); the President of the National Bank of Poland (NBP); and the President of the Central Statistical Office (CSO) (art. 56d(1) Projektu ustawy o zmianie ustawy o ochronie praw…, 2024). Importantly, the legislature has stipulated that the information (referred to in Article 56a(2)(2) Projektu ustawy o zmianie ustawy o ochronie praw…, 2024) is generated or processed and shared in a format that prevents the identification of individuals or specific properties.

Regarding the security of individual data collected in the portal, the legislative proponent assures that such data will be protected under personal data and tax confidentiality regulations. The IGF and its employees may use this data exclusively for tasks defined by the law[10]. The categories of information and data collected for the DOM Portal include: the date of the developer agreement and identifiers for ownership transfer agreements, the real estate land and mortgage register number, property address, type of property (apartment/single-family home), price, usable area, number of rooms, floor, in some cases, the total number of floors in the building, and basic buyer identification data (e.g., PESEL). The inclusion of PESEL numbers for residential property owners has raised the most significant controversy. Despite assurances that access to sensitive data will be limited to a strictly defined group of government institutions, concerns persist regarding personal data protection.

The legislative proponent has noted that during extensive consultations, the most frequently raised concerns included personal data protection, particularly regarding the collection of PESEL numbers and land and mortgage register numbers, additional administrative requirements imposed on developers and notaries, the scope of data collected for the DOM Portal (e.g., energy performance characteristics, transactions between legal entities), the scope of data presented within the portal (e.g., minimum transaction volume thresholds), and the financing of the DOM Portal's operations from the Developer Guarantee Fund (DGF). These issues were highlighted during a presentation by A. Polak of the Housing Department, Ministry of Development and Technology, at the Real Estate Financing Congress, October 24-25, 2024.

[10] Detailed justification of the proposed solutions – Projekt ustawy o zmianie ustawy o ochronie praw… (2024, p. 18).

Assessment of the Justification for the Preparation and Implementation of the Nationwide DOM Portal

In the context of Poland's still underdeveloped real estate market, the institutional factor represented by the idea of the DOM database can significantly contribute to the development and increased transparency of the housing market in Poland.

The operation of such a database, on a broader scale, will help align residential property prices with their actual market value by presenting data on transactional prices rather than asking prices. This will improve the quality of scientific research in this area and enhance the international comparability of housing price indices.

It is essential to emphasize the critical aspect of protecting residential property buyers in Poland. Currently, individuals face challenges in accessing reliable information about housing prices and often rely primarily on data provided by market entities, especially classified ad portals and other specialized platforms (Milewska-Wilk & Nowak, 2022).

High demand for housing in Poland places developers in a stronger position compared to buyers. In situations of information asymmetry and local monopolies held by developers, homebuyers are often unaware whether the price proposed to them (individually negotiated) is an asking price or a transactional price. Similarly, potential homebuyers lack sufficient information, which limits their decision-making capabilities and may lead to a waiting stance, delaying the decision to purchase property. As J. Łaszek and K. Olszewski (2016, p. 71-91) highlight, housing is sold through individual contact with the developer, which creates conditions typical of a monopoly, allowing developers to differentiate prices based on buyer characteristics.

Another important argument for implementing the DOM Portal is its potential as a tool for shaping appropriate housing policy. Until now, government is lacking an effective instrument to verify the impact of implemented housing programs. As a result, public assistance has often been directed toward social groups with sufficient creditworthiness to purchase property at market prices. For example, the recent government housing program (named Bezpieczny Kredyt 2%) benefited young, educated individuals living in large cities who held high-ranking positions and had not previously owned a home.

In summary, the wide range of information collected by the DOM Portal is intended to enable analysis and use across various dimensions and levels. Given the above analysis of the legal situation, the academic discussion on data accessibility, and the presented justification for developing the portal, it is strongly recommended to proceed with the implementation of this concept while addressing the noted observations.

Conclusion

The study analyzed the issue at hand by utilizing selected legislation and subject literature, which allowed for the formulation of research objectives. Subsequently, the synthesis of knowledge on the examined topic, based on these sources, enabled the development and fulfillment of the stated goals. As a result of this research, final conclusions were presented.

The most important conclusion from the research is that the new legislative initiative in the form of the Housing Transactions Data Portal (DOM), which will provide Polish residential property buyers with universal and free access to transaction price statistics in the housing market, has the potential to become a highly valuable tool for real estate market participants.

While the DOM Portal, as a tool for providing information about the real estate market to individuals and other market participants, offers advantages in its current proposed form, it is selective and incomplete. By leveraging administrative and existing data sources, processing them as early as possible, enabling digital transmission, and adhering to interoperability principles, it can deliver reliable data quickly. However, it will not cover parts of the market where buyers are legal entities.

For monitoring the effectiveness of housing policy tools, the portal will not be a comprehensive instrument, as it is primarily designed to monitor prices in the developer market, supplemented by data on other transactions but lacking necessary details about older apartments and buildings. It cannot be used to monitor improvements in energy efficiency, the introduction of renewable energy sources in housing stock, or the trading of residential properties by professional entities.

The project overlooks the existing Real Estate Price Register and its functions, the role of local governments in implementing housing policy, and possible areas of collaboration with the academic sector. The rental market is still neglected, with no proposed solutions for monitoring its size, prices, or the effectiveness of implemented policies.

In conclusion, the draft amendment to the Act on the Protection of Homebuyers of Residential Units or Single-Family Homes and the Developer Guarantee Fund, as well as certain other acts, requires further consultations and the enhancement of the DOM Portal's functionalities.

Translated by the Author

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ORIGINAL PAPER

POLAND'S TOURIST ACTIVITY AND ACCOMMODATION BASE BY VOIVODESHIP

Małgorzata Kobylińska
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
ORCID: https://orcid.org/0000-0001-9674-5418
e-mail: gosiak@uwm.edu.pl

JEL Classification: Z30, Z32.

K e y w o r d s: tourism, accommodation, spatial differentiation.

A b s t r a c t

The purpose of the article was to find out the changes in the size of the accommodation base and the number of tourists in Poland regionally in 2018, 2020 and 2022, and to determine the changes that took place in tourism as a result of the SARS-CoV-2 coronavirus pandemic. Based on the analysis, it was found that the number of accommodations and the number of tourists in Poland in the years under study varied greatly among the provinces. The highest level of the analyzed values was in the provinces of Lesser Poland, Pomerania and West Pomerania. The lowest values were recorded in the Opole province. Due to the limitations of the pandemic, a significant decrease in the number of tourists visiting Poland in 2020 by 50%, including foreign tourists by about 70%, compared to 2018, can be noted.

RUCH TURYSTYCZNY I BAZA NOCLEGOWA POLSKI WEDŁUG WOJEWÓDZTW

Małgorzata Kobylińska
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

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S ł o w a k l u c z o w e: turystyka, baza noclegowa, zróżnicowanie przestrzenne.

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Abstrakt

Celem artykułu było poznanie zmian wielkości bazy noclegowej i liczby turystów w Polsce w ujęciu regionalnym w latach 2018, 2020 i 2022 oraz określenie zmian, które miały miejsce w ruchu turystycznym w wyniku pandemii COVID-19. Na podstawie przeprowadzonej analizy stwierdzono, że liczba miejsc noclegowych oraz liczba turystów w Polsce w badanych latach była bardzo zróżnicowana w poszczególnych województwach. Najwyższym poziomem analizowanych wartości charakteryzowały się województwa małopolskie, pomorskie i zachodniopomorskie. Najniższe wartości zanotowano w województwie opolskim. Ze względu na ograniczenia wynikające z pandemii można zauważyć znaczny spadek liczby turystów odwiedzających Polskę w 2020 roku o 50%, w tym turystów zagranicznych o ok. 70%, w porównaniu z rokiem 2018.

Introduction

According to classical definitions, tourism is primarily associated with travel for the purposes of sightseeing, healthcare or leisure. In modern definitions of tourism, however, there are also additional economic and social dimensions, where it is referred to as an opportunity to earn money spent by tourists who are currently enjoying a temporary stay. While travelling, tourists visit new places and make new acquaintances. Tourist traffic is driven by the demand for tourism services, i.e. the services and consumer goods that tourists are willing to purchase while visiting. Tourism enterprises handle tourism traffic, including the provision of increasingly high-quality hotel, catering and entertainment services (Płocka, 2009, p. 6).

Improving the standard of living of local residents is an important factor in the development of tourism. An increase in the real average salary in the economy, disposable income and a decreasing rate of unemployment significantly contribute to satisfying the citizens' needs regarding tourism (Majchrzak-Jaszczak *et al.*, 2019, p. 64).

Non-economic factors also affect decisions on tourism demand. Increasingly often, tourists have high expectations regarding the emotional perception of the places they visit, the sites and the people they meet during their stay. It should be noted that tourist trips tend to be driven by different motivations. For some people, tourist trips provide a source of leisure and relaxation, while for others, they may serve an exploratory and social purpose (Niezgoda, 2012, p. 21).

Poland is found highly attractive by tourists. The country's area features a variety of natural values. The fundamental elements of a region's attractiveness include touristic development and access to transportation (Ozimek *et al.*, 2019, p. 7).

Territories located by the Baltic Sea are among the most attractive regions in Poland. The seaside towns and cities are constantly being transformed, becoming increasingly appealing to tourists, and are becoming one of the main tourist destinations. Visitors can enjoy their stay in well-known seaside

resorts or book accommodation in smaller picturesque spots. In the summer season of 2022, six seaside towns and cities in Poland (Kołobrzeg, Ustronie Morskie, Ustka, Władysławowo, Hel, Puck) were reviewed in terms of their tourist attractiveness. Data taken from the Central Statistical Office (GUS) and information on the localities concerned published on relevant websites were used for this purpose. In addition, spatial development in the studied localities was monitored during the summer season. The highest number of tourists throughout the year was recorded in the commune of Kołobrzeg, while the lowest was in the commune of Hel. Selected elements of tourism development were also evaluated, with a value of 1 assigned to the destination characterised by a very poor state of tourism development. Ustka was considered to be a model tourist destination in the opinion of tourists (Nędza & Matlingiewicz, 2022).

The area of Małopolskie voivodeship offers excellent conditions for tourism and recreation. It is one of the most developed tourist regions in Poland due to its large number of accommodation facilities. Małopolskie voivodeship features a significant number of tourist routes and museums. More than 90% of communes carry out activities related to tourism, taking into account the principles of sustainable development and the opinions of local residents (Bajgier-Kowalska & Kapera, 2019, p. 93).

The city of Cracow is visited by millions of tourists every year. Tourists can choose from a wide range of accommodation and restaurant facilities to suit their requirements. The main intention of people visiting Cracow is tourism because of the numerous historical sights of the city (Tracz *et al.*, 2019, p. 171).

In Poland, agrotourism activities are extensively developed. This is attributable to the richness of the natural environment in many regions of the country. The need to be close to nature has a significant impact on the development of this activity. Tourists increasingly seek scenic beauty, peace, and quiet, and they wish to spend time away from large urban agglomerations. One aspect of great importance to owners of agrotourism farms is gaining additional income from, among other things, the rental of accommodation and the sale of agricultural products (Ciepiela, 2016).

According to the report of the Ministry of Agriculture and Rural Development, in 2018, there were 3.5 tourist accommodation facilities with ten or more beds available per 100 km^2 in Poland. Hotel facilities ranked first (37.7% of the total number of facilities), followed by guest rooms and agrotourism quarters, accounting for 27.5% of all accommodation facilities in Poland. The largest share of these (almost 40% of all active agrotourism farms in Poland) were located in Małopolskie, Podkarpackie and Warmińsko-Mazurskie voivodeships (*Rolnictwo i gospodarka żywnościowa w Polsce*, 2019, p. 57).

The tourism industry was severely affected by the crisis resulting from the SARS-CoV-2 pandemic. This is particularly true for accommodation, food and beverage and leisure services. Based on a study conducted in 2020, almost

50 percent of people expressed a preference to spend their holidays domestically (Widomski, 2020, p. 775).

Information obtained from the Central Statistical Office indicates that 36.5 million tourists stayed in tourist accommodation facilities in Poland in 2019.

Compared to the previous year, this was an increase of 5.6%. In 2019, foreign tourists used 18.7 million overnight stays. Almost all foreign tourists stayed overnight in facilities with ten or more beds. By type of accommodation facilities, guest rooms and agrotourism accommodation dominated in Poland in 2019, accounting for 21.4% of all accommodation facilities.

The number of facilities with up to ten beds increased in comparison with previous years. In 2019, 88.5 million foreigners visited Poland.

Foreign tourists spent 4.5% more than in the previous year. The visitors were predominantly foreigners, who collectively accounted for 82.6% of tourists visiting Poland. Zachodniopomorskie, Pomorskie and Małopolskie voivodeships had the highest number of tourist accommodation facilities (per 100 km^2). In these voivodeships, there were between 7.0 and 10.2 facilities per 100 km^2, respectively. The tourism density rate was highest in the Małopolskie and Śląskie voivodeships, where it exceeded 230 tourists per km^2. The Mazowieckie voivodeship ranked first in 2019 owing to its accommodation development indicator. The reason for this was the fact that tourism in this province operates all year round. Małopolskie and Pomorskie voivodeships were ranked first due to the highest volume of domestic tourist traffic in 2019, with each of them visited by almost 7 million tourists in 2019 (GUS, 2020).

The events surrounding the spread of the SARS-CoV-2 coronavirus in 2020 had a profound impact on tourist traffic at a global level. Closing hotels and other nightlife, sports and cultural venues, limiting the operation of shopping malls, and restricting movement within the country for work or tourism purposes all contributed to the crisis in the tourism industry (Gabryjończyk & Gabryjończyk, 2021).

A survey concerning holiday trips of the residents of the Podkarpackie voivodeship indicated that in 2020 there was a noticeable increase in the number of people spending their holidays in Poland and holidaying with their families. The outbreak of the coronavirus had a considerable impact on people's decisions regarding holiday plans in Poland (Nizioł & Półchłopek, 2023).

Research Methodology

The analysis of the tourism industry was conducted using data on selected issues relating to tourism for the years 2018, 2020 and 2022. The paper uses secondary data taken from the Local Data Bank of the Central Statistical Office regarding:

– the number of accommodation establishments by selected types (number of establishments);
– the number of tourists staying at accommodation establishments (persons);
– the occupancy rate for accommodation establishments (in %).

According to the classification used by the Central Statistical Office, hotel facilities include hotels (usually located in urban areas and having at least ten rooms), motels (located along transport routes and, in addition to hotel services, also providing car services, including parking), boarding houses (having at least seven rooms and, in addition to hotel services, providing full board) or other accommodation establishments. Agrotourism quarters are defined as tourist accommodation facilities that have rooms or dwelling houses and other buildings belonging to the respective rural property. These establishments are owned by farmers who rent them out to tourists for an appropriate fee. The number of accommodation establishments was calculated for the type of facilities that were in operation on 31 July of the year in question. Their use applies to the entire reporting year, i.e., the number of tourists staying overnight was determined for the entire calendar year. The analysis relied on data on the number of hotel facilities and agrotourism accommodations, given the largest number of these types of facilities. Detailed information on the research methodology concerning tourism in Poland can be found on the Central Statistical Office website (GUS, 2019, 2021, 2023).

The purpose of this paper was to explore changes in the size of the accommodation base and the number of tourists in Poland at the regional level in 2018, 2020 and 2022, as well as to determine the changes that have taken place in tourism following the SARS-CoV-2 coronavirus pandemic.

Analysis of the Findings

Table 1 presents information on the number of tourist accommodation establishments, including hotel facilities and agrotourism accommodation.

During the years under study, Małopolskie, Pomorskie and Zachodniopomorskie voivodeships recorded the highest number of total accommodation facilities. In 2018, this number exceeded 1,500 facilities each time, while in 2022 it was lower by 13.05%, 14.78% and 10.05%, respectively. In 2020, the number of accommodation facilities in Małopolskie voivodeship decreased by less than 10% and in the remaining of the above-mentioned voivodeships by approximately 5% compared to 2018. Małopolskie and Dolnośląskie voivodeships were ranked first due to the highest number of hotel facilities in all the studied years. An increase in the number of hotel facilities (by approximately 3.13%) was recorded only in Dolnośląskie voivodeship in 2020. The smallest number of total hotel facilities was noted in Opolskie voivodeship, and compared to Pomorskie voivodship, they accounted for approximately 10% of the surveyed years. In Poland, the number

of hotel facilities in 2022 fell by 4.91%, while the number of agrotourism accommodation units decreased by 23.19% compared to 2018. The number of agrotourism accommodation units in Poland in 2020 decreased by 15.02%, and the number of hotel facilities decreased by less than 5% compared to two years earlier. A drop in the number of total accommodation facilities and agrotourism accommodation units can be observed in all voivodeships in 2020, with the largest decrease in Małopolskie voivodeship by 33.33% compared to 2018.

Table 1

The number of tourist accommodation establishments by selected types

Specification	Total accommodation facilities (as of July)			Total hotel facilities (as of July)			Agritourist quarters total (as of July)		
	2018	2020	2022	2018	2020	2022	2018	2020	2022
Polska	11,076	10,291	9,766	4,179	3,990	3,974	759	645	583
Dolnośląskie	1,046	1,012	914	447	461	442	75	69	57
Kujawsko-Pomorskie	414	374	372	204	190	193	26	20	18
Lubelskie	472	429	442	191	189	196	35	24	25
Lubuskie	300	281	257	136	128	118	26	22	20
Łódzkie	340	277	273	198	169	174	21	14	17
Małopolskie	1,510	1,362	1,313	552	526	547	83	60	54
Mazowieckie	614	561	548	360	340	345	42	37	38
Opolskie	173	138	120	86	73	69	13	10	7
Podkarpackie	642	609	605	232	222	219	63	60	56
Podlaskie	281	270	250	97	97	92	48	48	45
Pomorskie	1,637	1,555	1,395	350	361	358	74	65	60
Śląskie	671	620	603	342	310	314	44	35	24
Świętokrzyskie	251	235	227	137	129	127	29	24	23
Warmińsko-Mazurskie	507	490	469	211	206	196	75	60	51
Wielkopolskie	665	594	581	337	294	299	66	64	56
Zachodniopomorskie	1,553	1,484	1,397	299	295	285	39	33	32

Source: BDL GUS.

The largest share in the total number of accommodation establishments in Poland in 2022 belonged to Pomorskie and Zachodniopomorskie voivodeships, where it exceeded 14% (Fig. 1), while in Opolskie voivodeship it did not exceed 2%.

In 2022, Podlaskie voivodeship saw 5.4 p.p. more agrotourism accommodation establishments than hotel facilities.

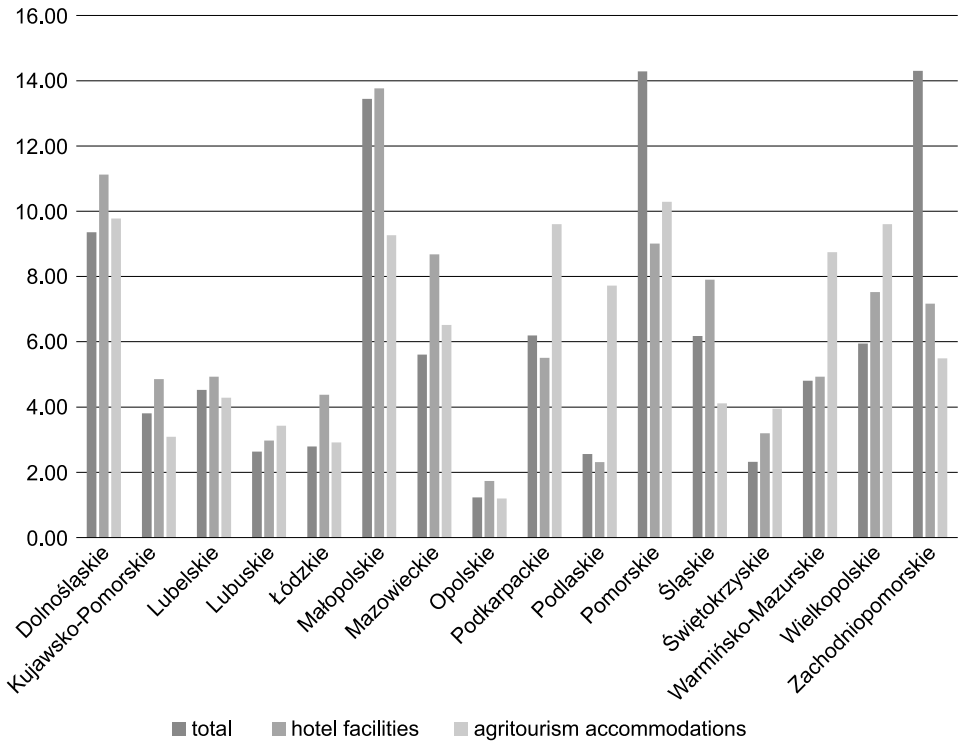

Fig. 1. Share of accommodation establishments of a given type in the total number of accommodation establishments in Poland in 2022 (in %)
Source: compiled on the basis of BDL GUS data.

Based on the data presented in Table 2, it can be observed that the highest number of tourists used accommodation in Małopolskie and Mazowieckie voivodeships, where more than 5 million tourists were reported in 2018 and 2022. This constituted approximately 15% of all tourists using overnight stays. In 2020, the share of all tourists using accommodation in Mazowieckie voivodeship decreased by 60.34%, while two years later, an increase of 178.47% was observed. In each of the analysed years, about 60% of tourists using accommodation visited five voivodeships (Dolnośląskie, Małopolskie, Mazowieckie, Pomorskie and Zachodniopomorskie). In the years under consideration, the fewest tourists used accommodation in Opolskie and Świętokrzyskie voivodeships, where their share never exceeded 2%.

Foreign tourists accounted for 20.89% of tourists using overnight accommodation in Poland in 2018, where a decrease of 8.23 p.p. in this value was recorded in the next analysed year. Foreign tourists using accommodation in 2018 and 2022 in the Małopolskie and Mazowieckie voivodeships accounted for between 20% and 25% of all foreign tourists. Given the COVID-19 pandemic,

Table 2

Total number of tourists using accommodation facilities (in persons)

Specification	Total					
	Tourists-total January-December			Foreign tourists January-December – non-residents		
	2018	2020	2022	2018	2020	2022
Polska	33,895,930	17,878,969	34,249,004	7,082,231	2,263,761	5,846,611
Dolnośląskie	3,654,787	2,067,828	3,732,773	696,726	278,009	534,049
Kujawsko-Pomorskie	1,326,633	716,234	1,370,209	116,637	37,860	76,288
Lubelskie	1,079,253	628,256	1 158,669	126,390	33,364	160,785
Lubuskie	687,751	399,845	635,432	177,639	73,169	124,797
Łódzkie	1,351,302	610,328	1,212,965	194,876	64,235	125,426
Małopolskie	5,207,352	2,389,128	5,196,105	1,504,318	367,052	1,178,390
Mazowieckie	5,336,963	2,116,493	5,893,738	1,588,719	390,626	1,461,969
Opolskie	419,238	213,303	336,781	54,454	22,632	32,169
Podkarpackie	1,263,445	710,332	1,209,430	151,037	44,754	208,509
Podlaskie	638,801	377,445	568,939	145,137	42,843	111,609
Pomorskie	3,047,790	1,972,559	3,289,820	572,393	176,690	424,329
Śląskie	2,809,293	1,350,043	2,665,400	422,025	130,420	364,825
Świętokrzyskie	624,099	335,217	617,200	36,984	14,252	25,102
Warmińsko-Mazurskie	1,308,573	872,936	1,204,600	162,345	45,487	60,688
Wielkopolskie	2,099,501	1,012,093	1,898,586	310,980	106,428	229,574
Zachodniopomorskie	3,041,149	2,106,929	3,258,357	821,571	435,940	728,102

Source: compiled on the basis of BDL GUS data.

these provinces saw a decrease in the share of foreign tourists in 2020 by around 75 p.p. compared to 2018 and witnessed the largest decrease in the number of foreign tourists. It can be noted that the largest number of foreign tourists in 2020 used accommodation in Zachodniopomorskie voivodeship (19.26%), while in Świętokrzyskie voivodeship the share was less than 1% in each of the surveyed years. Opolskie and Świętokrzyskie voivodeships were ranked last in terms of the share of foreign tourists using overnight accommodation.

Table 3 shows that the number of tourists using overnight accommodation in Poland in 2020 decreased by 47.25%, with the number of foreign tourists down by 68.04%. Two years after the announcement of the pandemic, there were 158.27% more foreign tourists staying overnight. The smallest decrease in the number of tourists who used accommodation in Poland in 2020 was observed in Zachodniopomorskie voivodeship (by 30.72%), while the largest decrease was

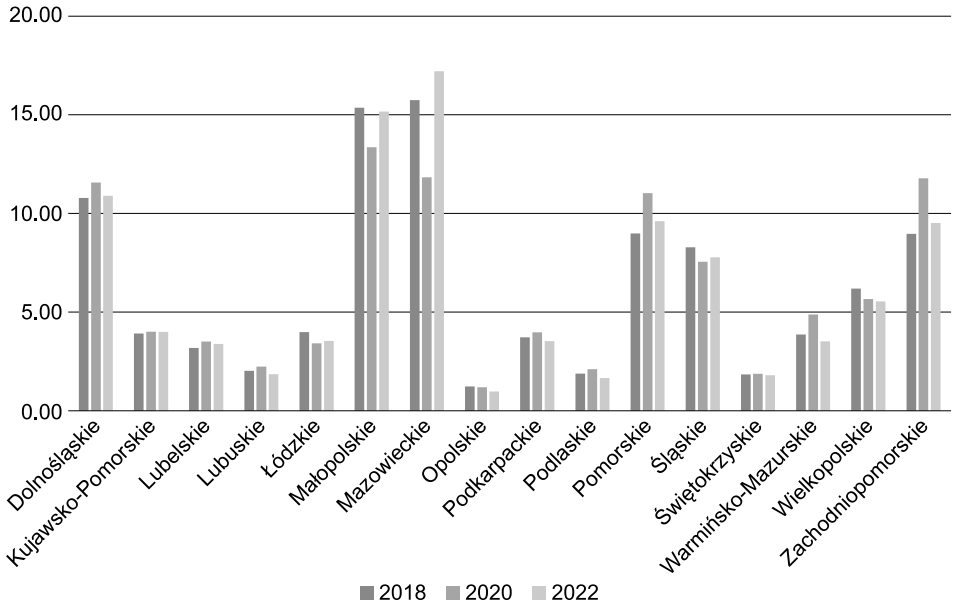

Fig. 2. Share of tourists in individual voivodeships in the total number of tourists using accommodation (in %)

Source: compiled on the basis of BDL GUS data.

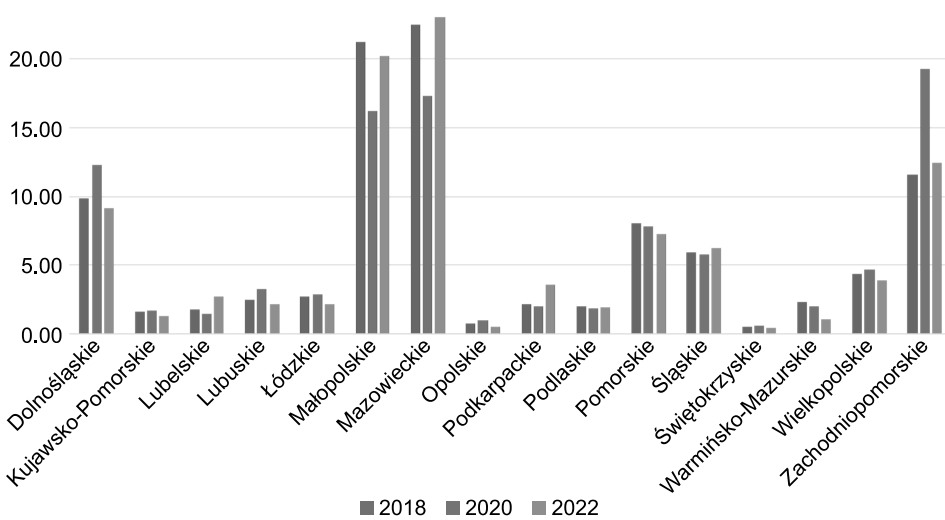

Fig. 3. Share of foreign tourists in the total number of tourists using accommodation in the voivodeships (in %)

Source: compiled on the basis of BDL GUS data.

Table 3

Dynamics of the overall number of tourists using accommodation facilities

Specification	Total tourists			Foreign tourists		
	2020/2018	2022/2018	2022/2020	2020/2018	2022/2018	2022/2020
Polska	0.53	1.01	1.92	0.32	0.83	2.58
Dolnośląskie	0.57	1.02	1.81	0.40	0.77	1.92
Kujawsko-Pomorskie	0.54	1.03	1.91	0.32	0.65	2.02
Lubelskie	0.58	1.07	1.84	0.26	1.27	4.82
Lubuskie	0.58	0.92	1.59	0.41	0.70	1.71
Łódzkie	0.45	0.90	1.99	0.33	0.64	1.95
Małopolskie	0.46	1.00	2.17	0.24	0.78	3.21
Mazowieckie	0.40	1.10	2.78	0.25	0.92	3.74
Opolskie	0.51	0.80	1.58	0.42	0.59	1.42
Podkarpackie	0.56	0.96	1.70	0.30	1.38	4.66
Podlaskie	0.59	0.89	1.51	0.30	0.77	2.61
Pomorskie	0.65	1.08	1.67	0.31	0.74	2.40
Śląskie	0.48	0.95	1.97	0.31	0.86	2.80
Świętokrzyskie	0.54	0.99	1.84	0.39	0.68	1.76
Warmińsko-Mazurskie	0.67	0.92	1.38	0.28	0.37	1.33
Wielkopolskie	0.48	0.90	1.88	0.34	0.74	2.16
Zachodniopomorskie	0.69	1.07	1.55	0.53	0.89	1.67

Source: compiled on the basis of BDL GUS data.

observed in Łódzkie (by 54.83%) and Mazowieckie (by 60.34%). Two years after the announcement of the pandemic, the number of tourists using overnight accommodation increased by 178.47% in Mazowieckie voivodeship, and this was the largest increase in this category. The largest decrease among foreign tourists using overnight accommodation was observed in 2020 in Małopolskie and Mazowieckie voivodeships (by 75.60% and 75.41%), while the smallest decrease (less than 50%) was reported in Zachodniopomorskie. In 2022, the number of foreign tourists in Podkarpackie voivodeship increased by 365.90% when compared to two years prior, followed by Małopolskie and Mazowieckie voivodeships with more than double the number of foreign tourists.

In 2020, significantly fewer tourists used accommodation in each voivodeship than in 2018 (Tab. 4). This was a consequence of the introduction of restrictions on travelling for tourism purposes. Regarding the rate of occupancy of accommodation in all tourist establishments, the largest decrease in 2020 was recorded in the Mazowieckie voivodeship – by 23.30 p.p. Agrotourism quarters in this

voivodeship were used by fewer tourists in 2020, a decrease of 3.3 p.p. compared to 2018. In 2020, the rate of occupancy of accommodation in all accommodation establishments decreased by 4 p.p. in the Warmińsko-Mazurskie voivodeship, while agrotourism establishments reported an increase of 5.7 p.p. compared to 2018. Pomorskie voivodeship was characterised by the highest occupancy rate in agrotourism establishments in 2022, while in Lubelskie, Podkarpackie, Podlaskie and Warmińsko-Mazurskie voivodeships, the occupancy rate of agrotourism establishments in 2022 was lower compared to 2020. There was a decrease in the hotel accommodation occupancy rate in every voivodeship in 2020. As for agrotourism accommodation, four voivodeships saw more overnight stays in 2020 compared to two years earlier.

Table 4

Occupancy of beds in selected types of facilities [%]

Specification	Total accommodations			Hotel facilities			Agritourism quarters		
	2018	2020	2022	2018	2020	2022	2018	2020	2022
Polska	40.1	26.8	40.4	40.8	25.5	41.3	15.3	14.2	16.7
Dolnośląskie	38.4	26.3	38.8	39.9	27.6	40.0	13.2	8.9	15.0
Kujawsko-Pomorskie	44.6	29.9	45.3	32.5	22.5	36.0	18.9	14.4	19.6
Lubelskie	31.8	21.1	33.8	30.4	20.8	35.1	18.1	17.8	15.4
Lubuskie	29.8	21.1	31.2	31.2	21.0	34.4	16.5	14.9	17.9
Łódzkie	34.0	21.9	38.2	35.0	21.9	38.4	12.4	11.4	15.5
Małopolskie	41.7	25.7	41.8	47.9	26.3	45.3	12.3	12.3	14.4
Mazowieckie	44.6	21.3	45.7	47.8	21.2	47.7	15.4	12.2	13.8
Opolskie	31.9	22.2	31.5	32.9	23.2	32.7	9.7	9.4	11.6
Podkarpackie	34.8	25.4	35.2	31.6	22.2	35.7	17.8	22.0	15.3
Podlaskie	29.2	22.1	32.8	31.8	22.3	36.0	12.1	13.9	10.7
Pomorskie	42.5	31.7	42.7	44.7	30.6	45.0	19.8	16.3	18.1
Śląskie	38.2	23.3	38.1	39.2	22.8	40.0	15.2	10.4	16.3
Świętokrzyskie	33.7	21.9	33.2	31.7	21.9	33.9	12.8	10.9	18.2
Warmińsko-Mazurskie	31.5	27.5	31.8	34.4	28.3	33.2	10.4	16.1	15.9
Wielkopolskie	30.7	20.4	31.7	32.7	20.6	34.1	19.4	17.4	23.6
Zachodniopomorskie	51.6	37.8	47.8	51.6	38.4	46.7	18.1	18.3	20.7

Source: compiled on the basis of BDL GUS data.

Summary and Conclusions

Poland is a highly attractive tourist destination. It is noticeable that the number of tourists and their use of accommodation vary greatly between the voivodeships. It is primarily related to the presence of natural values in a given area. The outbreak of the SARS-CoV-2 coronavirus pandemic in 2020 had a significant impact on the operation of the tourism industry both in Poland and worldwide. Increased tourist traffic contributes to the spread of the coronavirus and poses a threat to health and life.

The analysis carried out allows the following conclusions to be drawn:

1. There is a noticeable. significant variation in the number of accommodation facilities and their occupancy by voivodship.
2. Nearly half of the accommodation facilities were located in three voivodeships (Małopolskie. Pomorskie and Zachodniopomorskie).
3. The lowest number of accommodation facilities was in the Opolskie voivodeship.
4. Most tourists used accommodation in Małopolskie and Mazowieckie voivodeships. while the least number of tourists stayed in Świętokrzyskie voivodeship.
5. Due to the COVID-19 pandemic in Poland. the number of tourists using overnight stays in 2020 was nearly halved. while the number of foreign tourists decreased by two-thirds compared to 2018.
6. In 2022. the number of tourists using overnight accommodation in Poland almost doubled. while the number of foreign tourists increased by 168% when compared to 2020.
7. The largest increase in the number of tourists using accommodation in 2022 was recorded in the Mazowieckie voivodeship and. for foreign tourists. in the Podkarpackie voivodeship (compared to 2020).

The current study found that coastal and mountainous areas were the most popular with tourists. The tourism industry has suffered numerous setbacks as a result of the COVID-19 pandemic and the associated restrictions on social contact and travel. It will take time and significant financial resources to recover.

Translated by Joanna Jensen

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ORIGINAL PAPER

IMPACT OF GDP AND RES SHARE ON CO_2 EMISSIONS, ENERGY EFFICIENCY AND ECONOMIC GROWTH IN EUROPEAN UNION MEMBER STATES

Grzegorz Szczubełek
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
ORCID: https://orcid.org/0000-0002-2511-7278
e-mail: grzegorz.szczubelek@uwm.edu.pl

Daniel Rzeczkowski
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
ORCID: https://orcid.org/0000-0002-8458-5987
e-mail: daniel.rzeczkowski@uwm.edu.pl

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Key words: CO_2 emissions, renewable energy sources (RES), structural equation modelling (SEM).

Abstract

Economic growth and CO_2 emissions are closely linked to energy consumption. Energy transition towards renewable energy sources (RES) and improving energy efficiency are crucial to combating global warming. EU member states are striving to reduce CO_2 emissions while supporting economic growth. However, it is necessary to develop an understanding of how both gross domestic product (GDP) level and RES share affect energy efficiency and CO_2 emissions. The purpose of this paper is to analyse the impact of the GDP level and the renewable energy sources (RES) share on CO_2 emissions, energy efficiency, and economic growth in European Union states. The study employs structural equation modelling (SEM) using the partial least squares (PLS) method. The analysis is based on data collected from Eurostat, the OECD and other sources covering the period 2004-2023.

The paper constitutes a substantial contribution to the body of literature by providing a comprehensive analysis of the impact of GDP level and the share of renewable energy sources (RES) on CO_2 emissions, taking into account energy efficiency and urbanisation as key factors. The study revealed that a high level of GDP combined with a high share of RES in the energy mix is conducive to a more effective reduction of CO_2 emissions. Furthermore, urbanisation has a varying impact on economic growth depending on the level of GDP and the share of RES. This points to the

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need to take the state's specifics into account when developing energy policies. The findings may provide policymakers with some guidelines when shaping energy and environmental strategies in EU states.

WPŁYW PKB I UDZIAŁU OZE NA EMISJĘ CO_2, EFEKTYWNOŚĆ ENERGETYCZNĄ ORAZ WZROST GOSPODARCZY W PAŃSTWACH UNII EUROPEJSKIEJ

Grzegorz Szczubełek
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn

Daniel Rzeczkowski
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn

Kody JEL: Q43, Q56, O13, C39, R11, O44.

S ł o w a k l u c z o w e: emisje CO_2, odnawialne źródła energii (OZE), modelowanie równań strukturalnych (SEM).

A b s t r a k t

Wzrost gospodarczy i emisja CO_2 są silnie powiązane z zużyciem energii. Transformacja energetyczna w kierunku odnawialnych źródeł energii (OZE) oraz poprawa efektywności energetycznej są najważniejszymi elementami w walce z globalnym ociepleniem. Kraje UE dążą do redukcji emisji CO_2 z jednoczesnym wsparciem wzrostu gospodarczego. Konieczne jest jednak zrozumienie, jak poziom PKB i udział OZE wpływają na efektywność energetyczną oraz emisję CO_2. Celem artykułu jest analiza wpływu poziomu PKB oraz udziału odnawialnych źródeł energii (OZE) na emisję CO_2, efektywność energetyczną i wzrost gospodarczy w krajach Unii Europejskiej. W badaniu zastosowano modelowanie równań strukturalnych (SEM) z wykorzystaniem metody najmniejszych kwadratów cząstkowych (PLS). Analiza oparta jest na danych pochodzących z Eurostatu, OECD oraz innych źródeł obejmujących lata 2004-2023.

Artykuł stanowi istotny wkład w literaturę ze względu na kompleksową analizę wpływu poziomu PKB i udziału odnawialnych źródeł energii (OZE) na emisję CO_2, z uwzględnieniem efektywności energetycznej i urbanizacji jako głównych czynników. Przeprowadzone badanie wykazało, że wysoki poziom PKB w połączeniu z dużym udziałem OZE w miksie energetycznym sprzyja skuteczniejszej redukcji emisji CO_2. Ponadto urbanizacja ma zróżnicowany wpływ na wzrost gospodarczy, w zależności od poziomu PKB i udziału OZE. Wskazuje to na potrzebę uwzględnienia specyfiki kraju podczas formułowania polityki energetycznej. Wyniki dostarczają decydentom politycznym wskazówek do kształtowania strategii energetycznych i środowiskowych w państwach Unii Europejskiej.

Introduction

Climate change is one of the greatest challenges the world faces today. CO_2 emissions are a major factor contributing to global warming and are closely linked to economic development and energy consumption. It is vital to understand how to continue economic growth without increasing the negative impact on the environment.

Studies by Liddle and Parker (2024) indicated that by reducing energy consumption and increasing the share of renewable energy sources (RES) it is possible to decouple economic growth from CO_2 emissions. Wang *et al.* (2024) confirmed the importance of RES, highlighting the efficiency of wind energy in reducing emissions and the role of hydropower in supporting economic growth.

Energy efficiency is of key importance. However, the rebound effect – an increase in energy consumption following the introduction of efficient technologies – may outweigh the benefits (Sorrell *et al.*, 2009; Karakaya *et al.*, 2024). This indicates the need for strategies that combine technology and behavioural change.

Urbanisation is affecting CO_2 emissions and economic growth. In rapidly developing countries, it leads to increased emissions due to industrialisation and the need for new infrastructure (Tian *et al.*, 2024). RES integration and effective urban planning can mitigate these negative effects (Murshed *et al.*, 2022).

Despite numerous studies, there is a shortage of analyses that simultaneously examine the impact of GDP level and RES share on CO_2 emissions, energy efficiency and economic growth in EU states. This is particularly relevant in the context of their economic and energy diversity.

The objective of this study is to analyse the impact of GDP and RES share on CO_2 emissions, energy efficiency and economic growth in EU states. The following hypotheses are being verified here:

1. A high level of GDP combined with a high share of renewable energy sources (RES) promotes a more efficient reduction of CO_2 emissions.

2. Increasing the share of RES in the energy mix leads to a significant reduction in CO_2 emissions.

3. Investment in research and development (R&D) has a greater impact on improving energy efficiency in countries where the share of renewable energy sources (RES) is low.

4. The link between urbanisation and CO_2 emissions and economic growth is determined by the level of economic development and the share of RES; a higher share of RES mitigates the negative effects of urbanisation.

The study applied structural equation modelling (SEM) using the partial least squares (PLS) method. The data used originated from Eurostat, OECD and other sources, covering the period 2004-2023.

The study makes a contribution to knowledge by comprehensively analysing the impact of GDP and RES on CO_2 emissions in EU member states, taking

into account energy efficiency and urbanisation as central factors. The findings may provide valuable insight for policymakers when shaping effective energy and environmental strategies.

Literature Review and Identification of Key Factors

GDP and CO_2 emissions: towards sustainable growth

Contemporary studies on sustainable development concentrate on the complex relationship between economic growth, measured by GDP levels, and CO_2 emissions. The ambition to minimise the negative impact of the economy on the environment has led researchers to seek ways to decouple these two variables, enabling economic growth while reducing emissions.

A number of research papers have explored the role of renewable energy sources (RES) in decoupling economic growth from CO_2 emissions. Liddle and Parker (2024) identified 15 countries that successfully decoupled these variables, pointing to the key role of RES in decarbonising energy systems. Similar conclusions can be drawn from the study carried out by Wang *et al.* (2024), who highlighted the efficiency of wind energy in reducing emissions.

Barkat *et al.* (2024) demonstrated that foreign aid can reduce CO_2 emissions in developing countries by promoting green investment. Lu *et al.* (2024) emphasised the need to include emission factors in economic projections.

Gbadeyan *et al.* (2024) considered decoupling economic growth from CO_2 emissions as a fundamental element of the energy transition. While analysing the case of China, Shi *et al.* (2024) noted that the pursuit of rapid economic growth can lead to energy efficiency problems. In their examination of EU countries, Mohsin *et al.* (2024) found that despite the positive impact of green supply chains and the circular economy in reducing CO_2 emissions, economic growth can still generate increased emissions.

Amara *et al.* (2024) highlighted the positive impact of economic growth on the development of eco-innovation. Sikder *et al.* (2024) stated that the integration of green logistics and the circular economy has a positive impact on reducing CO_2 emissions in EU states. Zhang *et al.* (2024) stressed the importance of policies that support innovation and RES development in the context of adopting renewable energy. Dissanayake *et al.* (2023) noted the imperative of adapting energy policies to the specifics of each country.

In turn, Qin *et al.* (2024) proposed a spatial optimisation model of territorial functions that combines economic growth with CO_2 reduction in China. In their analysis of ASEAN (Association of Southeast Asian Nations) and GCC (Gulf Cooperation Council) countries, Naz *et al.* (2024) highlighted the importance of RES in GCC countries. Kinyar and Bothongo (2024) showed that eco-innovation in Great Britain had a stronger emission reduction effect than GDP growth alone.

Sikder *et al.* (2024) stressed that industrialisation and economic growth increase CO_2 emissions in developing countries. Onofrei *et al.* (2022) pointed to the need for appropriate policies and tools to manage climate risks in the EU.

The review of the literature presented above illustrates the complexity of the relationship between GDP and CO_2 emissions. In the context of this study focused on EU states, it is vital to understand how the combination of a high level of GDP and a high share of RES affects the efficiency of CO_2 reductions.

Hypothesis 1: A high level of GDP combined with a high share of renewable energy sources (RES) promotes a more efficient reduction of CO_2 emissions.

Role of RES in reducing CO_2 emissions

Contemporary scientific studies have clearly demonstrated the central role played by renewable energy sources (RES) in reducing carbon dioxide (CO_2) emissions and limiting negative environmental impacts.

Several studies have confirmed a direct link between RES use and CO_2 reduction. Dogan and Inglesi-Lotz (2024) found that increased use of biomass leads to reduced CO_2 emissions, and the environmental Kuznets curve (EKC) hypothesis[1] turned out to be true for countries using biomass. Ben-Ahmed and Ben-Salha (2024) found that both nuclear and renewable energy lead to reduced CO_2 emissions. Mehmood (2021) highlighted the considerable impact of renewable energy in reducing CO_2 emissions, noting the role of education in raising environmental awareness.

Zhang *et al.* (2024) observed that higher oil prices can make renewable energy more attractive and that technological innovation accelerates the transition to RES. Bakry *et al.* (2023) confirmed the significant impact green financing has on reducing CO_2 emissions. Acaravci and Ozturk (2024) found a long-term relationship between CO_2 emissions per capita, energy consumption per capita and GDP per capita in some European states, suggesting the veracity of the EKC hypothesis. Apergis and Payne (2024) concluded that renewable energy consumption is strongly related to GDP per capita, CO_2 emissions, as well as oil and coal prices.

Khan *et al.* (2022) proved that the relationship between renewable energy consumption and CO_2 emissions varies depending on the level of economic development. Naeem *et al.* (2024) reported that increased access to clean fuels and technologies is conducive to reducing CO_2 emissions while highlighting the need for improved environmental policies.

[1] The environmental Kuznets curve (EKC) is a hypothesis suggesting that during the initial stages of economic growth, environmental degradation accelerates, but after a certain level of income per capita is reached, it begins to decrease. This means that the correlation between economic growth and environmental pollution has the shape of an inverted "U".

A review of studies confirms the importance of RES in reducing CO_2 emissions. At the same time, it points to the need to consider a range of factors when assessing the effectiveness of RES in reducing emissions, such as the level of economic development, access to technology and environmental policies.

Hypothesis 2: Increasing the share of renewable energy sources (RES) in the energy mix leads to a significant reduction in CO_2 emissions.

Energy efficiency and climate policy: the paradox of the rebound effect

Energy efficiency is widely recognised as the key component of climate policy, enabling reductions in energy consumption and CO_2 emissions (Belaïd & Mikayilov, 2024). However, somewhat paradoxically, the introduction of energy-efficient technologies can lead to increased energy consumption, which is referred to as the rebound effect (Sorrell *et al*., 2009).

The rebound effect means that energy savings resulting from the implementation of efficient technologies are partially or fully offset by increased consumption elsewhere (Karakaya *et al*., 2024). This phenomenon can occur both at the microeconomic level (e.g., more frequently used appliances) (Dimitropoulos, 2007) and at the macroeconomic level (e.g., increased economic activity) (Bolat *et al*., 2023).

Research shows that the rebound effect can have a significant impact on the effectiveness of climate policies. Yang and Li (2024) showed that the rebound effect for emissions in China is between 10% and 60%. Mongo *et al*. (2024) observed the short-term effect in 15 European states.

Among the sources of the rebound effect is the "institutional trap" (Matraeva *et al*., 2024), i.e., established social norms that lead to inappropriate use of energy-efficient technologies.

Successful mitigation of the rebound effect calls for comprehensive strategies that combine different policy mechanisms, such as economic incentives and regulatory actions. Ziaei (2024) notes that increased public spending on energy innovation can lead to reduced CO_2 emissions in the long term, though in the short term, it can stimulate economic activity and thus generate increased emissions.

Energy efficiency plays a key role in reducing CO_2 emissions, but its effectiveness can be hampered by the rebound effect. Further research into effective strategies to reduce this effect is necessary.

Hypothesis 3: Investment in research and development (R&D) has a greater impact on improving energy efficiency in countries where the share of renewable energy sources (RES) is low.

Urbanisation versus economic development and energy: complex interdependencies

Urbanisation plays an important role in shaping economic growth, energy consumption and CO_2 emissions. Studies demonstrate that the interdependencies between urbanisation, economic growth and emissions are complex and depend on many factors, such as the stage of development and the level of RES deployment (Zhang & Yang, 2024).

In rapidly developing countries, urbanisation is often associated with increased CO_2 emissions due to burgeoning industrialisation and demand for infrastructure (Tian *et al*., 2024). However, RES integration has the potential to mitigate these effects (Murshed *et al*., 2022). In high-income countries, the relationship between urbanisation and emissions is more nuanced. Grodzicki and Jankiewicz (2022) found that urbanisation in Europe leads to increased emissions, yet a high share of RES can significantly reduce them.

The effect of urbanisation on emissions is not linear. Zhu *et al*. (2024) observed in China that emissions increase in the early phase of urbanisation, but later stabilise and decrease with the implementation of energy-saving technologies and efficient transport systems.

Sikder *et al*. (2024) showed that improvements in energy efficiency in developing countries can reduce the growth of emissions associated with urbanisation.

Tong (2024) noted that the impact of urbanisation on energy and emissions varies at the subnational level in China, indicating the importance of local policies. Quan *et al*. (2024) showed that urbanisation can be more effective than RES in reducing ecological footprints, but economic development can negatively affect environmental quality. Zhang *et al*. (2024) emphasised the necessity to combine efficiency gains with policies that support the optimisation of industrial structures and environmental protection.

The correlation between urbanisation and CO_2 emissions is complex and is influenced by several factors. Strategic implementation of energy policies is essential to minimise the environmental impacts of urbanisation.

Hypothesis 4: The link between urbanisation and CO_2 emissions and economic growth is determined by the level of economic development and the share of RES; a higher share of RES mitigates the negative effects of urbanisation.

Empirical Research Methodology and SEM Model Construction

The study relied on empirical data collected from official statistical sources such as Eurostat, the OECD and other institutions providing information on the economy, energy and the environment in EU states. Eurostat provided key

indicators such as gross domestic product (GDP) per capita, carbon dioxide (CO_2) emissions, the share of renewable energy sources (RES) and urbanisation rates. Data from the OECD were supplemented with information on innovation, and additional environmental statistics provided data on energy efficiency.

The analysis covers the period 2004-2022, allowing long-term trends in the economy, energy efficiency and CO_2 emissions in EU states to be observed over the past 18 years. The period chosen also makes it possible to consider the impact of key energy policies and macroeconomic developments.

The study used the following indicators, which were implemented as variables in the structural equation model (SEM) constructed in SmartPLS 4. These variables were divided into constructs and control variables.

Constructs:

– Renewable energy (RE): Energy consumption from renewable sources in EU states, measured as the percentage of energy from RES in total energy consumption. This includes sources such as wind, solar, biomass or hydropower. It allows the assessment of states' commitment to the energy transition.

– Research and development (R&D): R&D expenditure as a percentage of GDP, extracted from the Eurostat database, including investment in new energy technologies and the number of energy-related patents. It represents the level of innovation and the ability to implement new technological solutions.

– Energy efficiency (EE): Energy consumption in relation to economic growth, measured by final energy consumption per unit of GDP and final energy consumption per capita. The average indicator reflects the efficiency of energy use in the state's economy.

– Economic growth (EG): GDP per capita, serving as a measure of the level of economic development and prosperity. Values at fixed prices have been used, eliminating the impact of inflation and allowing the data to be comparable over time.

– CO_2 emissions (CO_2): Carbon dioxide emissions per capita, illustrating the environmental burden generated by individual states and allowing progress in reducing greenhouse gas emissions to be tracked.

Control variables:

– Urbanisation (URB): Percentage of population living in urbanised areas, taking into account indicators such as percentage of the urban population, urban density and urban population growth rate. It influences energy consumption, emission levels and economic structures.

– Degree of industrialisation (IND): Industry's contribution to GDP, representing the level of industrialisation of the economy. A higher share of industry can result in higher energy consumption and CO_2 emissions.

The SEM model takes into account both the measurement and structural parts, which allows for the simultaneous modelling of the relationship between latent variables (constructs) and observable variables.

In order to carry out a more precise analysis, EU states were divided into groups under two criteria: the level of GDP per capita and the share of RES in total energy consumption. This division helps to identify states representing different levels of economic development and commitment to the energy transition, which is crucial for the formulation of efficient energy and environmental policies.

Groups by GDP per capita:

– highest GDP level: Ireland, the Netherlands, Denmark, Sweden, Austria;
– high GDP level: Germany, Belgium, Finland, France, Slovenia;
– average GDP level: Italy, Spain, Czechia, Lithuania, Estonia;
– low GDP level: Portugal, Poland, Slovakia, Romania, Latvia;
– lowest GDP level: Hungary, Croatia, Greece, Bulgaria.

Groups by RES share:

– highest RES share: Sweden, Finland, Latvia, Denmark, Estonia;
– high RES share: Portugal, Austria, Lithuania, Croatia, Slovenia;
– average RES share: Romania, Greece, Spain, Germany, France;
– low RES share: Italy, Bulgaria, Czechia, Slovakia, Poland;
– lowest RES share**:** Hungary, the Netherlands, Belgium, Malta, Ireland.

This breakdown facilitates an analysis of the relationship between the level of economic development and the share of RES in the energy mix, which plays an important role in assessing the impact of these factors on CO_2 emissions and energy efficiency.

Model validation

The SEM model designed using SmartPLS 4 was validated, including an assessment of the relevance and reliability of the measurement model (Fig. 1):

– factor loadings: all indicators achieved values between 0.72 and 0.89, exceeding the acceptable threshold of 0.7;

– average Variance Extracted (AVE): For each latent variable, the AVE value was above 0.5, indicating adequate construct validity;

– construct reliability: Values exceeded 0.8, indicating high internal consistency;

– discriminant validity assessment: The Fornell-Larcker criterion and the HTMT coefficient were used; the values were below the threshold of 0.85, confirming good discriminant validity between the constructs.

Analysis of the path coefficients in the structural model showed values ranging from -0.602 to 0.517, indicating a diverse influence of the different variables on each other. The values of the coefficient of determination R^2 ranged from 0.341 to 0.713, suggesting a moderate to high explanatory power of the model. The Standardized Root Mean Square Residual (SRMR) value for the whole model was 0.057, indicating a good fit of the model.

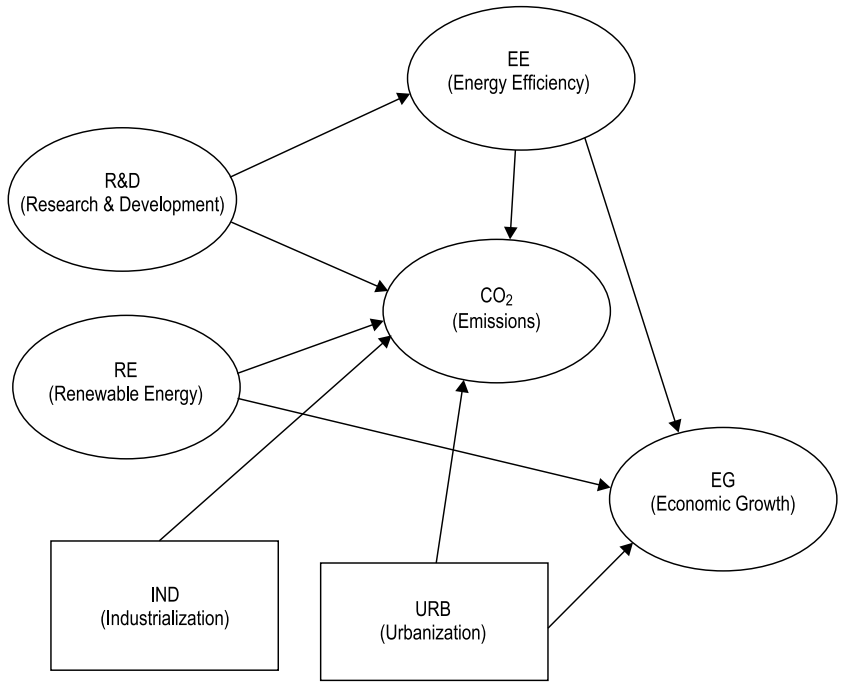

Fig. 1. Structural model of the SEM
Source: own study using SmartPLS4.

The PLS-SEM method was chosen for the following reasons:

– flexibility in the analysis of small samples: It allows reliable results to be obtained even with a limited number of observations;

– no requirement for normality of data distribution: Allows for the analysis of data that do not meet the assumption of normality;

– possibility to model complex structures: Ideal for studying complex relationships between latent and observable variables.

This is key to exploring the relationship between GDP, RES, CO_2 emissions and other factors, allowing the multidimensionality of these relationships to be addressed.

Empirical Results of the Analysis of the Impact of GDP, RES, and Other Factors on CO_2 Emissions and Economic Growth

This chapter presents the results of the empirical analysis of the impact of gross domestic product (GDP), renewable energy sources (RES) and other factors on carbon dioxide (CO_2) emissions and economic growth in EU member

states. Each of the research hypotheses adopted has been verified against the results obtained and cross-referenced with existing literature. This provides a deeper understanding of the relationships and to compare the results with those of previous studies.

H1: A high level of GDP combined with a high share of renewable energy sources (RES) promotes a more efficient reduction of CO_2 emissions.

Table 1 shows the results of the analysis of the impact of GDP level and the share of renewable energy sources (RES) on CO_2 emissions in different groups of EU member states. These results clearly indicate a strong correlation between economic development, RES use and the effectiveness of pro-environmental efforts.

Table 1

Results of the analysis of the impact of GDP and RES share on CO_2 emissions in groups of EU member states

Group of states	GDP → CO_2	RES → CO_2	RES share	R^2 for CO_2
Highest GDP per capita	-0.602	-0.340	high	0.621
High GDP per capita	-0.285	-0.192	average	0.394
Average GDP per capita	0.104	-0.319	average	0.525
Low GDP per capita	0.022	-0.213	low	0.409
Lowest GDP per capita	0.341	-0.060	lowest	0.341

Source: own study using SmartPLS4.

The groups of states with the highest levels of GDP per capita recorded the highest value of the R^2 coefficient of determination for CO_2 emissions, with a value of 0.621. This suggests that countries with a high level of economic development and a high share of RES, such as Sweden, Germany and the Netherlands, are most effective in reducing CO_2 emissions. The path coefficient value for GDP → CO_2 was -0.602, confirming that economic growth in states with high GDP can contribute to emission reductions, especially when accompanied by the use of renewable energy sources. Similarly, the path coefficient value for RES → CO_2 was -0.340, indicating a positive impact of RES on emission reductions.

In states with average GDP levels, limited effectiveness of emission reduction efforts was observed. The value of the GDP → CO_2 path coefficient was 0.104, suggesting that the economic benefits of economic growth often outweigh the environmental benefits, leading to an increase in CO_2 emissions. This effect may be due to the occurrence of the so-called rebound effect, a situation in which economic growth and technological efficiency lead to increased energy consumption. The value of the path coefficient for the RES → CO_2 relationship was

-0.319, which indicates that despite the impact of RES on reducing emissions, this influence is not strong enough to completely offset the effects of economic growth.

States with the lowest levels of GDP per capita achieved the lowest R^2 value for CO_2 (0.341), indicating limited environmental performance. In these states, the path coefficient value for GDP → CO_2 was 0.341, suggesting that economic development is associated with increased emissions. Although the contribution of RES is beneficial, its impact on reducing emissions is limited (the RES → CO_2 ratio was -0.060).

These results are confirmed in the literature. A study by Grodzicki and Jankiewicz (2022) revealed that an increase in the share of RES leads to reduced CO_2 emissions, especially in northern European countries where the share of renewables is highest. The study by Mongo *et al.* (2024) suggested that the effects of introducing eco-innovation, including RES development, can be observed only in the long run, whereas in the short term, there may be a rebound effect related to the costs of adapting to new technologies and a temporary increase in energy demand. Conversely, studies by Kinyar and Bothongo (2024) showed that investments in eco-innovation and renewable technologies in highly developed countries such as the UK have stronger effects in reducing emissions than in countries with lower levels of development.

It is also worth referring to the environmental Kuznets curve (EKC) hypothesis, which assumes an inverse relationship between economic growth and environmental degradation beyond a certain level of income per capita. The findings of this analysis are consistent with this hypothesis, particularly for countries with the highest GDP per capita. Research by Acaravci and Ozturk (2024) also confirmed this relationship for developed countries, where investments in environmentally friendly technologies contribute to CO_2 reductions. Similar conclusions can be drawn from a study by Mirziyoyeva and Salahodjaev (2023), who found that growth in GDP per capita has an inverted U-shaped correlation with CO_2 emissions. Countries with high levels of globalisation and GDP are effective in reducing emissions due to investment in renewable technologies and better access to the capital needed to implement them.

H2: Increasing the share of RES in the energy mix leads to a significant reduction in CO_2 emissions.

Table 2 shows the results of the analysis of the impact of the share of renewable energy sources (RES) on CO_2 emissions in different groups of European Union member states. The analysis was designed to verify whether an increase in the share of RES contributes to a significant reduction in CO_2 emissions. The results clearly indicate that increasing the share of RES in the energy mix leads to significant emission reductions in countries with higher levels of decarbonisation.

Table 2

Impact of energy efficiency on CO_2 emission reduction in EU member states

Group of states	RES → CO_2	RES	R^2 for CO_2
Highest RES share	-0.340	high	0.621
High RES share	-0.192	average	0.394
Average RES share	-0.319	average	0.525
Low RES share	-0.213	low	0.409
Lowest RES share	-0.060	lowest	0.341

Source: own study using SmartPLS4.

The results for countries with the highest RES share show that the path coefficient value for the RES → CO_2 relationship was -0.340, suggesting that high investments in renewables contribute to effective CO_2 reductions. In countries with a high RES share, such as Germany and Sweden, these results are confirmed in the literature, showing the effectiveness of investments in eco-innovation and renewable technologies in reducing emissions. A study by Zhang *et al.* (2024) found that Germany, due to its high RES share, is able to achieve significant CO_2 reductions, especially in the power sector (Zhang *et al.*, 2024).

In states with an average RES share, the value of the RES → CO_2 path coefficient was -0.319, which also indicates significant benefits associated with the development of renewable energy sources. However, it is worth noting that the impact of RES on emission reductions in states with low RES share is less significant (-0.213). A study by Soytas *et al.* (2007) suggested that for states with lower levels of economic development and a lower RES share, infrastructure and investment constraints may limit the effectiveness of pro-environmental efforts, resulting in a lower impact on CO_2 reductions (Soytas *et al.*, 2007).

The countries with the lowest RES share, as shown by the results of the analysis, reached only a minimal impact on CO_2 reduction (path coefficient -0.060). This may be due to the lack of adequate tools to promote investment in renewables and insufficient policy support. Zhang *et al.* (2024) indicate that the development of renewable energy sources requires strategic support policies and increased investment in innovation, which is crucial to achieving long-term reductions in emissions (Zhang *et al.*, 2024).

These conclusions are supported by the literature, where the benefits of increasing the share of RES in the energy mix are repeatedly highlighted. Studies on the transition to renewable energy sources in developed countries show that an increased RES share leads to improved environmental quality and reduced CO_2 emissions, especially in the long term (Acaravci & Ozturk, 2024). Similarly, studies by Zhang *et al.* (2024) and Soytas *et al.* (2007) indicated that opting for renewable energy sources plays a key role in reducing emissions in countries that have introduced appropriate support policies.

In conclusion, the verification of hypothesis 2 proved that increasing the share of RES does indeed lead to significant reductions in CO_2 emissions, but the impact varies depending on the level of economic development and the policies implemented by each state. States with higher RES shares and more advanced support policies, such as Germany, are able to achieve greater CO_2 reductions, confirming the rationale for further investment in renewable energy sources.

H3: Investment in research and development (R&D) has a greater impact on improving energy efficiency in countries where the share of renewable energy sources (RES) is low.

Table 3 presents the results of the analysis of the impact of research and development (R&D) investments on energy efficiency (EE) in European Union member states, taking into account different levels of renewable energy sources (RES) participation. These results show that in countries with a low RES share, R&D investments had the highest impact on improving energy efficiency. The value of the R&D → EE path coefficient was 0.412, and the R^2 value reached 0.517. This confirms that R&D investments in countries with a low RES share are crucial for modernising energy systems and introducing innovative technological solutions.

Table 3

Impact of investments in research and development (R&D) on energy efficiency in EU member states

Group of states	R&D → EE_avg	RSE share	R^2 for EE_avg
Highest RES share	0.178	high	0.423
High RES share	0.215	average	0.398
Average RES share	0.301	average	0.452
Low RES share	0.412	low	0.517
Lowest RES share	0.389	lowest	0.489

Source: own study using SmartPLS4.

States with the lowest RES share reached an R&D → EE path coefficient value of 0.389 and an R^2 value for energy efficiency of 0.489. This means that R&D investments in states with the lowest RES share also have a significant impact on improving energy efficiency, albeit slightly lower than in states with a slightly higher, but still low, RES share.

In states with higher RES shares, the value of the path coefficient was noticeably lower. For the groups of states with the highest RES share, this value was 0.178, indicating that R&D had a limited impact on energy efficiency. The R^2 value for energy efficiency in the states with the highest RES share

was 0.423. This may suggest that in these states, energy efficiency is already at such a high level that additional R&D expenditures do not have a significant impact on reducing energy consumption. Instead, these countries mainly focus on optimising the use of existing technologies.

Similar conclusions are confirmed in the literature. A study by Shi *et al.* (2024) indicates that developing countries with higher investment in R&D perform better in terms of energy efficiency and have a greater capacity to upgrade their energy systems. In contrast, a study by Liu *et al.* (2024) showed that in highly developed countries, energy efficiency is at such a high level that additional investment in R&D does not translate to significant benefits in terms of reducing energy consumption.

In states with a low RES share, investment in R&D is crucial, especially in the context of modernising existing energy systems and introducing innovative technologies. Research by Sikder *et al.* (2024) also confirmed that investment in R&D is instrumental in improving energy efficiency in developing countries, which can help reduce dependence on fossil fuels.

A study by Zhu *et al.* (2024) showed that in states with high RES shares, sustainable development policies and investments in sustainable urbanisation are more effective than additional R&D investments. This is because these countries are already equipped with advanced technologies, and additional investments in R&D may produce fewer benefits.

H4: The link between urbanisation and CO_2 emissions and economic growth is determined by the level of economic development and the share of RES; a higher share of RES mitigates the negative effects of urbanisation.

Table 4 presents the results of the analysis of the impact of urbanisation (URB) on economic growth (EG) in different groups of European Union member states, taking into account the level of GDP per capita and the share of renewable

Table 4

Impact of urbanisation on economic growth in EU member states

Group of states	URB → EG	GDP per capita	RSE share	R^2 for EG_CST
Highest GDP per capita	0.432	high	high	0.498
High GDP per capita	0.284	high	average	0.276
Average GDP per capita	0.517	average	average	0.354
Low GDP per capita	0.205	low	low	0.319
Lowest GDP per capita	0.208	low	lowest	0.208

Source: own study using SmartPLS4.

energy sources (RES). These results reveal that the impact of urbanisation on economic growth varies according to the level of GDP and the share of RES.

States with an average level of GDP per capita achieved the highest impact of urbanisation on economic growth, with a URB → EG path coefficient value of 0.517 and an R^2 value of 0.354. This means that urbanisation in this group of states plays a central role in stimulating the economy, especially by improving access to services and infrastructure. These states benefit from urban development as an important factor in stimulating economic growth.

In states with the highest level of GDP per capita, the value of the path coefficient for the URB → EG relationship was 0.432, while the R^2 value reached 0.498. Although urbanisation still had a positive impact on economic growth, its importance was lower than in countries with average GDP. This may be due to the fact that urban infrastructure in developed countries is already advanced, which makes further urbanisation less significant as an economic driver. It can be assumed that investment is shifting to other areas, such as technological innovation.

In states with lower and the lowest levels of GDP per capita, urbanisation had a relatively weaker impact on economic growth, with URB → EG path coefficient values at 0.205 and 0.208, respectively. The R^2 value for these groups of states was 0.319 and 0.208, respectively, suggesting that urbanisation is not the main driver of the economy, with limited access to financial and infrastructural resources being a barrier to realising the full potential of urbanisation.

Similar findings are confirmed in the literature. A study by Zhang *et al.* (2024) indicated that in developed countries such as Germany and the US, the economic impact of urbanisation varies, depending on the level of technological development and policies supporting renewable energy sources. In countries with medium GDP, urbanisation contributed to increased economic activity, improving access to services and infrastructure. In contrast, in states with a high RES share, the development of green areas and sustainable urbanisation are more focused on reducing emissions rather than having a direct impact on economic growth.

A study carried out by Bakry *et al.* (2023) suggested that sustainable urbanisation policies and green financing can support economic development and CO_2 emission reductions, but their impact is limited in developing countries due to a lack of adequate financial and institutional resources. In addition, Ziaei (2025) suggested that in OECD countries, investment in energy innovation may be more effective in reducing emissions than developing urban infrastructure, which may also explain the lower impact of urbanisation on economic growth in high-GDP countries.

Summary of the Findings and Recommendations for EU Energy Policy

A study carried out among European Union states examined the impact of GDP and the share of renewable energy sources (RES) on CO_2 emissions, economic growth and energy efficiency using structural equation modelling (SEM). The use of RES and economic growth were found to be key factors shaping CO_2 emissions and had a significant impact on economic development and energy efficiency.

High GDP levels combined with high RES share were found to be the most effective in reducing CO_2 emissions. States with a developed economy and a high share of RES, such as Sweden, Finland and the Netherlands, saw significant reductions in emissions. This confirms the hypothesis of decoupling economic growth from CO_2 emissions. A study by Liddle and Parker (2024) suggested that countries with high GDP and advanced decarbonisation can effectively decouple economic growth from emissions.

RES share had a significant impact on CO_2 reductions in every group of states. Greater emission reductions were observed in the groups with the highest RES share, which is consistent with the findings of Wang *et al.* (2024) indicating the effectiveness of RES in decarbonisation, especially wind energy. In states with lower RES shares, the impact was lower, suggesting the need to intensify efforts to develop RES.

Energy efficiency had a different impact on CO_2 emissions depending on the country's GDP level. In states with high and average GDP, energy efficiency does not always lead to reduced CO_2 emissions, suggesting the presence of a rebound effect. This effect, described by Karakaya *et al.* (2024), involves the obtained energy savings being offset by increased consumption in other areas. Its presence has been confirmed in states with medium and low GDP, suggesting the need for more effective measures to minimise this phenomenon.

Urbanisation appeared to have a complex effect on CO_2 emissions and economic growth, depending on a state's level of economic development. In countries with higher GDP, urbanisation was managed more effectively, allowing emissions to be minimised. In contrast, in states at lower levels of development, urbanisation contributed to increased emissions, suggesting the need for better planning of urban infrastructure and integration of renewable energy sources.

The addition of the RES share criterion to the analysis substantially increased the value of the results compared to the analysis based on GDP alone. The analysis, including the RES share, showed a more pronounced impact on CO_2 reduction and economic growth, especially in the groups of states investing heavily in RES. Models that considered only GDP levels failed to fully capture the benefits of energy transition in states with high RES shares. For instance, in countries such as Sweden and Finland, the R^2 value for CO_2 emissions was much higher, indicating a better fitting of the model to explain emissions variability.

This suggests that RES can play a key role in the effective transformation of the economy, regardless of the level of economic development. This is further supported by the findings of Ben-Ahmed and Ben-Salha (2024), who observed that RESs significantly reduce CO_2 emissions.

Based on the findings of the analysis, the following recommendations are made to policymakers in the context of optimising EU energy policies:

1. Investment in RES: EU states should continue to invest heavily in the development of RES, such as wind, solar or biomass power. RES play a key role in reducing CO_2 emissions and contribute to economic growth, especially in countries characterised by high and average levels of development.

2. Reducing the rebound effect: Policies to reduce the rebound effect, such as regulating energy consumption and implementing advanced efficiency technologies, are necessary in countries with average and low GDP levels.

3. Sustainable urbanisation: For developing countries, urbanisation should be linked to the implementation of green technologies and RES. Urban planning needs to take environmental aspects into account in order to reduce the negative impact of urban development on CO_2 emissions.

4. Supporting the countries with low RES share: States with low RES shares need to receive financial and technological support to intensify their energy transition. Financial incentives, such as tax breaks or subsidies for RES investments, can significantly improve the energy situation of these states.

To build on the findings of the current study, future analyses should consider other factors affecting CO_2 emissions, economic growth and energy efficiency, such as geographical (e.g., climatic conditions) and political (e.g., level of environmental regulation) variables. Including these variables would provide a more complete picture of the impact of different aspects on the energy transition in different countries.

Furthermore, future studies could extend the analysis to include countries outside the European Union. This would allow a comparison of results between countries with different levels of economic development and at different stages of energy transition. This could be useful in understanding how external factors affect the efficiency of RES-related policies.

Translated by Joanna Jensen

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8) Only articles which have two positive reviews are submitted for printing. If one of the reviews is negative, the article is submitted for evaluation to a third reviewer.
9) The review form is available on the website.
10) Names of the reviewers for individual issues of the journal are available in the current issue and on the website.

After receiving two positive reviews and taking into considerations the reviewers' corrections and recommendations the Author revises the article and submits to the editorial board the following:

a) the final version of the article in English, together with the title, key words and abstract in Polish and English,
b) responses to reviews,
c) the Author's statement (the relevant form can be found on the website),
d) information about the name and last name of the translator and the native speaker,
e) consent for the processing of common personal data (the relevant form can be found on the website).

The final version of the article submitted by the author will be verified by the statistical editor.