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Digital And Green Transformation In The Context Of Households, Markets, And Public Policies

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Table of Contents

PART I: Households in the Era of Digital Transformation

PART II: Digital Economy and Transforming Markets

PART III: Public Policies towards Green and Digital Transformation

Introduction

The 21st century is characterized by two fundamental and mutually reinforcing transitions: the digital transformation and the green transformation. Both processes redefine the way households function, markets evolve, and public policies are designed and implemented. This monograph brings together theoretical reflections and empirical research conducted in different countries to explore how these transformations manifest across various levels of socio-economic life.

The volume is divided into three interrelated parts, reflecting a logical progression from the micro-level of households, through meso-level market structures, to macro-level public policies.

Part I – Households in the era of digital transformation examines how digitalization affects everyday life, consumption, and social practices. Contributions address, among others, the use and non-use of smart technologies in Slovak households, the role of the digital economy in shaping household sectors in Ukraine, differences in internet access across European households, and the level of household digitalization in Poland and Lithuania. This section highlights not only the opportunities brought by digital tools but also the challenges related to inequality, adaptation of displaced persons, and cultural or generational factors that shape technology adoption.

Part II – Digital economy and transforming markets moves the perspective to enterprises and industries. Here, the focus lies on the potential of digital marketing for small-scale agripreneurs in Nigeria, creative strategies in the gastronomy sector, and the digitalization of SMEs in their interactions with larger business entities. This part underlines the disruptive potential of digital tools for competitiveness, innovation, and cooperation, while also revealing persistent barriers linked to resources, skills, and structural dependencies.

Part III – Public policies towards green and digital transformation addresses the macro dimension, emphasizing how governments and central banks integrate environmental and behavioral aspects into economic management. Studies on green fiscal policy and green central banking illustrate the interplay between digital transition and ecological sustainability, showing that the transformation is not only technological but also systemic and institutional.

Taken together, the contributions provide a multidimensional picture of digital and green transformation. The household perspective reveals

inequalities in access and adaptation, the market perspective demonstrates opportunities for entrepreneurship and innovation, while the public policy perspective situates these changes within the broader framework of sustainable development and resilience.

The main conclusion that emerges from this volume is that digital and green transitions are deeply intertwined and must be analyzed jointly. Digitalization can enhance energy efficiency, promote sustainable consumption, and strengthen social inclusion, yet it may also deepen inequalities if not accompanied by appropriate policies. Similarly, green transition policies must increasingly rely on digital tools to monitor, manage, and incentivize behavioral change.

This monograph aims to contribute to academic debate by combining empirical evidence from different national and regional contexts, offering comparative insights, and emphasizing the need for interdisciplinary approaches. It is addressed to researchers, policymakers, and practitioners who are interested in the dynamic interplay between digitalization, sustainability, and socio-economic development.

PART I

HOUSEHOLDS IN THE ERA OF DIGITAL TRANSFORMATION

Knapková M. (2025), *Digital tools and smart technologies in household management: patterns of use and non-adoption in Slovak households* [in] Piekut M., Knapková M. (eds.), Digital and Green Transformation in the Context of Households, Markets, and Public Policies. Kolegium Nauk Ekonomicznych i Społecznych, Politechnika Warszawska, Płock.

DIGITAL TOOLS AND SMART TECHNOLOGIES IN HOUSEHOLD MANAGEMENT: PATTERNS OF USE AND NON-ADOPTION IN SLOVAK HOUSEHOLDS

Miroslava Knapková*

Summary

This article presents preliminary findings on the use and non-use of smart technologies in Slovak households based on a survey of 522 respondents. The most commonly used tools include robotic appliances and smart heating systems, while key barriers to adoption are cost, preference for traditional routines, and lack of interest. No significant relationship was found between education level and technology use, but a gender difference emerged: women were more likely to cite traditional household management as a reason for non-use. The study offers early empirical insights from a post-socialist context, highlighting how cultural and social norms shape digital adoption.

Key words: smart home technologies, household management, gender roles, technology adoption, Slovakia, unpaid work.

Streszczenie

Artykuł przedstawia wstępne wyniki badania dotyczącego wykorzystywania i niewykorzystywania inteligentnych technologii w gospodarstwach domowych na Słowacji, opartego na ankiecie przeprowadzonej wśród 522 respondentów. Najczęściej stosowanymi rozwiązaniami są robotyczne urządzenia domowe i inteligentne systemy grzewcze, a głównymi barierami są koszty, przywiązanie do tradycyjnych praktyk oraz brak zainteresowania. Nie stwierdzono istotnej zależności między poziomem wykształcenia a używaniem technologii, jednak zauważono różnicę ze względu na płeć – kobiety częściej wskazywały tradycyjne zarządzanie domem jako powód niekorzystania z technologii. Badanie dostarcza wstępnych danych empirycznych z kontekstu postkomunistycznego, ukazując wpływ norm kulturowych i społecznych na przyjmowanie innowacji cyfrowych.

Key words: inteligentne technologie domowe, zarządzanie gospodarstwem domowym, role płciowe, adopcja technologii, Słowacja, praca nieodpłatna.

JEL: D13, O33, J16, R29

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Introduction

The digital economy has transformed not only production and services but also the daily organization of private life. Within this context, household management has emerged as a site of increasing technological intervention. Smart home technologies—such as robotic vacuums, smart thermostats, lighting systems, and security devices—offer potential gains in efficiency, convenience, and safety, as well as in organization of the whole unpaid domestic work. However, these technologies are not adopted uniformly across populations.

In Slovakia and similar Central and Eastern European countries, the digitalization of domestic life intersects with cultural norms, intergenerational differences, and varying levels of digital competence. While infrastructure readiness has improved substantially, there remains limited empirical knowledge about the actual uptake of smart technologies in Slovak households and the reasons why many families choose not to adopt them.

This article contributes to filling this gap. Drawing on a survey conducted in 2024, it examines the types of smart technologies used, the barriers to their adoption, and how these patterns vary by education, age, and gender. Article is divided into six parts, namely introduction, literature review, methodology and data collection, results, discussion and conclusion.

Literature review

The integration of digital tools and smart technologies into household management has attracted increasing scholarly attention in recent years, especially against the backdrop of energy transition, sustainability, and automation. Smart home environments—typically consisting of interconnected systems for lighting, heating, security, and appliance control—are widely promoted as efficient, sustainable, and convenient. However, actual adoption among households is shaped by a constellation of social, cultural, and emotional factors rather than technical potential alone.

Rowlands et al. [2013] emphasize that for smart technologies to function in daily life, system design must reflect householders' routines, emotional habits, and need for control. Their work on smart grid tools highlights that poor interface usability, misaligned expectations, and lack of trust significantly hinder adoption. A similar insight is offered by Balta-Ozkan et al. [2013], who argue that the perception of reliability, convenience, and control—rather than affordability or energy savings—primarily drives user engagement with home automation systems.

Gender plays a significant role in shaping domestic technology interactions. Martens et al. [2025] conceptualizes the “home maintainer” as a gendered figure performing not only logistical tasks but also emotional and cognitive labor—functions that are not easily replaced by digital systems. Wilhite [2008] similarly shows how energy consumption practices are embedded in traditional gender roles, with women often carrying the burden of household management. These roles shape not only routines but also emotional attachments to specific ways of “doing” home, which can conflict with automated or abstract systems.

The influence of education is more ambiguous. While commonly perceived as a factor promoting openness to digital innovation, higher education can also correlate with increased skepticism regarding data privacy, surveillance, and the actual

usefulness of new tools [Dourish & Bell, 2007]. Furthermore, in post-socialist settings such as Slovakia, education does not automatically translate into higher technology adoption. Wilhite [2008] argues that deeply rooted social values and experiences from centralized economies may temper enthusiasm toward digitization, regardless of educational attainment.

Several works also address the reasons for non-use. For instance, Martens et al. [2025] emphasizes that the reluctance to adopt smart technologies is often rooted in a mismatch between household roles—especially those carried out by women—and the design logic of the technologies themselves, which fail to accommodate emotional labor and tacit knowledge. Similarly, Wilhite (2008) explores how non-adoption is frequently related to the embeddedness of routines, habits, and social practices in energy consumption and domestic activities, which are not easily altered by new technologies.

Furthermore, Rowlands et al. [2013] identify key barriers to engagement with smart home systems, including the complexity of interfaces, lack of user-friendly feedback, and the cognitive burden associated with learning and trusting new digital tools. These challenges are particularly relevant in households where digital literacy or willingness to invest time into learning new systems is low. As Li et al. [2021] argue, the interaction between smart technologies and domestic life is shaped by power relations and identity, including age, gender, and class, which can make non-use a rational and culturally informed choice rather than a lack of access or awareness.

The gap in research focusing on Central and Eastern Europe remains significant. Much of the current literature is grounded in Western or Nordic contexts, where infrastructural readiness and trust in innovation are relatively high. Ahas et al. [2019] and Hess et al. [2025] call attention to the unique dynamics in post-socialist societies, where modernity is often aspirational but filtered through a lens of caution, historical experience, and resource awareness.

In sum, the adoption and non-adoption of smart technologies in households is shaped by an interplay of personal, cultural, and structural variables. Gendered routines, education, perceived usefulness, emotional comfort, and societal narratives all contribute to how technologies are accepted—or resisted—in everyday life. This study contributes to the expanding literature by offering new empirical evidence from Slovakia, highlighting both usage patterns and the socio-cultural reasons behind resistance to smart household innovations.

Methodology and data sources

This article presents preliminary results from an ongoing quantitative survey on the use and non-use of smart technologies in household management in Slovakia. The full questionnaire was designed to examine selected aspects of domestic work (unpaid work), including its organization (home management), and a dedicated section focused specifically on the use of modern technologies to facilitate household tasks and decision-making processes.

As of May 2025, the dataset includes responses from 522 individuals. These represent preliminary results of a survey that remains active (until end of June 2025). The gender structure of the sample consists of 344 females and 178 males. The survey was disseminated through two main channels. The first involved online distribution

via the faculty's social media platforms, which was supported by snowball sampling, it means that initial respondents were encouraged to share the link further within their personal networks. The second method consisted of direct targeting of households through trained university students who approached respondents personally across different regions of Slovakia.

The survey questionnaire contained both socio-demographic and substantive items. Key socio-demographic variables necessary for this article included gender (male, female, other) and highest completed level of education, classified into the following categories: a) no formal education, b) primary education, c) lower secondary without a school-leaving certificate, d) secondary education with school-leaving certificate, e) bachelor's degree, f) master's degree, and g) PhD or equivalent.

The questionnaire focused on selected aspects of domestic unpaid work and its organization (home management), with particular emphasis on the use of modern technologies to facilitate household tasks (unpaid work). This paper draws on responses to three key questions:

1. Do you use any modern technologies or devices in your household that help you organize and/or perform household tasks? (answers Yes/No)
2. If yes, which of the following technologies/devices does your household use (multiple answers possible):
    a. Task management applications (e.g., shared calendars, online planners, to-do lists)
    b. Robotic appliances (e.g., robot vacuum cleaners, smart fridges, intelligent washing machines)
    c. Automated lighting (e.g., motion sensors, programmable light timers)
    d. Smart heating systems (e.g., remotely controlled thermostats, zoned heating)
    e. Smart alarms (e.g., water/gas leak detectors, smoke alarms)
    f. Smart home security (e.g., electronic locks, smart cameras, remote access systems)
    g. Security-related entry systems (e.g., automated doors/garages, door/window sensors)
    h. Other (open-ended response)
3. If no, what are the main reasons for not using modern technologies or devices (multiple answers possible):
    a. No interest in smart home technologies
    b. Technologies are too expensive
    c. preference for traditional household management
    d. Perception that such technologies are unnecessary
    e. Negative prior experiences
    f. Privacy concerns
    g. Fear or discomfort in using such technologies
    h. Perception of unreliability
    i. Preference for self-reliance
    j. Unwillingness to learn new technologies
    k. Perceived minimal utility

l. Belief that smart technologies are merely a marketing trick

m. Perception that such technologies would not help with household management

n. Other (open-ended response)

To address the two main research questions (1) which smart technologies are most commonly used and (2) what are the main reasons for non-use of smart technologies descriptive statistics such as frequencies and percentages were computed using the JAMOVI statistical software.t

To test the relationship between smart technology use and education level (H1), and the impact of gender on reasons for non-use (H2), inferential statistics, specifically, chi-square tests of independence were used at a significance level of 0.05.

Hypothesis H1 tested the assumption that education level is associated with the likelihood of using smart technologies:

Null hypothesis (H_0): There is no association between education level and smart technology use.

Alternative hypothesis (H_1): There is an association between education level and smart technology use.

Hypothesis H2 evaluated whether gender significantly influences the reported reasons for non-use of smart technologies:

Null hypothesis (H_0): Gender has no impact on reasons for non-use of smart technologies.

Alternative hypothesis (H_1): Gender influences reasons for non-use of smart technologies.

Results

This section presents the results of the empirical analysis conducted on the preliminary dataset of 522 respondents. As shown in the Table 1, the research sample is composed predominantly of female respondents (65.9%), which may influence the findings regarding household technology use and gendered preferences or concerns. This overrepresentation of women could be attributed to greater interest in or responsibility for home management activities, which are more frequently associated with female roles in Central European cultural contexts.

Table 1. Sample distribution by gender and by the education obtained

Frequencies of Gender		
Gender	**Counts**	**% of Total**
Male	178	34.1
Female	344	65.9
Total	522	100
Frequencies of Highest Level of Education Attained (as of the date of completing the questionnaire)		
Highest Level of Education Attained	**Counts**	**% of Total**
No education (elementary school not yet completed)	3	0.6
Primary education (elementary school completed)	30	5.7
Secondary education without school-leaving certificate	45	8.6
Secondary education with school-leaving certificate	331	63.4
Tertiary education – first level (completed bachelor's degree)	43	8.2
Tertiary education – second level (completed master's degree)	66	12.6
Tertiary education – third level (PhD title)	4	0.8
Total	522	100

Source: own elaboration.

The majority of respondents (63.4%) have completed secondary education with graduation, followed by respondents with a master's degree (12.6%). Only a small fraction hold PhD-level education or report no completed formal education. This distribution suggests that the majority of participants are situated in the mid-range of educational attainment, which may have implications for how they perceive and engage with smart technologies. As found in the literature, higher education can contribute to both openness and skepticism toward technology (Dourish & Bell, 2007).

Table 2 presents the use of smart technologies in households, disaggregated by gender and calculated as a percentage within each gender group. Among male respondents, 48.9% report using smart technologies, while 51.1% do not. In contrast, among female respondents, only 40.1% report using such technologies, whereas a higher proportion, 59.9%, report non-use.

Table 2. Use of Smart Technologies in Households by Gender

Gender	**Response**	**Count**	**% Within Gender**
Male	No	91	51.1
Male	Yes	87	48.9
Female	No	206	59.9
Female	Yes	138	40.1

Source: Own elaboration.

Table 3 summarizes which types of smart technologies are most frequently used in Slovak households. Each respondent could select multiple technologies; therefore, the percentages reflect the proportion of total respondents (N = 490) who indicated use of each specific technology, not mutually exclusive categories. The most frequently reported technologies include robotic appliances (35.1%), followed by automated lighting (18.78%) and smart heating systems (13.67%). These results suggest that the adoption of smart technologies is primarily focused on devices that automate physical domestic tasks and improve energy efficiency. Less frequently reported are task management apps and security-related systems, which may indicate either lower perceived usefulness or lack of awareness and trust in these digital tools.

Table 3. Most Frequently Used Smart Technologies in Households

Technology	**Number of Users**	**% of Total Responces**
Robotic appliances	172	35,1
Automated lighting	92	18,78
Smart heating	67	13,67
Task management apps	54	11,02
Smart home security	48	9,8
Smart alarms	30	6,12
Security entry systems	27	5,51
Total no. of Responses	490	

Source: Own elaboration.

Table 4 presents the most frequently reported reasons why respondents do not use smart technologies in household management. As multiple responses were allowed, the percentages reflect the proportion of total responses (862). The most cited barrier was cost (42.7%), indicating that affordability is a primary limitation for many households. A large portion of respondents also prefer traditional or self-reliant methods (35.6%) or express a general lack of interest (32.2%). These findings reflect a significant role of personal values, habits, and possibly generational preferences in shaping technology adoption. A substantial number of respondents also report being accustomed to traditional household management (29.3%) or not perceiving a clear need for smart technologies (26.4%). Lower-frequency responses—such as privacy concerns, skepticism about reliability, or negative experiences—indicate that trust and familiarity are important, though less dominant, factors. Notably, only a small fraction (2.5%) believe smart technologies would not help at all, suggesting that perceived utility is not entirely absent, but often outweighed by cultural, emotional, or financial considerations.

Table 4. Reasons for Non-Use of Smart Technologies in Households

Reason	Frequency	% of Total Responses
Used to traditional methods	168	19,49
No interest in smart technologies	150	17,4
Too expensive	114	13,23
Do not need smart solutions	93	10,79
Prefer traditional and self-reliant solutions	89	10,32
Would use them only minimally	68	7,89
Don't want to learn new technologies	31	3,6
Privacy concerns	35	4,06
Negative experiences	19	2,2
Fear or discomfort	14	1,62
Perceived unreliability	27	3,13
Just a marketing trick	18	2,09
Would not help in household management	36	4,18
Total no. of Responses	862	

Source: Own elaboration.

Hypothesis testing

In order to better understand the social and demographic factors influencing the use of smart technologies in the home, two hypotheses were formulated and tested using chi-square tests of independence. This section presents the results of these tests, supported by contingency tables and interpretative commentary. To test both hypothesis, a Chi-square test of independence was conducted.

H1: Association between education level and smart technology use

Null hypothesis (H_0): There is no association between education level and smart technology use.

Alternative hypothesis (H_1): There is an association between education level and smart technology use.

Table 5 shows the relationship between respondents' highest completed level of education and their reported use of smart technologies in household management.

Table 5. Cross-tabulation of Education Level and Smart Technology Use

Education level	**No**	**Yes**	**Total**
No education (unfinished primary)	2	1	3
Primary education (completed)	19	11	30
Secondary without school-leaving exam	29	16	45
Secondary with school-leaving exam	188	143	331
Tertiary (1st level: bachelor's)	20	23	43
Tertiary (2nd level: master's)	37	29	66
Tertiary (3rd level: PhD)	2	2	4
Total	297	225	522

Source: Own elaboration.

Respondents with secondary education with school-leaving exam form the largest group in both smart technology users and non-users. They represent 63.4% of the total sample, making them a central demographic for interpretation. Among those with bachelor's degrees, 53.5% (23 of 43) report using smart technologies, a slightly higher adoption rate than the group with master's degrees (43.9%, or 29 of 66). All four respondents with a PhD are equally split (2 yes, 2 no), which is not statistically meaningful due to the low frequency. Those with only primary education or no formal education show a markedly lower rate of smart technology use.

A chi-square test was conducted to determine whether the association between education level and smart technology use is statistically significant. The result (χ^2 = 3.66, df = 6, p = 0.723) indicates that the observed differences in usage rates are not statistically significant at the 0.05 level. In other words, there is no confirmed association between education level and smart technology adoption in this dataset.

H2: Gender Differences in Reasons for Non-use of Smart Technologies
Null hypothesis (H_0): Gender does not influence the reasons for non-use of smart technologies.
Alternative hypothesis (H_1): Gender significantly influences the reasons for non-use of smart technologies.

This hypothesis was tested by performing a series of chi-square tests, one for each reason selected by non-users (N = 297). The goal was to determine whether men and women differ in the explanations they give for not integrating smart technologies into household management. The Table 6 shows the frequencies of selected reasons for not using smart home technologies, disaggregated by gender, and the corresponding p-values of the chi-square test.

Table 6. Descriptive Analysis and Chi-square Results

Reason for Non-use	Female (n = 344)	Male (n = 178)	χ^2	p-value	Significant
No interest in smart technologies	97 (28.2%)	53 (29.8%)	0.143	0.706	No
Too expensive	83 (24.1%)	31 (17.4%)	3.100	0.078	No (marginal)
Prefer traditional household management	121 (35.2%)	47 (26.4%)	4.130	0.042	Yes
Do not need such solutions	63 (18.3%)	30 (16.9%)	0.171	0.679	No
Had negative experiences	12 (3.5%)	7 (3.9%)	0.066	0.797	No
Privacy concerns	23 (6.7%)	12 (6.7%)	0.001	0.981	No
Fear of using smart technologies	10 (2.9%)	4 (2.2%)	0.196	0.658	No
Perceived unreliability	19 (5.5%)	8 (4.5%)	0.253	0.615	No
Prefer to rely on traditional or manual solutions	62 (18.0%)	27 (15.2%)	0.676	0.411	No
Lack of motivation to learn new technologies	22 (6.4%)	9 (5.1%)	0.377	0.539	No
Would only use them minimally in our household	48 (14.0%)	20 (11.2%)	0.765	0.382	No
Believe they are just a marketing gimmick	11 (3.2%)	7 (3.9%)	0.190	0.663	No
Believe they wouldn’t help us in household management	24 (7.0%)	12 (6.7%)	0.010	0.920	No

Source: Own elaboration.

Out of the 13 assessed reasons, only one showed a statistically significant gender difference at the 5% level, namely the one assesing that women were significantly more likely than men to state that they are used to traditional forms of managing the household ($\chi^2 = 4.13$, $p = 0.042$). This finding suggests that traditional gender roles may still shape women's approach to household management more strongly than men's.

Although the perception that smart technologies are too expensive showed a relatively low p-value ($p = 0.078$), it did not reach the conventional level of significance. However, this could suggest a potentially meaningful gender difference worth exploring further after closing the data collection.

For other reasons — such as lack of interest, privacy concerns, perceived unreliability, or belief in marketing manipulation — no statistically significant differences were observed. Both genders expressed these reasons with comparable frequencies, indicating a general consistency in how smart technologies are perceived when not used.

Discussion

The empirical findings of this study provide preliminary insights into the dynamics of smart technology use and non-use in Slovak households. Despite the increasing

availability and promotion of digital solutions for home management, the adoption landscape remains uneven and shaped by a complex interplay of gender roles, socio-cultural norms, and perceptions of utility. These findings align with the broader theoretical and empirical literature emphasizing that the diffusion of household technologies is conditioned more by social meaning and daily practice than by mere access or technical feasibility [Rowlands et al., 2013; Wilhite, 2008].

As shown in the results, the most frequently used smart technologies were robotic appliances (35.1%) and smart heating systems (13.7%). These tools directly reduce physical workload or improve energy management, and thus bring practical benefits that appear to resonate most with household priorities. Conversely, technologies requiring cognitive engagement or perceived as more abstract, such as task management applications (11%) or security-related devices (under 10%), are adopted much less frequently. This pattern reflects the findings of Balta-Ozkan et al. [2013], who argue that perceived convenience and control are more influential than promises of long-term efficiency or innovation. Devices that visibly "do something" in the home, such as vacuum, heat, light, are more readily accepted than those whose benefits are less tangible or involve learning curves.

The gendered differences in usage and attitudes deserve particular attention. While overall adoption was lower among women (40.1% of women vs. 48.9% of men), women were significantly more likely to state that they are "used to traditional forms of managing the household" as a reason for not adopting smart technologies ($p = 0.042$). This supports Martens et al.'s [2025] theory of the "home maintainer," where female household members perform not only physical chores but also emotional and cognitive labor, which smart technologies are poorly equipped to replicate.

Traditional expectations surrounding women's responsibility for home management in Slovak society may create both psychological and practical barriers to replacing familiar routines with digital systems. As Wilhite (2008) and Martens et al. [2025] point out, many domestic practices are embedded in "tacit knowledge" and affective labor, making them resistant to substitution by automation. The finding that women disproportionately report a preference for traditional methods also resonates with the broader literature on technological resistance, not as ignorance or conservatism, but as a rational choice embedded in identity, competence, and family dynamics [Li et al., 2021; Rowlands et al., 2013].

Interestingly, the chi-square test found no statistically significant association between education level and the use of smart technologies ($p = 0.723$), despite some variation across subgroups. While higher educational attainment is often linked to greater digital engagement, this study's results suggest that in the Slovak context, other factors, such as trust, cultural habits, or household roles, may outweigh the influence of formal education. This supports the claim by Dourish and Bell [2007] that experience-based skepticism toward technology, including concerns about surveillance or real utility, may increase with education rather than decline. Moreover, the post-socialist experience, as highlighted by Hess et al. [2025], may generate cautious attitudes toward modernity and technological optimism, even among highly educated individuals.

Respondents cited cost (13.23% of responses), preference for traditional or self-reliant solutions (19.49%), and lack of interest (17.4%) as the main reasons for not

adopting smart technologies. These findings reveal a preference for personal agency and established household routines over the perceived complexity or impersonality of smart systems.

The relatively low occurrence of reasons like privacy concerns or negative experiences suggests that resistance is not driven primarily by distrust or poor performance, but rather by the mismatch between what technologies offer and what households expect or value. As Balta-Ozkan et al. [2013] and Rowlands et al. [2013] argue, technology must align with lifestyle, habits, and emotional comfort, not just technical efficiency. Additionally, the fact that only 4.18% believed such technologies would not help at all suggests that rejection is not absolute. Rather, many respondents perceive that these tools would not provide enough benefit to justify disruption to existing routines. This supports Wilhite's [2008] argument that energy and domestic practices are deeply socially embedded and not easily changed by technical solutions alone.

The study reinforces the view that smart home adoption is not simply about digital literacy or device availability. It is embedded in broader structures of meaning, such as gendered expectations, cultural norms, domestic roles, and lived experience. The Slovak context illustrates how modernization is negotiated rather than automatic. As Ahas et al. [2019] and Hess et al. [2025] point out, post-socialist societies may want to become "smart," but they do so carefully and selectively.

Conclusions

This article presented preliminary findings from an ongoing quantitative survey on the household management in Slovakia. The results suggest that, despite increasing availability of digital tools, smart technologies are far from universally integrated into domestic life. The reasons for this are multifaceted including economic, cultural, emotional, and gendered aspects.

One of the key limitations of the study is that the sample is not representative of the Slovak population, and no representativeness tests were conducted due to the exploratory and preliminary nature of the research. Data collection is still ongoing, and final conclusions will depend on the completion of this process and subsequent statistical refinement.

Additionally, it must be noted that the questionnaire used in the survey is not primarily focused on smart technology use. Instead, it explores broader dimensions of home management and unpaid domestic work. The section related to smart technologies forms only a limited part of the instrument. This should be considered when interpreting the results and assessing their applicability.

Nevertheless, the study is based on a unique empirical dataset collected in Slovakia, a context underrepresented in current smart home literature. It highlights not only patterns of use, but also reasons for non-use, drawing attention to persistent cultural practices, gender roles, and the limits of technological optimism. The findings confirm that smart home adoption cannot be seen merely as a matter of availability or education but must be interpreted through the lens of household experience, emotional labor, and social norms.

Future research will benefit from a finalized dataset, the inclusion of qualitative follow-up, and possible comparative analysis with other Central and Eastern European

countries to determine whether the observed patterns are specific to Slovakia or more broadly applicable in post-socialist contexts.

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THE IMPACT OF THE DIGITAL ECONOMY ON THE HOUSEHOLD SECTOR IN UKRAINE

Maryna Baldzhy •

Summary

The purpose of this article is to investigate the impact of the digital economy on the household sector, which serves as a key economic actor in Ukraine's economic system. The subject of the study is the role of households in the country's economic development and the integration of digital economy elements into this process. Theoretical perspectives focus on the patterns of interrelation between the development of the digital economy and the functioning of the household sector. Based on the methodology for assessing the state of the household sector, this study explores the influence of the digital economy on the financial behavior of economic agents. The analysis confirms the need to incorporate digital economy elements into the functioning of households, with particular emphasis on the necessity of implementing digital technologies in rural households.

Key words: Ukrainian households, digital economy, economic and financial behavior, household digitalization, rural households.

Streszczenie

Celem artykułu jest zbadanie wpływu gospodarki cyfrowej na sektor gospodarstw domowych, który jest wiodącym podmiotem gospodarczym w systemie gospodarczym kraju. Przedmiotem badań naukowych jest badanie roli gospodarstw domowych w rozwoju gospodarczym Ukrainy i wprowadzenie do tego procesu elementów gospodarki cyfrowej. Perspektywy teoretyczne obejmują wzorce relacji między rozwojem gospodarki cyfrowej a funkcjonowaniem sektora gospodarstw domowych. Bazując na metodologii oceny stanu sektora gospodarstw domowych przeprowadzono badanie wpływu gospodarki cyfrowej na zachowania finansowe podmiotów gospodarczych. Analiza wykazała potrzebę wprowadzenia elementów gospodarki cyfrowej do funkcjonowania gospodarstw domowych, a w szczególności potrzebę wprowadzenia technologii informacyjnych do gospodarstw wiejskich.

Słowa kluczowe: ukraińskie gospodarstwa domowe, gospodarka cyfrowa, zachowania ekonomiczne i finansowe, cyfryzacja gospodarstw domowych, gospodarstwa domowe na obszarach wiejskich.

JEL: D1

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Introduction

In the current stage of Ukraine's economic development, households play a crucial role as leading economic actors. The market-based organization of economic life is structured around the interaction of three primary institutional agents: the state, businesses, and households. Among these, households are central to the market circulation of goods and resources, with their consumption serving as a key indicator of societal well-being. Despite their importance, households remain among the least explored economic agents under modern conditions [Horodniak I. 2016: 13].

Under the influence of digitalization, service provision processes have become more streamlined, leading to substantial changes in service models for citizens. These transformations have affected both households themselves and their financial behavior. The use of modern information technologies accelerates service delivery to households and enhances service quality.

Therefore, the relevance of this issue is evident. Further research should focus on a detailed analysis of the behavioral transformation of Ukrainian households in the context of digitalization, which will enable the modeling of future household behavior.

Literature review and problem statement

The theoretical and applied foundations of household sector development in Ukraine have been explored by various scholars, including prominent sociologists, economists, and financial experts. Consumer motivation and behavior have been studied by I.V. Horodniak [2016], R.D. Blackwell et al. [2005], Ya.S. Laryna [2012], and L.O. Vasylkevych [2010]; the financial component has been addressed by O.S.Shamanska [2015]; and the impact of digitalization on household financial behavior has been examined by M.V. Dubyna, N.I. Kholyavko, O.V. Popelo [2022], as well as O.V. Popelo, N.I. Kholyavko, M.V. Dubyna, A.V. Tarasenko [2022], N.B. Dobryanska [2024], among others. Contemporary research builds on modern global theories of household studies. The new household economics theory, presented in the works of G. Becker, J. Mincer, K. Lancaster, R. Gronau, T. Schultz, and G. Gershuny, includes the following approaches: the "family as a mini-factory" model; time allocation theory; Gronau's model; partner selection theory in the marriage market; the altruistic model of intra-family distribution; specific family capital theory; fertility economic theory; and the sociological version of the new economics—the household strategies theory [Bazylevych 2006].

Within the framework of neo-institutional theory, scholars such as R. Pollak, A. Giddens, J. Hodgson, H. Simon, J. Stiglitz, R. Coase, and H. Demsetz have developed several conceptual models, including: transaction cost reduction; the concept of "moral hazard"; and bargaining models of intra-household resource distribution. These reflect modern approaches that reject the idea of absolute rationality in favor of bounded rationality, consider incomplete, imperfect, and asymmetric information, and challenge the ideality of the market system due to the predominance of transaction costs [Bazylevych. 2006; Bazylevych 2008; Pahl, 1989]. Within this theory, the household is considered a distinct institution and a management structure. Contemporary neo-institutional theorists emphasize an institutional approach to understanding households, which accounts for historical experience, traditions,

customs, economic mentality, systems of power relations, and specifics of property rights [Kataranchuk, 2018: 27].

In Ukrainian legislation, the term "household" appears only in the Law of Ukraine "On Agricultural Census," which defines it as "a group of individuals who live together in a single dwelling or part of it, provide for themselves collectively, run a shared household, and fully or partially pool and spend resources. These individuals may be related by kinship, affinity, neither, or both. A household may also consist of a single individual" [Verkhovna Rada of Ukraine. 2008]. This definition is repeated in the "Glossary of Terms for the National Model of the Activity of State Statistics Bodies" [ukrstat.gov.ua]. Despite the narrow legal definition, statistical data collection includes quantitative assessments of the number of households and their role in the national economy.

The study of household functioning is incorporated into macroeconomics curricula, which examine their functions, consumption and investment behavior, and participation in resource markets. Households are included in circular flow models of resources, goods, and income, which illustrate their interaction with other macroeconomic agents. These models demonstrate the primary interconnections between the household sector and business sector through resource and product markets [Kataranchuk, 2018: 29].

In characterizing the functioning of households operating under modern market conditions in Ukraine, researchers consider a wide range of economic, social, political, and cultural factors. For instance, Yu.Yu. Stankevych [2015] argues that "a household is a complex multi-spatial system that simultaneously exhibits the following characteristics:

1. It is a voluntary association of individuals, typically connected by family or kinship ties, united not only by a common budget and shared goals, but also by cohabitation; sometimes, a household may consist of a single person;
2. It functions as an important economic agent within the market economy, influencing both national prosperity and the moral and spiritual well-being of the population;
3. It has the freedom to dispose of various property rights, including monetary, labor, intellectual, and material resources;
4. It encompasses all types of economic activity, both subsistence and market-based;
5. It acts as a primary source of financial resources for the family budget, addresses issues of population reproduction and individual development within the family, thereby significantly impacting the social development of society;
6. It is built on principles of mutual trust, support, cooperation, education, and the transfer of experience to future generations" [Stankevych, 2015: 48].

Households are not only consumers of goods and services but also engage in various forms of economic activity. Household members make significant contributions to production by operating businesses or engaging in independent professional activity without forming legal entities, or by providing labor to other enterprises as employees. It is generally accepted that household members engaged in individual entrepreneurial activity act not as separate units but on behalf of the entire

household [Kizyma, 2010]. Subsequent research will rely on legislative interpretations of the term "household."

However, contemporary literature largely lacks a systematic approach to studying the impact of the digital economy on the household sector and its long-term consequences, highlighting the need for a more thorough examination of how digital technologies affect household behavior.

The assessment of the state of the household sector under the influence of elements of the digital economy is based on an appropriate methodology. This approach made it possible to study the impact of digitalization on the financial behavior of economic agents. The application of this methodology provides a current overview of the transformation processes occurring in the functioning of households under modern conditions.

Research results

The analysis of the efficiency of Ukrainian households is based on the study of the economic and financial behavior of economic agents as consumers and on the assessment of their welfare. It relies on the investigation of both external and internal environmental factors affecting Ukrainian households, within the framework of methodological approaches to statistical processing.

According to statistical indicators monitored and analyzed using a sample-based methodology [ukrstat.gov.ua] since 2010 and available from open sources until 2021, household consumption behavior depends on the size and structure of their real income (Table 1). Source: Data from 2016 onward exclude temporarily occupied territories of Donetsk and Luhansk regions, as well as the Autonomous Republic of Crimea and the city of Sevastopol. These years are marked with an asterisk (*).

As shown in Table 1, approximately 90% of all household income is received in cash form. The remainder is comprised of the value of consumed products obtained through private subsistence farming, self-harvesting, and other non-cash sources.

Table 1. Dynamics of the size and structure of total household resources in Ukraine, 2010–2021

Indicator	2010	2013	2016*	2018*	2021*
Average monthly total resources per one household, UAH	3481,0	4470,5	6238,8	9904,1	14490,6
Structure of household total resources, %					
Cash income	89,1	90,8	86,0	89,9	93,9
Value of consumed products that were produced at private subsistence	5,0	3,9	4,8	3,8	3,0
Non-cash benefits and subsidies	0,6	0,4	4,7	2,8	0,1
Non-cash benefits	0,5	0,5	0,4	0,4	0,3
Other receipts	4,8	4,4	4,1	3,1	2,7

Source: [ukrstat.gov.ua]

The development of information technologies across all sectors of society has led to the active digitalization of the economy, engaging various economic agents,

including households. Households increasingly utilize digital technologies for personal needs such as education, income generation, self-realization, purchasing goods, and obtaining services.

The financial behavior of digitalized households is characterized by the following: conducting financial transactions via digital devices (smartphones, tablets, etc.); using innovative information technologies (electronic payment systems, payment cards, self-service terminals, ATMs, cashback withdrawals at cashier desks, internet banking, mobile banking, SMS banking, telephone banking, digital insurance); employing cardless payment through mobile applications; predominantly using self-service for financial services; seeking consultations on financial products and services through online communication, including robotic advisors; using online media for constant access to financial services; involving previously excluded household members in financial services (e.g., teenagers, pensioners); preferring cashless transactions; utilizing predominantly remote service formats; increased investment activity by households as non-professional private investors; accelerated, simplified, and optimized decision-making processes for saving and budgeting using FinTech; improved income, expense, and debt management due to seamless account access; simplified monitoring of payments; pragmatic fund allocation; enhanced activity in deposit, credit, and other financial operations; use of new types of financial services; preference for individualized services; personalization of financial services; improved financial literacy [Popelo, Kholiavko, Dubyna, & Tarasenko 2022: 110]; and acquisition of digital competencies and skills.

Household well-being significantly varies depending on objective characteristics such as the number of adults and children in the family (Table 2).

Table 2. Household characteristics in Ukraine, 2010–2021

Indicator	**2010**	**2013**	**2016***	**2018***	**2021***
Average size of household, persons	2,59	2,58	2,58	2,58	2,58
Average size of household per conventional adult, persons	2,12	2,11	2,11	2,11	2,10
Households, by number of persons within it (%)					
one person	23,4	22,6	19,7	19,7	18,2
two persons	28,3	29,1	32,3	32,8	35,4
three persons	25,5	26,9	26,9	26,5	26,6
four persons and more	22,8	21,4	21,1	21,0	19,8
Share of households with children under 18 years old	37,9	38,0	38,2	37,8	37,8
Share of households without children	62,1	62,0	61,8	62,2	62,2
Households with children (%), by number of children within it					
one child	72,6	75,4	76,0	75,1	79,3
two children	23,4	22,4	21,4	21,4	18,8
three children and more	3,0	2,2	2,6	3,5	1,9

Source: [ukrstat.gov.ua].

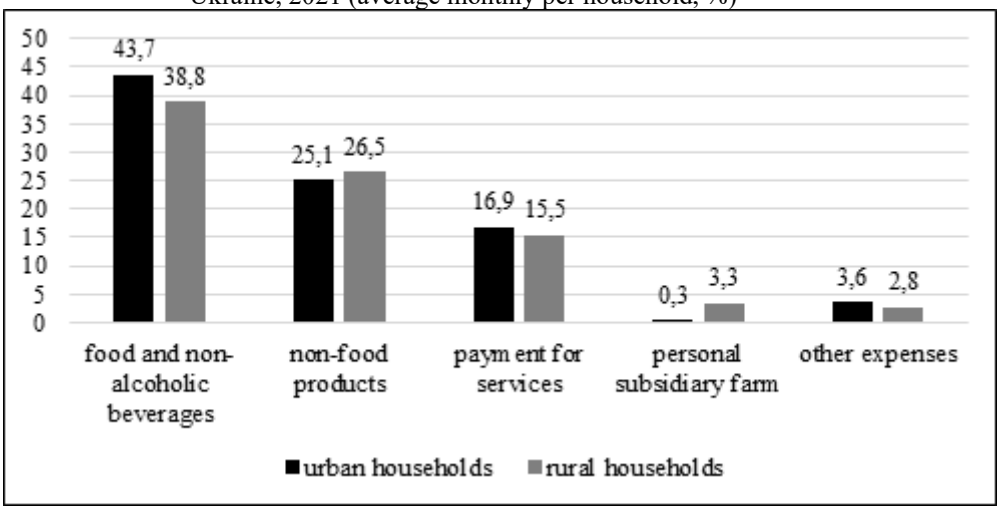
Household digitalization often depends on the presence of children, as it may begin with the educational process. At the same time, an increase in the number of children in a family may reduce its financial capacity, potentially leading to limited use of digital technology.

Nonetheless, the development of digital technologies has opened a new "window of opportunity" for improving household welfare and enhancing the quality of life for household members. Through digital technologies, household members in Ukraine can more easily capitalize on their knowledge, skills, and competencies to improve their financial standing — for instance, by creating, developing, and selling their ideas, products, and services via online platforms, digital personal avatars, or bots without intermediaries or employers; and by conveniently starting businesses from scratch and monetizing their creative and intellectual potential.

According to the data, rural households spend significantly less than urban ones, except for non-food items and expenditures related to maintaining subsistence farming. This disparity may be due to the limited availability of innovation-driven services in rural areas. For example, in 2021, rural households spent more on transportation and communication (+3.0% and +0.6%, respectively), as well as on education and cultural recreation (+0.9% and +1.1%, respectively).

Digitalization has also significantly affected rural households. There is a notable difference in expenditures between rural and urban households (Diagram 1).

Diagram 1. Structure of household monetary expenditures in urban and rural areas of Ukraine, 2021 (average monthly per household, %)



Source: [ukrstat.gov.ua].

Household financial behavior is strongly influenced by trends in the development of the digital economy and the widespread adoption of digital technologies in decision-making processes. These trends enhance access to financial products, accelerate decision-making, and give rise to new risks, ultimately affecting the nature of financial behavior and the structure of household expenditures (Table 3).

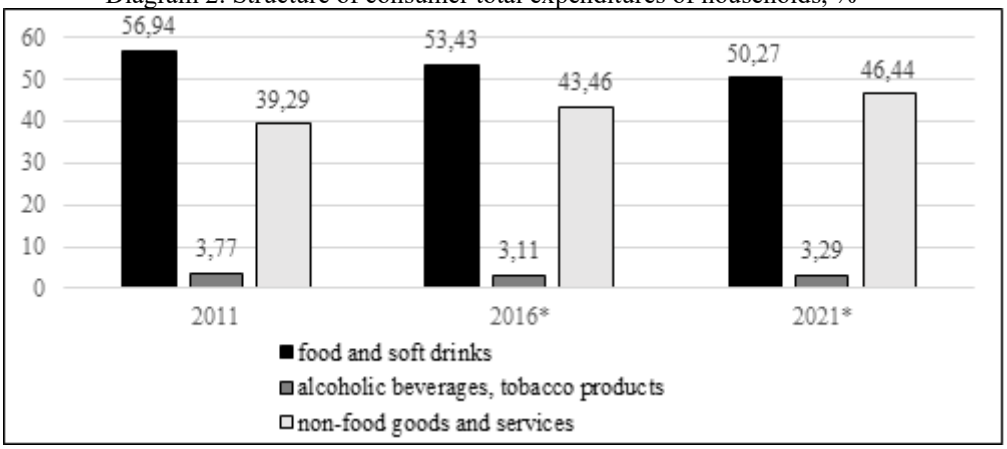
Table 3. Average monthly household expenditures and their structure in Ukraine, 2011, 2016, and 2021, %

Expenditures	2011	2016*	2021*
Середні витрати за місяць у розрахунку на одне домогосподарство, грн.	3458,0	5720,4	11243,4
	100%	100%	100%
Споживчі сукупні витрати, %	90,1	93,2	91,3
Неспоживчі сукупні витрати, %	9,9	6,8	8,7

Source: [ukrstat.gov.ua].

A leading role belongs to consumer total expenditures, which include food, non-food items such as clothing and footwear; housing, water, electricity, gas, and other fuels; household equipment, appliances, and maintenance; healthcare; transport; communication; recreation and culture; education; restaurants and hotels; and various goods and services. Non-consumer total expenditures demonstrate variability, comprising 9,9% in 2011; 6,8% in 2016, and 8,7% in 2021.

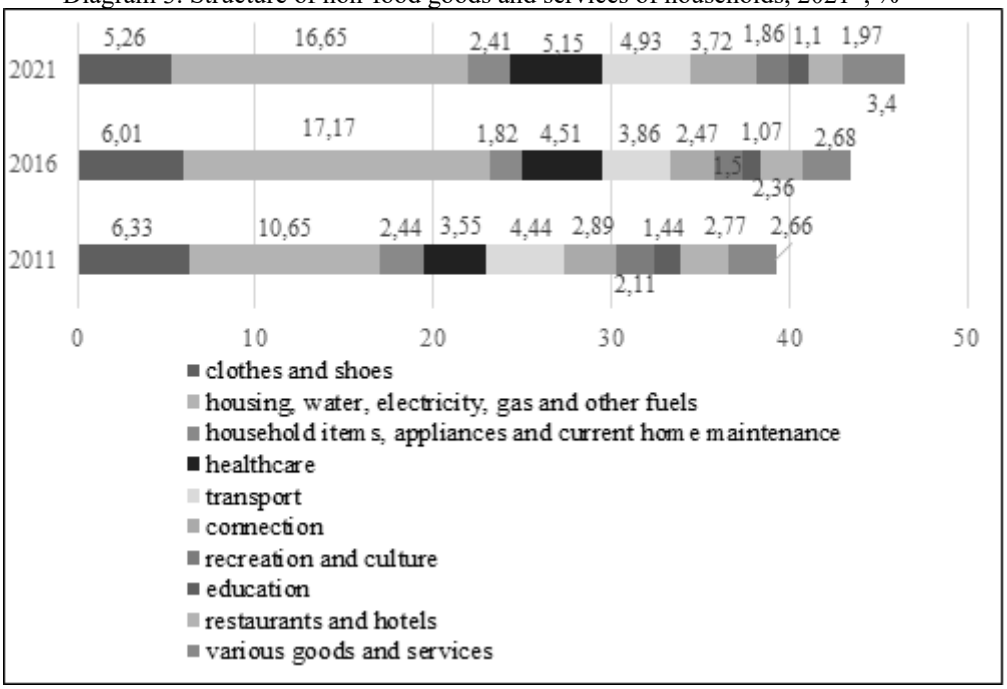
Diagram 2. Structure of consumer total expenditures of households, %



Source: State Statistics Service of Ukraine

The largest share of total average monthly expenditures per Ukrainian household is accounted for by food and non-alcoholic beverages. However, this share has gradually decreased (from 56.94% in 2011 to 50.27% in 2021) in favor of increased spending on non-food goods and services, which rose from 39.29% to 46.44%, respectively.

Diagram 3. Structure of non-food goods and services of households, 2021*, %



Source: State Statistics Service of Ukraine

Changes in the structure of non-food goods and services reflect significant trends characteristic of the digital economy. Against the background of declining service costs delivered via the global network, their quantity and scope are increasing. Accordingly, the share of expenditures on communication grew (from 2.89% in 2011 to 3.72% in 2021), as did spending on various goods and services (from 2.66% to 3.40%, respectively), which includes internet access and the purchase of necessary equipment.

Currently, Ukraine is experiencing an active manifestation of digital economy trends, characterized by the emergence of various innovations and the rapid spread of information technologies. Ukrainian households increasingly use payment cards, ATMs, self-service terminals, and mobile applications, which eliminate the need for direct contact with financial institution staff and enable independent financial operations, including cashless transactions. The popularity of these tools continues to grow due to faster service delivery. In 2018, the share of internet users in Ukraine stood at 58%, increasing to nearly 72% by 2022 [surl.li/ieohjo]. This dynamic was driven not only by the rapid development of the digital economy but also by the COVID-19 pandemic and russia's military aggression against Ukraine. These factors led to increased internet usage, a heightened need for constant news monitoring, the use of alternative service and communication channels, and efficient business operations.

Overall, it is worth noting that households engaged in economic activity are currently addressing the following strategic objectives to maintain competitive positions and digitize their operations:

− First, establishing closer relationships with suppliers and customers;
− Second, enhancing their own operational efficiency;
− Third, improving the quality of produced goods.

It is evident that fulfilling all three tasks is impossible without integrating information systems and digital technologies into household economic activity. Hence, there is a growing need to create online sales platforms (e-commerce) and adopt innovative internet solutions, which help reduce costs and maintain revenue at least at a minimal level.

Table 4. Digital technologies for use in households

Digital technologies and tools	Application in household economic activity
Supply ChainManagement (SCM)	Supply chain management is the coordination of a business' entire production flow, from sourcing raw materials to delivering a finished item. The global supply chain is a complex network of suppliers, manufacturers, distributors, retailers, wholesalers and customers [surli.cc/zrfsea].
Customer Relationships Management (CRM)	CRM (customer relationship management) is the combination of practices, strategies and technologies that companies use to manage and analyze customer interactions and data throughout the customer lifecycle. The goal is to improve customer service relationships, assist with customer retention and drive sales growth [surl.li/vftdfy].
Business processmanagement (BPM)	A management approach in which activities are viewed as a set of interrelated processes aimed at delivering a target outcome (product or service) that provides value to the consumer and generates income overall. The result of the activity is assessed not by the quality of individual functions performed by each unit of the organization, but by the overall outcome achieved through the execution of all functions across the entire value chain [surl.lu/fnezzc].
Social media marketing (SMM)	The strategic use of social platforms to achieve household goals, including networks such as Facebook, Twitter, Instagram, and others [salo.li/e0F2014].

Source: compiled by the author.

Modern Ukrainian households possess all the necessary capabilities and prerequisites for actively utilizing advanced information and communication technologies in their activities. This is enabled by simplified business processes, operational flexibility, rational cost structures, established client communication, and strong motivation.

Conclusion

Digitalization enables broad population engagement in new types of entrepreneurial activity, stimulating economic development and facilitating the implementation of programs aimed at improving well-being and reducing poverty. The use of new technologies helps to overcome one of the main drawbacks often attributed to social programs—namely, the provision of aid rather than education

[Blackwell R.D., Miniard P.W. & Engel J. F. 2005]. For any initiative to have a long-term and sustainable impact, it must be used beyond the implementation period.

Moreover, digitalization can foster the development of small businesses, which is recognized as one of the key drivers of long-term economic growth. When combined with improved financial behavior of households, it becomes feasible to integrate wider population groups into the economic and social fabric.

Household digitalization also has a positive influence on various societal aspects. It offers educational opportunities, alternatives to traditional employment, sources of additional income, and enhances the accessibility of goods and services.

To broaden the scope of services available to users of information technologies, an effective system for ensuring digital literacy and competence has been developed, particularly for rural residents. This includes the use of modern digital tools. The creation of a unified information space for rural households provides an opportunity for comprehensive use of digital information resources.

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THE LEVEL OF HOUSEHOLD DIGITALIZATION IN THE AGE OF DIGITAL TRANSFORMATION WITH A FOCUS ON POLAND AND LITHUANIA

Marlena Piekut [•]
Marina Valentukevičienė [†]

Summary

Digital transformation is a key pillar of EU development, shaping industry, services, and citizens' daily lives. This chapter examines the level of household digitalization in selected European countries, focusing on e-commerce, internet banking, and e-government services. A comparative analysis of Eurostat data (2013–2024) combined with k-means clustering was used to classify countries by their digital maturity. The study also reviews EU, Polish, and Lithuanian regulations on digital public and commercial services. Results show marked regional disparities: Lithuania excels in internet banking and e-government due to consistent digital policies and advanced identification tools, while Poland records higher e-commerce use. The clustering analysis identified five distinct digital development models among European states.

Key words: e-commerce, internet banking, e-government, Poland, Lithuania, household digitalization, public policy, CEE countries

Streszczenie

Transformacja cyfrowa stanowi jeden z filarów strategii rozwoju UE, wpływając coraz bardziej na sektor usług i przemysłu i na codzienne życie obywateli. Celem rozdziału jest identyfikacja i ocena poziomu cyfryzacji gospodarstw domowych w wybranych państwach europejskich w obszarach e-commerce, bankowości internetowej i e-administracji. Zastosowano analizę porównawczą danych Eurostat z lat 2013–2024 i analizę skupień metodą k-średnich (klasyfikacja państw według poziomu cyfrowego zaawansowania). Uzupełnieniem badania jest przegląd regulacji prawnych UE, Polski i Litwy dotyczących cyfrowych usług publicznych i komercyjnych. Wyniki wskazują na istotne zróżnicowanie regionalne w zakresie korzystania z usług cyfrowych. Litwa osiąga wyższe wskaźniki w zakresie bankowości internetowej i e-administracji, co jest efektem spójnej polityki cyfrowej i zaawansowanych narzędzi identyfikacji. Polska przewyższa Litwę w zakresie e-zakupów. Analiza skupień pozwoliła wyodrębnić pięć typów cyfrowych modeli krajów europejskich.

Słowa kluczowe: e-zakupy, bankowość internetowa, e-administracja, Polska, Litwa, cyfryzacja gospodarstw domowych, polityka publiczna, Europa Środkowo-Wschodnia.

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Introduction

The digital transformation is one of the key priorities of the European Union's policy agenda through 2030, increasingly impacting not only the industrial and service sectors, but also the everyday lives of citizens and households. The rapid development of online services such as e-commerce, online banking, and e-government requires not only access to digital infrastructure, but also adequate skills and trust in institutions. At the same time, the rising costs of transformation and disparities in access to digital resources exacerbate social inequalities, making the issue of household digitalization particularly important from a socio-economic policy perspective [Bouzarovski, Thomson & Cornelis, 2021; Helsper, 2017; Van Deursen, 2020].

Despite a growing body of research on digitalization, there is still a lack of analyses that integrate a microeconomic perspective with a comparative approach between Central and Eastern European countries, which tend to be more vulnerable to external transformational shocks and exhibit significant institutional diversity [Roztocki et al., 2019]. The research gap particularly concerns an integrated examination of three key areas of digital services—online shopping, online banking, and e-government—in terms of their availability, usage, and country-specific determinants. Existing studies often treat these areas separately or focus exclusively on Western European countries [Stângaciu et al., 2024; Păuceanu et al., 2023; Grigorescu et al., 2023; Androniceanu & Georgescu, 2021].

The aim of this chapter is to identify and assess the level of household digitalization in European countries, with particular emphasis on Poland and Lithuania, in the context of their use of e-commerce, online banking, and e-government services. The article compares the dynamics and structure of the digital transformation in these two countries and their position relative to other EU member states. The use of the k-means cluster analysis method to classify European countries according to their level of digitalization allows for the identification of different types of digital societies in Europe and the positioning of Poland and Lithuania within this typology.

The structure of the chapter includes: a literature review on the definition and scope of digital transformation, an analysis of the legal frameworks in Poland and Lithuania, the research methodology, presentation and interpretation of empirical findings. The chapter concludes with a summary and recommendations for public policy and future research directions.

Literature review

Digitalization and Digital Transformation – Definitions, Scope, and Interpretations

In the academic literature, *digitization* is most commonly understood as a technical process involving the conversion of analog data, resources, or processes into a digital form. It refers to the transformation of data—such as documents, images, or signals—into a digital format that enables their storage, processing, and transmission through information and communication technologies (ICT) [Brennen & Kreiss, 2016; Tilson et al., 2010].

However, digitization is a narrower concept than *digital transformation*—it constitutes a necessary technical condition for transformation but is insufficient for structural change. *Digital transformation*, as described in the literature, is a complex, multidimensional process of change that encompasses not only technology but also operational models, social relationships, organizational structures, culture, and consumer behavior [Vial, 2019; Verhoef et al., 2021]. It is therefore not merely about implementing new technologies, but about fundamentally reshaping how institutions, organizations, and societies operate.

Recent scholarship increasingly emphasizes that digital transformation is not a one-time event but an evolutionary process that unfolds unevenly, depending on technological resources, digital skills, and public policies [Bharadwaj et al., 2013; Legner et al., 2017].

Digital transformation affects many areas of life. The literature identifies, among others, the following dimensions:

- Technological – the introduction of technologies such as cloud computing, IoT, big data, AI, and blockchain [Garcia Altafin et al., 2025],
- Social – changes in social relationships, work, education, consumption, and healthcare [Wojtynia et al., 2023],
- Economic – the growth of the digital economy, e-commerce, digital platforms, and on-demand services [Manyika et al., 2016],
- Institutional and political – changes in the structure of public services (e-government, digital state), access to data, and the issue of digital citizenship rights [Mergel et al., 2019].

While early research focused primarily on organizations and enterprises, there is a growing body of studies examining the impact of digital transformation on the daily lives of citizens. In the context of households, this transformation entails increasing expenditures on digital infrastructure (internet access, devices, software), changes in modes of work (remote work), education (e-learning), and services (e-health, online banking), a growing importance of digital skills, and the risks of digital exclusion [Helsper, 2017]. It also involves changes in consumption patterns—from streaming platforms to subscription-based services. As Van Deursen [2020] notes, unequal access to digital resources leads to a new form of social inequality: *second-level digital inequality*, related to the quality and proficiency of technology use.

The challenges and inequalities identified in the literature as arising from digital transformation at the household level have not gone unnoticed by public policy. In particular, the European Union and its member states—including Poland and Lithuania—are undertaking a range of initiatives aimed at fostering an inclusive and sustainable digital transformation.

Digital Transformation in Public Policies of the EU, Poland, and Lithuania

In EU documents such as *The Digital Decade Policy Programme 2030*, digital transformation is viewed as a key driver of socio-economic development. In particular, the EU promotes universal access to broadband internet, the development of e-government services, the improvement of digital skills, and the sustainable development of digital infrastructure [European Commission, 2021]. Digital transformation is also closely linked to the green transition—digital technologies are

used to optimize energy consumption (e.g., smart grids), monitor environmental conditions, and support low-emission transport [Lom et al., 2016].

Within the broader context of digital transformation, three areas are of particular importance: online shopping (e-commerce), online banking (digital finance), and e-government. Each of these sectors is subject to both EU regulations and national laws implementing those directives and regulations.

E-commerce in EU, Polish, and Lithuanian Legislation

The European Union has long developed a legal framework to ensure consumer protection and the efficient functioning of the digital market. Key legal instruments governing e-commerce include:

1. Directive 2011/83/EU on consumer rights, which sets out online sellers' information obligations, the 14-day right of withdrawal, and rules on additional charges and delivery;
2. Directive 2000/31/EC on electronic commerce (the "e-Commerce Directive"), which regulates the provision of online services across the EU, including liability rules for internet service providers and transparency requirements;
3. Regulation (EU) 2018/302 on geo-blocking, which prohibits unjustified discrimination based on nationality, residence, or establishment;
4. Regulation (EU) 2019/1150 (P2B Regulation) on promoting fairness and transparency for business users of online intermediation services, ensuring platform transparency and algorithmic ranking disclosures.

In Poland, these EU rules have been implemented primarily through three national acts:

1. The Act of 30 May 2014 on Consumer Rights (Journal of Laws 2020, item 287), which implements Directive 2011/83/EU. It includes detailed provisions on distance contracts, mandatory information obligations, withdrawal rights, and the return of goods;
2. The Act of 18 July 2002 on the Provision of Electronic Services (Journal of Laws 2020, item 344), which regulates service providers' obligations, commercial communication, and intermediary liability;
3. The Act of 16 February 2007 on Competition and Consumer Protection (Journal of Laws 2023, item 1689), which enables the Office of Competition and Consumer Protection (UOKiK) to combat unfair market practices and enforce rules on geo-blocking and platform-consumer relations.

In Lithuania, e-commerce legislation is primarily based on the transposition of Directives 2011/83/EU and 2000/31/EC. Specifically:

- The Civil Code of the Republic of Lithuania (LR Civilinis kodeksas) contains provisions on distance contracts, including electronically concluded agreements, with detailed rules on the right of withdrawal, seller information obligations, and liability for non-performance (Articles 6.228–6.228[10]);
- The Law on Consumer Rights Protection (LR Vartotojų teisių apsaugos įstatymas) sets out consumer protection principles in e-commerce transactions. The supervising authority is the State Consumer Rights Protection Authority (Valstybinė vartotojų teisių apsaugos tarnyba);

- The Law on Information Society Services (LR Informacinės visuomenės paslaugų įstatymas) transposes the e-Commerce Directive and regulates electronic service provision, intermediary liability, and online advertising rules.

Lithuania has also actively implemented the geo-blocking and P2B Regulations (EU 2018/302 and 2019/1150), aligning its law with EU standards for platform-business relationships.

In comparing legal frameworks, Lithuania has a more centralized oversight structure for the e-commerce market, with a single specialized authority (Valstybinė vartotojų teisių apsaugos tarnyba) overseeing compliance. In Poland, supervision is more fragmented, involving institutions such as UOKiK and the Trade Inspection. Moreover, Lithuania has adopted clearer regulations implementing Regulation 2018/302 and has actively promoted cross-border online commerce. Poland has taken a more conservative approach, with limited educational outreach to businesses on these obligations.

Online Banking (Digital Finance) in EU, Polish, and Lithuanian Legal Frameworks

In EU law, the digital financial services sector is governed by several key regulations:

1. PSD2 – Directive (EU) 2015/2366 on payment services, which introduced *open banking*, allowing third-party access to bank accounts with user consent and enhancing transaction security through strong customer authentication (SCA);
2. eIDAS Regulation (EU) 910/2014, which enables the use of electronic signatures in financial contracts and establishes a unified digital identity framework;
3. GDPR – Regulation (EU) 2016/679, which governs the processing of personal data, including in online financial services.

In Poland, the PSD2 directive has been implemented through:

- The Act of 19 August 2011 on Payment Services (Journal of Laws 2023, item 556), which defines banks' obligations, SCA requirements, and the operation of third-party providers (TPPs);
- Secondary legislation and regulations issued by the Polish Financial Supervision Authority (KNF), which outline technical and organizational requirements for online banking security;
- The Banking Law Act of 29 August 1997 (Journal of Laws 2023, item 2488), which regulates remote account and credit agreements, including the use of electronic signatures and video verification.

In Lithuania, digital banking operates under national laws that implement PSD2 and regulate financial market operations:

- The Law on Payment Services (LR Mokėjimo įstatymas) transposes PSD2 and sets detailed rules on strong customer authentication (SCA), third-party access to bank accounts, and fee transparency;
- The Law on Credit Institutions (LR Kredito įstaigų įstatymas) governs banking activities, including online services. The Bank of Lithuania (Lietuvos bankas) acts as the financial market regulator and enforcer of cybersecurity and open banking standards. It also provides a regulatory sandbox for fintechs;

- The Law on Electronic Identification and Trust Services (LR Elektroninės atpažinties ir elektroninių paslaugų įstatymas) implements the eIDAS Regulation and enables the use of qualified electronic signatures in contracts with financial institutions.

In comparison, Lithuania has established itself as a regional fintech hub thanks to fast-track licensing procedures and an active regulatory policy by the Bank of Lithuania. The country offers a regulatory sandbox, facilitating the testing of innovative business models. In contrast, Poland takes a more cautious approach to licensing fintech firms. Its regulatory framework is less flexible toward new business models, resulting in a smaller number of registered e-payment providers compared to Lithuania.

E-Government in EU, Polish, and Lithuanian Legal Frameworks

At the EU level, e-government is supported by two key legal acts: 1) Directive (EU) 2016/2102 on the accessibility of websites and mobile applications of public sector bodies, which requires public institutions to design digital services in line with accessibility standards, particularly WCAG 2.1; 2) The eIDAS Regulation (EU) No 910/2014, which enables the cross-border recognition of electronic identification means and trust services (e.g., electronic signatures, seals, and electronic delivery services).

In addition, the European Interoperability Framework—reinforced by initiatives under the *Digital Europe* programme—aims to establish common rules for data exchange between public authorities and across EU member states.

In Poland, the development of e-government is regulated by several key legislative acts: 1) The Act of 17 February 2005 on the Informatization of the Activities of Entities Performing Public Tasks (Journal of Laws 2023, item 57), which establishes obligations for public entities to provide online services, ensure system interoperability, and implement trust services; 2) The Act of 18 November 2020 on Electronic Deliveries (Journal of Laws 2023, item 285), which introduces e-deliveries as the default method of communication between citizens and public administration; 3) The Act of 4 April 2019 on Digital Accessibility of Public Sector Websites and Mobile Applications (Journal of Laws 2019, item 848), which transposes Directive 2016/2102 and mandates compliance with WCAG 2.1 standards.

Key digital infrastructure in Poland includes ePUAP, mObywatel, and CEIDG, which are legally grounded and form the core of public administration's digital ecosystem.

In Lithuania, e-government development has been strategically implemented through a cohesive legal and institutional framework. The main legislative acts in this area include:

- The Law on the Development of the Information Society (LR Informacinės visuomenės plėtros įstatymas), which provides the legal foundation for implementing e-government services and defines the responsibilities of institutions involved in public sector digitization;
- The Law on Electronic Identification and Trust Services, which forms part of the eIDAS implementation and regulates the use of electronic signatures, seals, and electronic delivery in public administration;

- The Law on the Accessibility of Public Information (LR Viešosios informacijos prieinamumo įstatymas), which transposes Directive 2016/2102 and obliges public institutions to ensure the digital accessibility of websites and mobile apps according to WCAG 2.1.

In practice, Lithuania has implemented a wide range of digital public services through the ePILIS portal (Elektroninės valdžios vartai) and the Mobile-ID system, which allows citizens to authenticate themselves in administrative and financial systems using a mobile phone.

These legal frameworks—both at the EU and national levels—not only enable the secure and efficient functioning of e-commerce, digital finance, and e-government, but also contribute to enhancing user trust in the digital environment, harmonizing services across the Single Market, and ensuring the effective enforcement of digital civil rights.

Comparative Perspective: Poland vs. Lithuania

A comparative assessment shows that Lithuania has implemented a more integrated and centralized citizen identification system (Mobile-ID), which supports a wide array of services including e-banking, e-health, and e-tax systems. In contrast, Poland operates several parallel systems—such as Profil Zaufany, mObywatel, and the electronic ID (e-dowód)—which may be less intuitive for end-users.

On the other hand, Poland adopted a dedicated law in 2019 addressing the digital accessibility of public institutions, specifying concrete obligations for the accessibility of public websites. Lithuania, by contrast, has limited its implementation to the minimum requirements of Directive 2016/2102.

It is also worth noting that Lithuania stands out as a regional leader in Central and Eastern Europe in terms of digital innovation in banking and the integration of e-government with digital identity, as exemplified by Mobile-ID and the rapid development of its fintech sector. Poland, meanwhile, boasts a highly developed e-commerce ecosystem, with a large number of online stores and advanced logistics solutions (e.g., parcel lockers), but still faces challenges in achieving greater coherence and interoperability across its e-government systems.

Methodology of the Study

In order to analyse the development of digital services in European countries between 2013 and 2024, a quantitative approach was employed, based on the analysis of secondary data derived from official sources and international statistical databases, particularly Eurostat.

The study focused on three key areas of service digitization:

1. Online shopping – the share of individuals purchasing goods or services online as a percentage of the total population;
2. Internet banking – the percentage of citizens using online banking services in the past 12 months;
3. E-government – the proportion of people who accessed public administration services via electronic means.

These indicators were analysed in both cross-sectional (for 33 European countries in 2024) and dynamic terms (changes over the period 2013–2024). This

approach enabled the identification of general trends as well as regional differences in the digitization of services.

In the first stage of the study, a statistical and comparative analysis was conducted using data for individual countries from 2013 to 2024. Special attention was given to Poland and Lithuania, as two countries with a similar starting point but different trajectories in the development of digital services. Comparing their results allowed for a more in-depth exploration of the factors influencing the effectiveness of implementing both public and commercial e-services.

In the second stage, in order to classify European countries by their level of digitization, the k-means clustering method was applied. This technique allows for grouping observations (in this case, countries) into clusters based on similar values for selected variables. The clustering analysis used three variables: 1) the share of online shoppers in 2024, 2) the percentage of citizens using internet banking in 2024, 3) the percentage of citizens accessing e-government services in 2024.

Prior to conducting the k-means clustering, a Ward's hierarchical clustering method was used to determine the optimal number of clusters. The number of clusters was established based on a dendrogram. The clustering analysis made it possible to distinguish five distinct groups of countries, differing in the level and characteristics of digital development. This classification enabled a comparison of national digital profiles and the identification of leaders and laggards in the digital transformation process across Europe.

The analysis also incorporated desk research, including a review of relevant academic literature and strategic policy documents on the digitization of services in Europe.

Results

Trends in the Digitization of Online Shopping (2013–2024)

In most EU countries, a steady increase in the share of individuals purchasing online has been observed. For the EU-27, this indicator rose from 43% in 2013 to 72% in 2024, marking an increase of over 28 percentage points over 11 years. The leaders in digital shopping in 2024 included: Ireland – nearly 95% of people made online purchases, The Netherlands – 94%, Norway and Denmark – 91% each, Sweden – 88%, Finland – 79%.

These countries are characterized by high internet penetration and well-developed e-commerce infrastructure.

In contrast, countries with the lowest levels of online shopping included: Turkey – 47%, Albania – 38%, Serbia – 60%, Bosnia and Herzegovina – 44%.

Although these countries have also experienced growth, their levels remain significantly below the EU average. In high-performing countries (above 80%), the growth rate has slowed in recent years, suggesting market saturation and that the maximum potential user base has nearly been reached.

In this context, Lithuania and Poland offer an interesting comparative case. Despite having similar starting points, Lithuania was somewhat quicker and more effective in implementing tools and infrastructure to support e-commerce. In 2013, only 26% of Lithuanians and 32% of Poles engaged in online shopping. By 2024, these rates had increased to 64% in Lithuania and 67% in Poland.

Although Poland slightly surpassed Lithuania in absolute terms in recent years, Lithuania demonstrated a more consistent and dynamic growth trajectory, particularly between 2015 and 2020, when the share of online shoppers in Lithuania rose by over 20 percentage points, reaching 54% in 2020, compared to 61% in Poland.

It is also worth noting that both countries in 2024 remain below the EU average and significantly behind the top performers.

The pace of digital transformation accelerated significantly after 2019, likely influenced by the COVID-19 pandemic (2020–2021), which boosted the popularity of online shopping. Differences between EU countries are gradually narrowing, yet significant disparities remain between Western and Eastern Europe. In more developed countries, the e-commerce market is reaching maturity, and future growth is expected to depend more on increasing shopping frequency than on onboarding new users.

Despite considerable progress in the digitization of commerce, both Poland and Lithuania still hold growth potential, especially in terms of: digital literacy education, enhancing consumer trust, and expanding e-commerce logistics infrastructure.

Trends in the Use of Electronic Banking in Europe (2013–2024)

Over the past decade, the use of electronic banking (e-banking) in Europe has shown a clear upward trend, albeit with significant regional differences. Eurostat data from 2013 to 2024 not only reveal the overall development of digital services in the financial sector but also allow for the identification of distinct groups of countries based on the level of e-banking adoption.

Countries such as Norway, Denmark, Finland, the Netherlands, Sweden, and Iceland have consistently reported the highest rates of e-banking use – with over 90% of citizens declaring its use in the last 12 months already in the early 2020s. In 2024, Norway reached nearly 97% e-banking users, Denmark – 98%, Finland – 95%, and the Netherlands – 96%.

Lithuania belongs to the group of countries with a dynamically growing level of e-banking use. In 2013, over 46% of Lithuanians used e-banking, rising to nearly 80% in 2024, representing almost a twofold increase. Lithuania's growth rate exceeded the EU average – the EU-27 reached 67.2% in 2024. Similar trends are observed in the Czech Republic, which increased from 42% in 2013 to 84% in 2024, also placing it among the leading developing countries in Central and Eastern Europe.

Poland also recorded growth in e-banking usage – from 32% in 2013 to 57% in 2024. However, the growth pace was slower than in the Baltic states or the Czech Republic. In 2024, Poland remained below the EU average (67%) and lagged significantly behind Lithuania and Latvia (both at 85%).

Possible reasons for this difference include the uneven availability of digital services at the local level (e.g., digital exclusion in rural areas), a lower level of social trust in digital banking services, and a slower development of e-administration in the early years of the decade, which often correlates with e-banking growth.

At the other end of the spectrum, countries such as Bulgaria (31% e-banking users in 2024) and Romania (28%) have only recently accelerated the development of electronic banking services. Their low rates over many years have kept the EU average relatively lower.

Both Poland and Lithuania are countries in Central and Eastern Europe, but they differ markedly in the pace of digitization of banking services. Lithuania is approaching the level of Scandinavian countries, while Poland remains in the medium usage group. This disparity may affect the pace of fintech and digital economy development, the availability of e-public services (due to links with e-identification and e-banking), and the level of citizens' digital competencies.

The analysis shows that Lithuania is an example of successful digitization of financial services in the region, while Poland, despite progress, still remains below the EU average. Further development of electronic banking in Poland requires enhancing digital skills, expanding infrastructure, and promoting security and trust in online services. However, both countries can benefit from the common EU policy on digital transformation and cross-border service integration (e.g., eIDAS system, open banking).

Use of E-Government Services

Moving on to the use of functionalities offered to citizens by public administration (e-government), in 2013 only 42% of EU citizens used e-government services, and by 2024 this number increased to 56%. The growth was gradual, with acceleration during 2019–2021 (the pandemic period), but after 2021 there was slight stagnation and even a decline to 51% in 2022, which may be due to methodology or changes in user behavior.

The leaders in e-government in 2024 were: Denmark – 95% of citizens using e-government, Norway and Finland – both at 90%, and Estonia – 81%. These Nordic and Baltic countries consistently rank among the leaders in digital administration, offering a wide range of e-services, well-integrated ID systems, and a high level of trust in public institutions.

Countries showing strong growth during the analyzed period include Hungary, Latvia, Portugal, Ireland, Cyprus, and Albania. These countries implemented several digital reforms in recent years (e.g., eID, simplified government portals), yielding visible effects.

On the other hand, countries with a low level of e-government usage are Romania (18%), Bulgaria (25%), and Montenegro (26%). Reasons may include low penetration of digital services, low social trust, or lack of widespread eID implementation.

Poland has relatively low e-government usage rates and ranks in the lower part of the EU standings despite some progress. Lithuania shows significantly better results, comparable to Scandinavian and Western European countries. Poland could draw inspiration from Lithuania regarding the efficiency of digital public services, digital education, and encouraging citizens to use e-services.

Digitization of administration in Europe shows an increasing trend, but the pace and level vary significantly between countries. Leaders focus on service integration, ease of use, and trusted login systems. Countries with low results should focus on digital education, improving services, and increasing citizen trust.

Groups of European Countries by Digitalization Level of Services

Based on a k-means cluster analysis conducted for 33 European countries, considering three indicators — the share of people making online purchases, using online banking, and e-government services — five groups of countries with different levels of digital advancement were identified.

The first group, called "moderate users" (n=9), includes countries such as Poland, Germany, Italy, and Slovakia. These countries feature moderate levels of online shopping (on average 65–75%) and relatively low shares of citizens using online banking and e-government. For Poland, the indicators are: online shopping – 67%, online banking – 57%, e-government – 43%. The particularly low use of digital administration services may indicate institutional barriers and limited trust in public digital services.

The second group, called "digitally advanced" (n=12), includes countries like Lithuania, Czech Republic, Belgium, Estonia, and Spain. These countries are characterized by a high share of online banking users (often above 80%) and relatively developed e-government systems. For example, Lithuania's results are: online shopping – 64%, online banking – 80%, e-government – 69%. Although the share of online shoppers is not the highest, the very high level of use of administrative and financial online services indicates effective implementation of digital public sector strategies.

The third group, called "digitally delayed countries" (n=6), mainly consists of Southeastern European countries such as Bulgaria, Romania, and Serbia. These countries exhibit low levels across all analyzed indicators. For instance, in Romania only 28% of citizens use online banking, and merely 18% use e-government.

The fourth group comprises "digital leaders" (n=5), such as Denmark, Netherlands, Sweden, Finland, and Ireland, who achieved the highest indicators in all three categories. For example, in Denmark 98% of the population uses online banking and 95% use e-government services. These countries represent a model of highly integrated and widely accessible digital infrastructure.

Albania and Turkey form a separate group, called "atypical cases" (n=2), due to inconsistent indicators – despite low online banking usage (below 40%), both countries achieve relatively high scores in e-government usage (Albania – 68%, Turkey – 70%). This may suggest a prioritization of implementing digital public services regardless of overall societal digitalization levels.

Discussion

The results of the conducted analyses indicate significant differences in the level of digitalization between European countries, especially between Poland and Lithuania, despite their similar geopolitical context and membership in the European Union. The quantitative studies confirmed that Lithuania achieves clearly higher rates of internet banking usage (80%) and e-government usage (69%) than Poland (57% and 43%, respectively). At the same time, Poland surpasses Lithuania in the share of citizens making online purchases, although this difference is not significant (67% versus 64%).

The applied k-means cluster analysis enabled the classification of European countries according to their level of digital advancement and confirmed that Poland

belongs to the group of "moderate users," whereas Lithuania falls into the category of "digitally advanced." These results correspond with earlier findings in the literature, pointing to the success of Lithuania's strategic approach to the digitalization of public administration and the financial sector [OECD, 2023; Twizeyimana & Andersson, 2019]. Lithuania's case confirms that a coherent and consistent "digital-by-design" policy and strong integration of services with digital identity (Mobile-ID) translate into high adoption of digital services by society.

In contrast, Poland—despite implementing advanced technological tools such as the mObywatel app and Trusted Profile—has not achieved similarly high levels of service utilization. This may indicate insufficient transparency, usability, and trust in public institutions, as also highlighted in studies by Roztocki et al. [2019] and Bélanger and Carter [2008]. This supports the thesis that the key factor is not the mere presence of digital infrastructure but its integration with the needs and expectations of citizens.

A critical analysis of the obtained results also points to the limitations of the applied method. Although cluster analysis allowed for typology of countries, it did not capture qualitative aspects of digital service usage—such as user satisfaction, interface intuitiveness, or the level of digital security. The used indicators (user shares) are quantitative in nature and do not reflect the full complexity of the phenomenon. It would be worthwhile to consider expanding the methodology with a qualitative component in the future (e.g., UX studies, focus groups) as well as cost-effectiveness analysis of e-services.

Attention should also be paid to the impact of contextual factors—such as the COVID-19 pandemic, which accelerated digitalization across Europe but did not affect all countries uniformly. This points to the importance of institutional flexibility and the state's readiness to implement changes quickly. As Aleisa [2024] notes, trust in e-services grows when users perceive them as safe, transparent, and tailored to their needs—elements more strongly present in Lithuania's strategy than in Poland's.

In summary, the results of this study are consistent with observations from other authors [Mahmood et al. 2020, Ciancarini et al. 2024], who emphasize that the success of digital transformation depends on the synergy of technology, public management, and citizen trust. Lithuania's example shows that even a smaller country, with appropriate institutional and political support, can become a regional leader in the digitalization of public and financial services. Poland, despite clear progress, still requires deeper reflection on its digital society development strategy.

Conclusion

The conducted study led to the following statements and conclusions. There has been a systematic increase in the level of digitalization — between 2013 and 2024, all analyzed indicators (e-shopping, e-banking, e-government) show an upward trend in most EU countries, although the pace of growth and saturation levels vary regionally.

Lithuania surpasses Poland in the digitalization of public and financial services: in 2024, Lithuania achieves higher rates of e-banking usage (80% vs. 57%) and e-government usage (69% vs. 43%). Poland has a slightly higher share of citizens making online purchases (67% vs. 64%), but Lithuania has demonstrated a more

consistent and dynamic growth in this indicator during the earlier stages of transformation.

Regional disparities remain evident — Scandinavian countries and the Benelux countries show the highest digitalization rates (above 90%), while Southeastern Europe (e.g., Bulgaria, Romania, Serbia) still lags behind.

The COVID-19 pandemic acted as a catalyst for digital transformation, especially in 2020–2021, accelerating the development of e-services and increasing the adoption of digital tools in citizens' everyday lives.

Poland requires further development efforts, particularly in the areas of expanding digital infrastructure (especially in rural areas), increasing public trust in online services, integrating public services, and promoting digital skills. Lithuania, on the other hand, serves as an example of effective digital transformation in the Central and Eastern European region, with a well-integrated system of financial and public services, which translates into high rates of digital activity among citizens.

Cluster analysis allowed the identification of five types of digital models among European countries: digital leaders (e.g., Denmark, the Netherlands, Sweden), digitally advanced (including Lithuania, the Czech Republic, Estonia), moderate users (including Poland, Germany, Slovakia), digitally lagging countries (e.g., Bulgaria, Romania), and atypical cases (e.g., Turkey, Albania).

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SUSTAINABLE CONSUMPTION AND CIRCULAR ECONOMY INTEGRATION AMONG DISPLACED PERSONS FROM UKRAINE: ADAPTATION, AWARENESS, AND CHALLENGES

Nataliia Antoniuk •

Summary

This chapter explores the adaptation of displaced persons from Ukraine to sustainable consumption and circular economy principles in Austria. Based on a sociological survey and interviews conducted in Graz, the study identifies changes in daily environmental behavior. Respondents showed high environmental awareness, especially in waste separation, energy saving, and sustainable transport. The role of local infrastructure, social networks, and host-country initiatives proves crucial in enabling circular practices. Gender-based differences were found in climate awareness and adaptation difficulties. Housing instability and language barriers remain key challenges. The Austrian context—with services like repair bonuses and recycling systems—creates favorable conditions, though obstacles for displaced persons persist. Integration into sustainable consumption benefits both Austria and Ukrainians, who gain experience useful for post-war reconstruction. While findings are rooted in the local context, they offer insights for other host countries with similar systems.

Keywords: displaced persons, circular economy, sustainable consumption, Austria, Ukraine

Streszczenie

Rozdział analizuje adaptację osób przesiedlonych z Ukrainy do zasad zrównoważonej konsumpcji i gospodarki o obiegu zamkniętym w Austrii. Na podstawie badań w Grazu opisano zmiany w codziennych zachowaniach środowiskowych. Respondenci wykazali dużą świadomość ekologiczną, zwłaszcza w zakresie segregacji odpadów, oszczędzania energii i zrównoważonej mobilności. Kluczową rolę odgrywają infrastruktura lokalna, sieci społeczne i inicjatywy kraju przyjmującego. Zaobserwowano różnice ze względu na płeć w postrzeganiu klimatu i trudnościach adaptacyjnych. Niestabilność mieszkaniowa i bariery językowe pozostają wyzwaniami. Austriackie programy, jak bonusy naprawcze czy systemy recyklingu, sprzyjają ekologicznej integracji, choć przeszkody nadal istnieją. Integracja ta przynosi korzyści obu stronom – Austrii i Ukraińcom, którzy zdobywają doświadczenie przydatne w odbudowie kraju. Wyniki mogą mieć zastosowanie również w innych krajach przyjmujących.

Słowa kluczowe: osoby przesiedlone, gospodarka o obiegu zamkniętym, zrównoważona konsumpcja, Austria, Ukraina

JEL: Q56, D12, R23, F22

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Introduction

The global migration crisis, intensified by the full-scale Russian invasion of Ukraine in 2022, has led to significant socio-economic changes worldwide. Displaced persons from Ukraine face new challenges of adaptation, which affect not only their social practices but also their consumption behavior. One of the key aspects of this transformation is their attitude toward sustainable consumption and the integration of circular economy principles.

The subject of this research is highly relevant due to the large-scale migration of Ukrainians to European Union countries, particularly to Austria. According to UNHCR data, as of early 2024, more than 5.9 million Ukrainians were under temporary protection abroad, including over 90,000 in Austria [UNHCR, 2024]. This situation presents new challenges for both displaced persons from Ukraine and the host societies aiming to ensure effective integration. The issue of adapting consumption habits in new socio-economic environments and their role in shaping environmentally responsible behavior becomes especially important.

Austria, which actively supports sustainable development and implements circular economy principles, faces the need to understand how displaced persons from Ukraine are adapting their consumption habits. Analyzing these changes will help evaluate the effectiveness of current integration programs and identify potential directions for improving sustainable consumption policies. Furthermore, the growing number of displaced persons may significantly affect the structure of demand for goods and services, requiring further research to develop both economically and ecologically sound solutions.

According to a European Commission study [2023], more than 50% of Ukrainian refugees in the EU demonstrate a willingness to adjust their consumption behavior in line with the environmental standards of their host countries [European Commission, Flash Eurobarometer 538, 2023].

The findings of our research will contribute not only to a better understanding of behavioral changes among displaced persons from Ukraine but also to the development of practical recommendations for public authorities, NGOs, and businesses on integrating displaced persons into the circular economy. Recognizing the specific adaptation patterns of displaced persons from Ukraine can support the creation of more effective programs to promote sustainable development both in Austria and in post-war Ukraine.

Research Hypotheses.

If displaced persons from Ukraine have access to environmental education and resources for sustainable consumption, their adaptation to the circular economy occurs more quickly and effectively.

Socio-economic factors such as income level, employment status, and access to environmental infrastructure play a decisive role in shaping sustainable consumption practices among displaced persons from Ukraine.

Research Hypotheses:

1. If displaced persons from Ukraine have access to environmental education and resources for sustainable consumption, their adaptation to the circular economy occurs more quickly and effectively.

2. Socio-economic factors such as income level, employment status, and access to environmental infrastructure have a decisive impact on shaping environmentally conscious behavior among displaced persons in Austria.

The relevance of the first hypothesis lies in the fact that environmental education is one of the key tools for shaping conscious consumption. Displaced persons from Ukraine often relocate unexpectedly, without prior preparation for the new cultural and behavioral norms of the host country, including ecological standards. Access to clear and practical information about local environmental policies, waste management systems, reuse opportunities, or energy-saving practices significantly increases their chances of integrating effectively into the circular economy [Antoniuk N., Kostiuk V., 2024]. This is supported by numerous empirical studies that show a positive link between awareness and ecological action.

The second hypothesis highlights the crucial role of socio-economic context in influencing behavioral change. For displaced persons from Ukraine, factors such as income level, employment stability, and access to ecological infrastructure (e.g., recycling centers, second-hand markets, public transport systems) are critical in determining both the possibility and willingness to adopt sustainable practices. Individuals with limited access to resources often prioritize basic needs, meaning that circular behaviors can only be realistically adopted under supportive social and economic conditions.

The research methodology

The research conducted by Dr. Nataliia Antoniuk (Doctor of Economics, Prof., Kyiv, Ukraine) in collaboration with Prof. Ilona Otto within the framework of the Climate Change Graz Post Doc Fellowship at the University of Graz (UniGraz, Austria) (2023–2024) focuses on the transformation of consumption habits among temporarily displaced persons from Ukraine in Austria. The study explored an interdisciplinary intersection between social factors, ecological behavior, and the potential integration of circular economy principles into the daily lives of newcomers.

The research methodology included:

1. Quantitative sociological survey of over 115 temporarily displaced persons in the city of Graz. The questionnaire covered topics such as: changes in household practices, attitudes toward waste sorting, transportation use, energy-saving behavior, and participation in local environmental initiatives.

2. *In-depth interviews* with 10 respondents to explore motivations, barriers, and individual strategies of adaptation in a new social and environmental setting.

3. *(Partial) mapping of local environmental infrastructure* accessible to displaced persons in Graz: waste separation systems, upcycling hubs, repair points, and community initiatives.

4. *Comparative analysis* with other European studies (UkrAiA, IOM Austria), allowing for the contextualization of findings and identification of Austria's unique features in supporting ecological integration.

This research considers temporarily displaced persons not only as a vulnerable group in need of protection but also as potential agents of change in the field of climate action**.** In light of Prof. Ilona Otto's earlier work on social tipping points [Otto, I., Donges, J. F., Cremades, R., Bhowmik, A., Hewitt, R. J., Lucht, W., & Rockström, J., 2020], the authors emphasize that local initiatives focused on behavioral change within specific social groups can have a substantial multiplier effect.

In this context, the study by Kohlenberger, Buber-Ennser, and Rengs [Kohlenberger, Buber-Ennser, and Rengs, 2023] provides valuable insights into the migration patterns, motivations, and integration paths of Ukrainian refugees in Austria and Poland. Their findings help explain how socio-demographic characteristics of displaced Ukrainians can influence not only their integration but also their potential to engage in sustainability and climate-related actions in host communities.

Thus, the findings of this study provide a solid foundation for the development of targeted integration policies that connect social adaptation, climate justice, and circular economy principles—both in host countries and in the post-conflict recovery of Ukraine.

Research Results

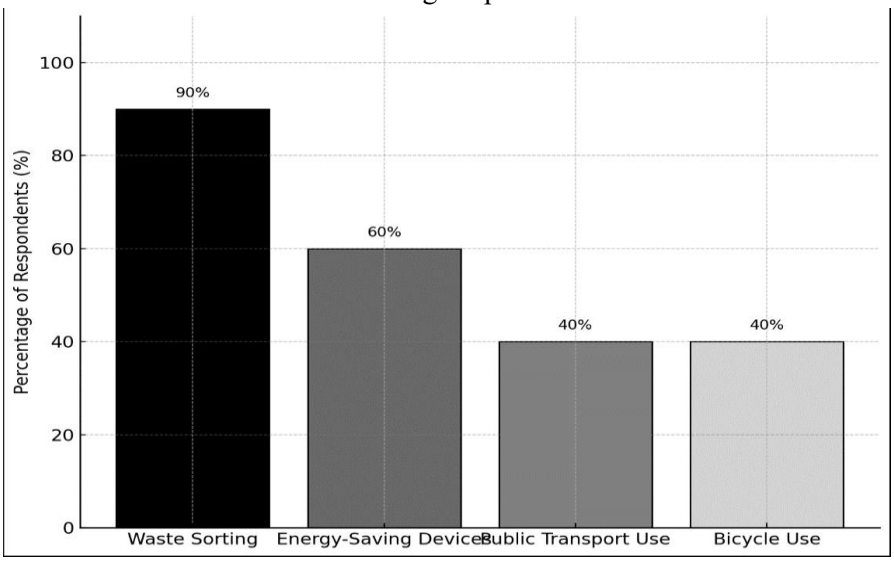
Following Russia's full-scale invasion of Ukraine in 2022, millions of Ukrainians were displaced. Austria became one of the host countries that accepted a significant number of displaced persons, facing the dual challenge of humanitarian support and integration. This scenario also created an opportunity to explore how displaced individuals adapt their behaviors under new circumstances. The results revealed that adaptation is a gradual process: 60% of respondents indicated that it took them between one and two years to fully adapt to their new living conditions. The primary barrier to adaptation was language, as reported by 70% of participants, which

significantly affected their engagement in environmental practices [UkrAiA & IOM Austria, 2022].

Despite these challenges, the findings demonstrate a high level of environmental awareness among the respondents. Notably, 90% reported practicing waste separation, 60% used energy-saving devices, and 40% regularly used public transportation or bicycles. These behaviors indicate that environmentally conscious practices are not merely aspirational but are already embedded in the daily routines of many displaced individuals. Moreover, 70% expressed support for local climate initiatives, and 50% considered themselves well-informed about Austrian environmental policies, which highlights their readiness to participate in EU-level climate action [Migration Policy Centre, 2023].

Bicycle use emerged as a significant aspect of sustainable mobility. According to the data, 40% of respondents used bicycles as a regular mode of transport. The primary reasons cited were cost savings (60%), environmental concerns (20%), and convenience (20%) (Fig. 1). This suggests that both practical and ecological motivations drive behavioral change. Cycling is perceived not only as a cost-effective option but also as a meaningful contribution to environmental sustainability. Such practices reflect a strong willingness among displaced persons to align with European environmental norms and participate in long-term ecological transformation. These results highlight the potential of promoting low-emission mobility through affordable and accessible solutions, thereby reinforcing climate-friendly behavior in everyday routines.

Graph 1. Environmental Practices Among Displaced Persons from Ukraine in Austria



Source: created by the author

Gender-based insights revealed subtle but important differences in climate adaptation. Men and women generally shared similar perceptions regarding the impact of climate change on their daily lives, with about one-third of each group acknowledging its effects. However, women reported more challenges adapting to Austria's climate and demonstrated slightly higher climate awareness post-relocation. Interestingly, women were also more likely to report not thinking about climate change at all, possibly due to their higher involvement in caregiving and domestic responsibilities. These findings underscore the need for gender-sensitive communication and support strategies in environmental education [Otto et al., 2020].

Another critical aspect of the study was the role of social networks and community initiatives in promoting circular behavior. Respondents who engaged in community programs, particularly those affiliated with *RepaNet*—Austria's re-use and repair network—showed a significantly higher likelihood of adopting and maintaining sustainable habits. Participation in activities such as item exchange, repair workshops, and upcycling served as practical entry points into the circular economy and increased motivation to reduce waste in everyday life [RepaNet, 2023].

Residential stability emerged as a key determinant of environmental behavior. According to IOM Austria [2023], individuals who changed residences more than three times per year were significantly less likely to practice waste sorting or energy conservation. This instability disrupted routine formation and reduced the likelihood of adopting sustainable practices. Therefore, policy efforts aimed at long-term accommodation are crucial for enabling circular adaptation.

When compared to other EU countries such as Poland or the Czech Republic, Austria offers more structured support for displaced persons. This includes broader access to housing, integration programs, and environmental services [Migration Policy Centre, 2024]. However, the study also revealed regional disparities within Austria, highlighting inconsistent access to sustainable services across different provinces. These findings suggest the need to address infrastructural gaps to ensure equitable ecological integration.

The Austrian context highlights the important role of state policies and civic initiatives in shaping a sustainable domestic environment. Many Ukrainian displaced persons actively integrate into this system, while others remain on the margins due to limited access to adaptation resources. Effective tools — such as subsidies for appliance repairs (e.g., the *Reparaturbonus*), accessible waste-sorting systems, free shops, and repair cafés — help to create conditions conducive to the development of new consumption practices. However, not all displaced Ukrainians engage with these opportunities equally. Language barriers, psychological fatigue, financial vulnerability, and limited institutional support often hinder full participation in environmentally responsible behavior.

At the same time, living in Austria offers significant potential for reverse knowledge transfer to Ukraine. Prior to the full-scale invasion of 2022, environmentally conscious behavior in Ukraine was largely driven by economic necessity rather than ecological awareness. Practices such as reusing items, repairing appliances, and conserving resources existed, but were mostly compelled by scarcity rather than grounded in a sustainability mindset. Environmental initiatives before the war were concentrated in major cities and rarely reached the broader population, while state support for circular solutions remained limited.

Currently, in the context of Austria's developed environmental infrastructure, many displaced Ukrainians are gaining new experiences that not only improve practical skills but also shift perceptions of ecological responsibility. Living in a country where recycling, repair, swapping, and waste reduction are part of the social norm increases individuals' willingness to participate in the circular economy. However, contradictions persist: even with access to sustainable consumption infrastructure, some individuals do not adopt environmentally responsible practices. Often, they remain in a survival mode, where ecological considerations are not a priority due to psychological stress, uncertainty, or financial instability.

An analysis of behavioral patterns suggests that sustainable choices are more likely when they are intuitively simple, logistically accessible, and socially supported [Antoniuk, Bochko, Kulczycka, 2024]. For instance, the use of free shops or repair cafés is often not driven by environmental awareness, but rather as a response to economic constraints. Nevertheless, even in such cases, a gradual shift in values occurs: there is increasing respect for reuse, the habit of waste sorting is taking root, and interest in sustainable lifestyles is emerging. One persistent barrier is the lack of accessible Ukrainian-language information, adapted educational materials, and culturally sensitive interfaces — both online and offline (Graph 2).

Graph 2. Four Dimensions of Circular Adaptation: The Journey of Displaced Persons from Ukraine Toward a Sustainable Future

Source: created by the author

This includes, for example, instructions on waste sorting, how to sign up for municipal programs, or the use of local digital services. As a result, many Ukrainians do not participate in initiatives offered by municipalities or NGOs, even when they formally have access to them.

A positive factor is the emergence of horizontal, community-driven initiatives led by Ukrainians themselves — mutual aid groups, Telegram channels, item exchanges, and home repairs. Though not always branded as "green" or "sustainable," these initiatives in fact embody circular economy principles. In Austrian cities such as Vienna, Graz, and Linz, there is growing participation of the Ukrainian diaspora in local sustainability efforts, including volunteering, community development projects, and intercultural activities. This form of inclusion fosters not only new practical skills but also a sense of belonging in the host society, which in turn supports long-term adaptation to its ecological standards.

Overall, the current situation reveals a fragmented but promising process of adaptation among displaced Ukrainians to the realities of a circular economy. However, this process remains vulnerable to external factors — including length of stay abroad, the availability of social capital, support from host communities, and the influence of media and educational programs. Continued research and targeted support for these processes are essential for transforming individual practices into lasting elements of environmental culture.

Looking ahead, the experiences gained abroad may become a foundation for social and ecological transformation in Ukraine. The return or remote participation of the diaspora in advancing sustainability — through educational programs, policy advocacy, municipal-level knowledge exchange, and community initiatives — offers a pathway for reverse transfer. Citizens returning with new conceptions of ecological norms can become a critical mass of change agents within local communities, universities, and businesses. Institutionalizing this potential at the local level — through the creation of reuse centers, repair workshops, swap platforms, and awareness campaigns informed by host-country experiences — is of particular importance.

In this way, the experience of Displaced Persons from Ukraine in Austria represents not only adaptation to new environmental standards but also a tangible resource for Ukraine’s sustainable future. It supports the notion that the circular economy can serve not only as an economic or ecological strategy but also as a social bridge — linking the country of origin with the host context, and connecting past experiences with future reconstruction. Turning this experience into coherent policy in Ukraine will require state-level strategies, cross-sector cooperation, and the recognition of displaced persons as active participants in the ecological transition.

Conclusions

The research on sustainable consumption and the integration of circular economy principles among displaced persons from Ukraine reveals a complex and multidimensional adaptation process to new living conditions in host countries. The analysis focused on behavioral, socio-cultural, and economic factors shaping how displaced persons perceive and engage in environmentally responsible lifestyles.

Firstly**,** the level of awareness regarding sustainable consumption and circular economy concepts is uneven but evolving**.** Respondents demonstrated both a notable openness to new ecological practices and deeply rooted habits formed in the pre-war Ukrainian context. Their consumption patterns reflect the interplay between the need to economize resources, psychological stress from displacement, and limited access to circular economy infrastructure (e.g., waste separation, repair services, exchange systems, zero-waste initiatives).

Secondly**,** adaptation to circular practices largely depends on the surrounding environment—namely, the availability of services, educational initiatives, social support, and local cultural norms. Many displaced Ukrainians are willing to adopt sustainable models but encounter barriers related to language, bureaucracy, financial vulnerability, and a lack of accessible information.

Thirdly**,** promoting sustainable practices among displaced persons requires a holistic and inclusive approach—combining awareness-raising, institutional support, welcoming environments (e.g., through community-based or municipal programs), and acknowledgment of displaced persons' prior environmental knowledge and behavior.

In this context, Austria offers a strong example of circular economy implementation through well-developed municipal services, legal frameworks, and vibrant civic engagement. Initiatives such as separate waste collection, the *Reparaturbonus* (repair subsidy), and second-hand or reuse platforms provide material and cultural conditions conducive to circular practices. However, even in such a favorable environment, Ukrainian displaced persons still face challenges—highlighting the need for tailored communication, proactive outreach, and inclusive program design**.**

Importantly, the integration of Ukrainian displaced persons into sustainable consumption models in Austria benefits both sides: it advances the host country's environmental and social goals while equipping Ukrainians with valuable experience that can be leveraged during post-war reconstruction.

Policy Recommendations for Ukraine's Recovery and Transition:

1. Institutionalize circular economy principles within national and local development and reconstruction strategies;

2. Develop local infrastructure for sustainable consumption: community-based repair hubs, reuse and exchange centers, waste sorting and composting systems;

3. Implement educational and communication campaigns for both adults and youth, linking sustainability with economic rationality and cultural values;

4. Leverage displaced persons' experiences as a source of practical knowledge—through advisory roles, civic participation, and community engagement;

5. Promote grassroots initiatives and partnerships among NGOs, local authorities, businesses, and academic institutions.

The crisis-induced experience of displaced Ukrainians can serve as a foundation for Ukraine's sustainable socio-economic transition—one that is more adaptive, solidarity-based, and environmentally responsible.

While the findings are deeply rooted in the Austrian context—particularly the urban setting of Graz—they offer transferable insights for other host countries with similar institutional frameworks. However, certain cultural, infrastructural, and policy-specific aspects may limit full generalization. Thus, the results should be interpreted both as a reflection of local dynamics and as a potential basis for broader comparative studies across Europe.

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DIVERSITY IN INTERNET ACCESS AMONG EUROPEAN HOUSEHOLDS

Justyna Karwowska •

Summary

The aim of the article is to present the access to the internet in households of European Union countries, with particular emphasis on Poland in the years 2004-2024. Data from Eurostat for the years 2004-2024 were used to conduct the analysis. The research methods used include cluster analysis using the Ward method. The data presented by Eurostat allowed the division of EU Member States into four separate groups. Bulgaria, Greece and Romania belong to the cluster with the lowest percentages of internet access, while the best situation is characterized by Denmark, Germany, Luxembourg, the Netherlands, Finland and Sweden. Poland was in the cluster with the third place in terms of the examined feature. The results indicate a gradual increase in convergence between EU countries in the analyzed indicator, but disparities between countries are still significant.

Keywords: internet access, digitalization, cluster analysis, Ward's method, households

Streszczenie

Celem artykułu jest przedstawienie dostępności do internetu gospodarstw domowych państw Unii Europejskiej ze szczególnym uwzględnieniem Polski w latach 2004-2024. Do przeprowadzenia analizy wykorzystano dane pochodzące z Eurostatu za lata 2004-2024. Zastosowane metody badawcze to analiza skupień metodą Warda. Prezentowane przez Eurostat dane umożliwiły podzielenie państw członkowskich UE na cztery odrębne grupy. Bułgaria, Grecja i Rumunia należą do skupienia z najniższymi odsetkami w dostępie do internetu w analizowanym okresie, natomiast najlepszą sytuacją charakteryzują się Dania, Niemcy, Luksemburg, Niderlandy, Finlandia i Szwecja. Polska należy do skupienia znajdującego się na trzecim miejscu pod względem badanej cechy. Wyniki wskazują na stopniowy wzrost konwergencji między państwami UE, jednak dysproporcje pomiędzy państwami dalej są znaczne.

Słowa kluczowe: dostęp do internetu, cyfryzacja, analiza skupień, metoda Warda, gospodarstwa domowe

JEL: O33, O52, C38

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Introduction

Information and Communication Technologies (ICT) have become the foundation of the modern information society, revolutionizing the way we work, learn and communicate [Wojnar 2020: 52]. In the age of digitalization, more and more aspects of life are moving to the virtual world, where the Internet plays a key role. The global network not only enables the rapid flow of information, but also lowers the barriers of access to knowledge, culture and services [Ulman and Ćwiek 2021: 34], contributing to improving the quality of life [Kryzhanovskij, Baburina and Ljovkina 2021] and stimulating economic growth [Fernández-Portillo, Almodóvar-González and Hernández-Mogollón 2020]; [Aitken 2019]; [Gasz 2024: 87]. Nowadays, internet access is not just a convenience – it is increasingly becoming a necessary condition for active participation in social, professional and cultural life. Its lack leads to digital exclusion (e-exclusion), which deepens existing social and economic inequalities [Jedlińska 2018: 226]; [Czarnecka, Kelm and Koczur 2023: 91]; [Ulman and Ćwiek 2021: 34]; [Gasz 2024: 87]; [Dziembała 2021: 52]; [Kujawski 2018: 254].

Despite common goals for digital transformation, EU Member States show significant differences in their level of technological advancement. To monitor these differences and coordinate efforts towards digital cohesion, the European Commission regularly analyses progress across countries in the Digital Economy and Society Index (DESI) [Gasz 2024: 81]. One of the DESI components is digital infrastructure, which measures, among other things, internet accessibility in households with at least one person aged 16-74 (in %) [Eurostat 2025c].

In 2022, Poland scored 40.6 points in the Digital Economy and Society Index, ranking 24th out of 27 EU countries, below the EU average. Although ahead of Greece, Bulgaria and Romania, this result indicates significant delays in key areas of digitalization [Eurostat 2025b]. In the years leading up to 2020, Poland remained below the EU average in terms of the percentage of households with internet access [Pekasiewicz and Szczukocka 2017: 255]; [Grzega 2015: 362-363]; [Grzega 2021: 357-358]. However, according to Eurostat data, there has been dynamic growth in recent years, thanks to which Poland not only matched the EU-27 average, but also achieved results above the average [Eurostat 2025c].

In Central and Eastern Europe, there are significant differences in access to digital technologies and their use in households [Lecka 2024]. At the same time, at the level of the entire European Union, there is a clear gap between the north and the south of the continent [Bukht and Heeks 2017: 1]; [Borowiecki et al. 2021]. While Scandinavian countries consistently maintain their position as leaders in digitalization, the regions of Southern and Southeastern Europe still have the lowest rates in this area [Ulman and Ćwiek 2021: 47].

The European Union is drawing attention to the need for convergence in terms of internet access for all Member States. Although an overall improvement is observed,

[Borowiecki et al. 2021 it is recommended to further actively accelerate the digitalization process [Piekut and Rybaltowicz 2024: 86]. Having access to the internet in households is crucial for achieving the goals of the European Union's digital policy, such as creating a unified and competitive information society. Furthermore, the situation in EU Member States is changing dynamically, which is why it is important to monitor it on an ongoing basis.

The article aims to present the diversity in the possession of internet access among households in the European Union, with a special focus on Poland in the years 2004-2024. This objective was achieved using global data from Eurostat (the statistical office of the European Union), which collects, compiles, and disseminates statistics and data on EU Member States and other countries in collaboration with national statistical offices. This allows for generalized international inferences.

Research material and research methodology

The source material was data from the Eurostat database and the Central Statistical Office. Internet accessibility in European households was analyzed in the years 2004-2024. The selected research period was dictated by the desire to observe changes in the indicator from 2004, i.e. from the moment of accession of ten new countries to the structures of the European Union, including Poland, to the currently latest data presented by Eurostat.

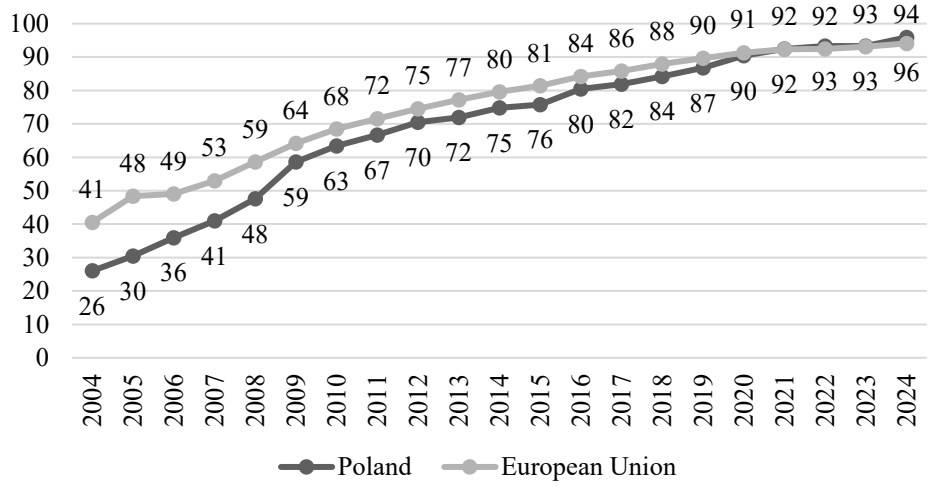
To examine the similarities and differences between EU countries in terms of internet accessibility, cluster analysis using Ward's method was used. A distance measure was used to group countries: the square of the Euclidean distance, which resulted in a tree diagram, which was used to determine the number of country clusters. The tree diagram was cut at 10,235, which indicated the division of countries into 4 clusters. The data used for classification did not require standardization, because in each country they were expressed as a percentage.

Ward's method is a hierarchical agglomerative method of cluster analysis, the aim of which is to combine homogeneous objects into increasingly larger clusters. It uses the variance analysis approach to estimate the distances between clusters. In this method, the sum of the squared deviations of any two clusters, formed at any stage of the algorithm, is minimized [Ward 1963]. This method is seen as effective, creating coherent clusters. Its disadvantage is the tendency to form clusters of small size and sensitivity to outliers [Stanisz 2007]. The analysis was performed using the program Statistica 13.3 and Excel.

Internet access in households in the EU-27 Member States – survey results

Data analysis shows that in 2004, only 26% of Polish households had access to the Internet, while the EU average was 41% (Chart 1). The largest difference occurred in 2005, when the EU average was 18 p.p. higher than the result for Poland. In subsequent years, a systematic reduction of this technological gap was observed, and since 2021 the trend has reversed. According to the latest data, in the last year of the analysis, the indicator in Poland was 96%, which was higher than the EU average by almost 2 p.p. Over 21 years, the percentage of households with access to the Internet increased in Poland by 70 p.p., while in the EU by 53 p.p.

Chart 1. Share of households in Poland and the European Union with access to the Internet in 2004-2024 (%)



Source: own study based on: Eurostat. Households - level of internet access (isoc_ci_in_h), https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_in_h__custom_15587531/default/table?lang=en (online access 1.03.2025).

In all EU countries, an upward trend in terms of internet access was noted (Table 1). The lowest rates for 2024 were recorded in: Greece (87%), Croatia (88%) and Lithuania (90%). The highest rates were recorded in countries such as: the Netherlands (99%), Luxembourg (99%) and Finland (98%). In 2024, Poland ranked sixth in terms of household access to the network.

In 2024, 11 countries recorded results below the EU-27 average: Belgium, Bulgaria, Germany, Estonia, Ireland, Greece, Croatia, Italy, Lithuania, Portugal, Slovakia. It is worth noting that in six of them (Bulgaria, Greece, Croatia, Italy, Lithuania and Portugal) the situation has not changed since 2004. In turn, results above the average level were recorded among 15 countries: the Czech Republic,

Denmark, Spain, France, Cyprus, Latvia, Luxembourg, Hungary, Malta, the Netherlands, Austria, Poland, Romania, Finland and Sweden. Among them, there are six countries that have achieved an indicator above the average in all years (Denmark, Luxembourg, the Netherlands, Austria, Finland and Sweden). For comparison, in 2007 the situation was the opposite. At that time, 15 countries achieved a result below the average, and only 12 above the average level. The disparities between countries were also greater. The current level of internet accessibility shows high household saturation with this service [Grzega 2021]. Despite the observed progress, internet accessibility is still varied, which may be related to the level of telecommunications infrastructure of a given country, the wealth of society or the policies pursued by the governments of the Member States [Wojnar 2020].

Tabel 1. Share and changes in the share of households with Internet access in selected years in European Union countries (in %)

Specification	2004	2007	2012	2021	2024	Change in p.p. 2004-2024
European Union	40.6	53.0	74.5	92.3	94.1	53.5
Belgium	-	60.2	77.7	92.0	91.4	-
Bulgaria	9.7	19.0	50.9	83.5	92.1	82.5
Czech Republic	19.4	35.1	72.6	89.3	94.6	75.2
Denmark	69.4	78.1	92.0	96.1	96.9	27.5
Germany	60.0	70.7	85.5	91.9	92.7	32.7
Estonia	30.8	52.2	73.8	91.8	92.9	62.1
Ireland	39.7	57.3	81.1	97.5	93.0	53.3
Greece	16.5	25.4	53.6	85.1	86.9	70.4
Spain	33.6	43.5	66.6	95.9	96.8	63.2
France	33.6	55.1	80.0	93.3	94.4	60.8
Croatia	-	40.6	66.4	86.1	88.4	-
Italy	34.1	43.4	62.9	90.5	93.4	59.3
Cyprus	52.8	38.9	61.8	93.4	94.9	42.1
Latvia	14.7	50.5	68.7	91.2	94.3	79.7
Lithuania	11.6	44.4	60.1	86.6	90.4	78.8
Luxembourg	58.6	74.6	93.1	99.2	98.8	40.2
Hungary	14.2	37.7	66.8	90.8	94.8	80.6
Malta	-	53.9	76.7	90.5	95.6	-

Netherlands	65.0	82.9	93.6	98.6	99.0	34.0
Austria	44.7	59.6	79.3	95.0	95.0	50.4
Poland	26.0	41.0	70.5	92.4	95.9	69.9
Portugal	26.2	39.6	61.0	87.3	90.6	64.4
Romania	5.6	22.3	53.8	88.7	94.6	89.0
Slovenia	46.9	57.6	73.9	93.0	94.1	47.2
Slovakia	23.3	46.1	75.4	90.0	90.5	67.2
Finland	50.9	68.8	86.8	96.6	97.4	46.5
Sweden	-	78.6	91.7	93.2	95.4	-

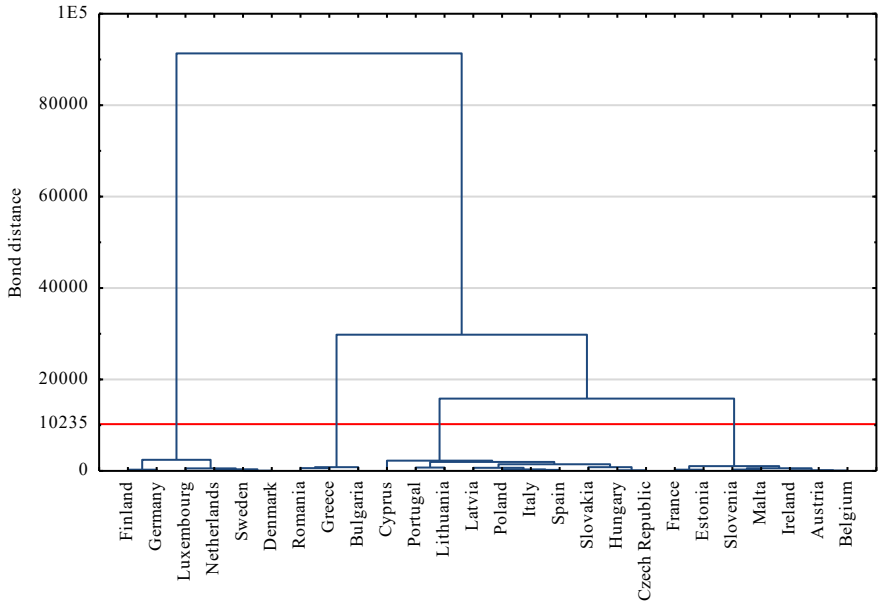
Source: own study based on: Eurostat. Households - level of internet access (isoc_ci_in_h), https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_in_h__custom_15587531/default/table?lang=en (online access 1.03.2025).

Clusters of countries by percentage of households with internet access

The use of cluster analysis made it possible to select groups of countries with similar percentages of households with Internet access for the years 2004-2024. Croatia was excluded from the analysis due to missing data in the initial years, which could have significantly affected the results. Therefore, 26 EU countries were studied using Ward's method. As a result of grouping, four clusters were created, because the dendrogram was intersected at the height of 10,235. On the left side, there was one cluster of six elements, while on the right side, three clusters were created: three, ten and seven elements (Chart 2).

Cluster I, the smallest, included three countries: Bulgaria, Greece and Romania, which were characterized by significantly lower shares of the studied feature compared to the other countries (Table 2). On average, slightly more than half of the population in this group had access to the Internet (56%). It is worth noting that Romania had both the lowest (6% in 2004) and the highest (95% in 2024) share of households with Internet access. Since joining the European Union, the situation in this country has changed significantly. After 20 years, Romania has caught up with other EU countries, achieving an indicator higher than the EU average. In the countries from cluster I, it is worth noting that the indicator increases every year. The slowest increase concerns Greece, which in the initial year of analysis was in a better situation than Romania and Bulgaria, while in 2024 it is in third place.

Chart 2. Membership in clusters of EU countries by the share of households with Internet access in 2004-2024 (Ward method)



Source: own study based on: Eurostat. Households - level of internet access (isoc_ci_in_h), https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_in_h__custom_15587531/default/table?lang=en (online access 1.03.2025).

A characteristic feature of cluster II was the highest average percentage of households with Internet access (88%). In 2024, these values ranged from 93% (Germany) to 99% (the Netherlands). Cluster II included two Northern European countries that are pioneers in promoting digital development [Borowiecki et al. 2021]. It is worth noting that these countries are characterized by the lowest increases in the indicator, which results from their high position in the initial year of analysis.

Cluster III included the largest number of countries and ranked third in terms of household internet access, with an average of 68%. It included: the Czech Republic, Spain, Italy, Cyprus, Latvia, Lithuania, Hungary, Poland, Portugal, and Slovakia. The lowest rate was recorded for Lithuania: 12% in 2004, and the highest for Spain: 97% in 2024. In the last year under review, Poland ranked second compared to the other countries in this cluster. Cluster III included all the countries of the Visegrad Group (Poland, the Czech Republic, Slovakia, and Hungary), where the percentage of households with internet access increased significantly. Despite the progress in the digitalization of the Visegrad Group, there is a need for further investments related to this [Piekut and Rybaltowicz 2024: 86].

Cluster IV included seven countries: Belgium, Estonia, Ireland, France, Malta, Austria and Slovenia. The average for the cluster was 76%. The lowest share was

recorded in 2004 for Estonia (31%) and the highest in 2021 for Ireland (98%). This cluster ranks second in terms of the percentage of households with internet access.

Table 2. Characteristics of clusters generated by Ward's method

Cluster number	Number of countries	Minimum	Maximum	Average in cluster
I	3	5.6% (Romania, 2004)	94.6% (Romania, 2024)	56.3%
II	6	50.9% (Finland, 2004)	99.2 % (Luxembourg, 2021)	87.8%
III	10	11.6% (Lithuania, 2004)	96.8% (Spain, 2024)	68.0%
IV	7	30.8% (Estonia, 2004)	97.5% (Irleand, 2021)	76.0%

Source: own study based on: Eurostat. Households - level of internet access (isoc_ci_in_h), https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_in_h__custom_15587531/default/table?lang=en (online access 1.03.2025).

Having access to the Internet does not guarantee full use of its functions. In an era of rapid technological progress, slow connections can hinder certain user activities. The study examines the situation of Poland in comparison to the European Union and Denmark (one of the leaders in digitalization) in terms of technologies used for this purpose (Table 3). Rural areas, which tend to have more problems with access to the Internet, were analyzed separately.

In 2023, Poland recorded a lower share of households covered by the 5G network than in the EU – both overall (72%) and in rural areas (59%). In comparison, in Denmark, 100% of households were covered, regardless of place of residence, and the EU average was 89% for households overall and 74% for rural areas. Despite the challenges associated with 5G, Poland is doing better than the EU average in terms of access to fibre to the premises (FTTP). In 2023, 75% of Polish households had this option, compared to 64% in the EU. Denmark once again proved to be the leader, with 84% of households overall and 90% in rural areas. A similar trend is observed in the case of fixed access to very high-capacity networks (VHCN). In Poland, this coverage included 81% of all households and only 57% of rural households, which is above the EU average. Although Poland is systematically improving the availability of modern technologies, it still lags behind leaders such as Denmark. This is particularly visible in rural areas, where the differences in access to fast internet are the greatest.

Tabel 3. Share of households covered by 5G, FTTP and VHCN in 2023 (in %)

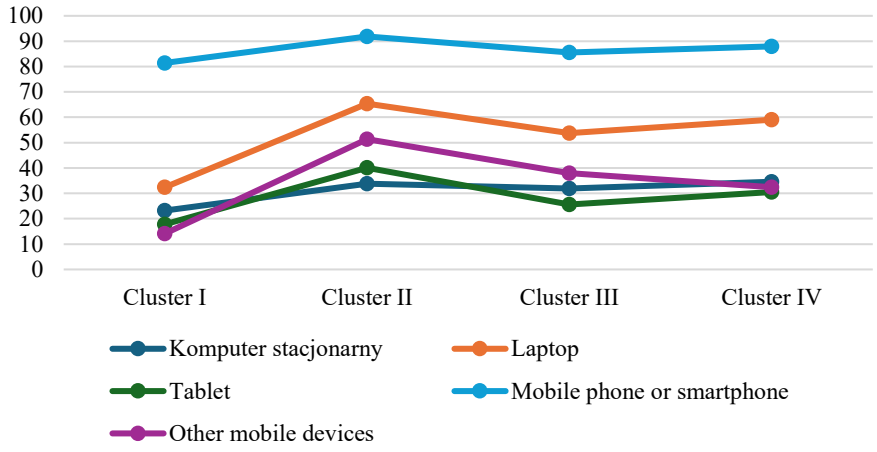
Specification	Poland		European Union		Denmark	
	Total	Village	Total	Village	Total	Village
5G Coverage	71.9	58.5	89.3	73.7	100	100
Fibre to the premises (FTTP)	75.4	56.3	64.0	52.7	84.0	90.3
Fixed very high capacity network (VHCN)	81.1	57.2	78.8	55.6	97.2	90.8

Source: own study based on: Eurostat. Broadband internet coverage by technology (isoc_cbt), https://ec.europa.eu/eurostat/databrowser/view/isoc_cbt__custom_16859644/default/table?lang=en (online access 21.03.2025).

The research showed some differences in the type of devices that the society used to access the Internet (Chart 3). In 2023, smartphones were the most popular tool for accessing the network – from 81% of people in cluster I to 92% in cluster II used them to access the Internet. Laptops came second in terms of popularity, although with clear differentiation between clusters: cluster II recorded the highest percentage of users (65%), while in cluster I it was only 32%. In the case of other mobile devices (e.g. Smart TV, Smart Watch, smart speakers), the percentage of users ranged from 14% (Cluster I) to 51% (Cluster II). Countries belonging to Cluster I were characterized by the lowest use of this type of equipment compared to other devices. Tablets were declared by 18% to 40% of respondents, while in Groups III and IV their relatively lower popularity was noted compared to other devices. Desktop computers remained in use, but with varying intensity: 23% of users in Cluster I and 35% in Cluster IV. The least frequent access to this type of device compared to other equipment was noted in Cluster II.

The results show the occurrence of an advanced level of digitalization of the countries from cluster II (high indicators for smartphones, IoT and laptops) and the lowest level of technological development for cluster I due to the lowest indicators recorded.

Chart 3. Share of people with access to the Internet by type of device used in 2023 (% of people)



Source: own study based on: Eurostat. Individuals - devices used to access the internet (isoc_ci_dev_i) https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_dev_i__custom_16847222/default/table?lang=en (online access: 1.05.2025).

In addition, the greatest popularity of smartphones is observed as the basic tool for accessing the Internet, which is evidence of their mobility, convenience of use and the availability of cheap mobile data packages. The decrease in the importance of desktop computers may indicate their replacement with portable devices. The greatest popularity of Smart devices in cluster II with a large difference in relation to the other clusters shows that their possession depends on the wealth of society and the level of technological development.

Internet access in various types of Polish households

The next section of the study analyzes internet access in households, taking into account three key criteria: household type, degree of urbanization, and place of residence class. The period studied covers 2008-2024 and reveals significant differences in the level of digitalization between individual groups (Table 4).

In terms of household type, there is a clear advantage for households with dependent children over those without children. In 2024, 100% internet access was achieved among households with children, while for childless households, this rate was 94.3%. The persistent difference of 5.7 percentage points suggests a significant digital gap between these groups. This phenomenon can be interpreted in the context of changing needs and priorities. Full internet access among households with children indicates that it has become perceived as an indispensable tool supporting the education and development of the younger generation. At the same time, this persistent difference may reflect varying approaches to digital technologies and

differences in competencies between parents raising children and those without children.

Table 4. Share and changes in the share of Internet access in various types of Polish households (in %)

Specification		2008	2012	2021	2024	Change in p.p. 2008-2024
Household type	No dependent children	40.9	60.0	88.8	94.3	53.4
	With children to support	61.4	91.5	99.7	100.0	38.6
Degree of urbanization	Low	40.7	65.5	91.9	95.3	54.6
	Medium	44.5	70.6	91.1	95.5	51.0
	High	54.8	74.8	93.7	96.6	41.8
Household location	Rural areas	36.1	66.1	91.8	95.5	59.4
	Smaller cities	50.3	69.5	91.6	95.6	45.3
	Big cities	56.0	75.8	93.8	96.7	40.7
Total		47.6	70.5	92.4	95.9	48.3

Source: own study based on: Główny Urząd Statystyczny, Urząd Statystyczny w Szczecinie (2012-2024). Społeczeństwo informacyjne w Polsce w 2008-2024 r., Szczecin

The degree of urbanization and the class of residence are other factors significantly differentiating internet access. Throughout the entire period under review, a pattern persisted: the higher the level of urbanization, the greater the availability of internet connections. In 2008, the differences between individual areas were particularly pronounced. While in highly urbanized areas, 55% of households reported internet access, in less urbanized areas, this rate was only 41%. Sixteen years later, in 2024, these figures rose to 97% and 95%, respectively, demonstrating significant progress in the digitization process across the country. It is worth noting that the greatest progress in internet access was recorded in areas previously most digitally excluded: the least urbanized (by 55 percentage points) and rural areas (by 59 percentage points). Significant changes also occurred in various types of localities. Internet access was lowest in rural areas, and as cities grew, it became increasingly common. However, in 2024, disparities based on location decreased. Rural residents recorded a lower rate than residents of small towns by 0.1 percentage points and 1 percentage point lower than those of large cities, a dramatic change compared to 2008. This demonstrates the effectiveness of efforts to reduce the digital divide among rural residents, although it should be noted that not all households still have access to the Internet.

Conclusions

The study assessed the level of Internet accessibility of European households, with particular attention paid to households located in Poland in the years 2004-2024. The analyses carried out made it possible to achieve the research purpose set in the introduction to the study.

It was found that the situation in Poland in terms of access to the Internet has improved. For several years, indicators have been above the EU-27 average and increasingly higher positions have been recorded in relation to other Member States. Across all households identified based on location class, degree of urbanization, and household type, a dynamic increase in the share of households with internet access was observed, and disparities between distinct groups, such as rural vs. urban, were diminishing. There were also household types, such as those with dependent children, for which the rate reached 100% in 2024. Nevertheless, having access to the Internet is one of many indicators used to measure progress in the field of digital technologies. In Poland, despite the development of technologies enabling the provision of fast Internet, there is still a lag in this area compared to countries that are digital leaders, which is particularly noticeable in rural areas.

The data presented show that there has been a growing trend in the dissemination of Internet access in all EU-27 countries. Currently, households are highly saturated with this service, which is particularly true in Western and Northern European countries. In the Benelux countries, the Internet access rate reaches values approaching 100%. However, the growth rates are the fastest in the southeastern part of Europe.

To sum up the conducted clustering studies, it should be noted that in the years 2004-2024 there were similarities between individual EU countries in terms of the percentage of households with Internet access. The statistical methods used in the study allowed the separation of four cluster structures, among which the highest results were obtained by countries belonging to cluster II (the Netherlands, Luxembourg, Denmark, Sweden, Finland and Germany), and the lowest for cluster I (Bulgaria, Greece and Romania). The type of devices used by society confirms the occurrence of an advanced level of digitalization of countries from cluster II and the lowest level of technological development for cluster I.

Studies indicate a gradual increase in convergence between EU countries in terms of the analysed indicator. The ongoing changes in the dissemination of the Internet in households contribute to the achievement of the objectives of the EU policy adopted in 2023 "Path to a Digital Decade" [Ministry of Digitization 2025]. However, despite all the investments and policies made recently, differences in access to the internet are visible. Digital exclusion is a serious challenge that can lead to deepening inequalities. Lack of access to the internet limits full participation in social and economic life, thus reducing the quality of life of citizens. The European Union plays a key role in

equalising opportunities between countries. The European Union bodies and the governments of the Member States are creating support programmes and initiatives aimed at developing the internet. Further action in this area is necessary to ensure that all citizens of the Member States have equal access to the benefits of digitalisation. This will also contribute to creating a more inclusive and competitive Europe.

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PART II

DIGITAL ECONOMY AND TRANSFORMING MARKETS

Ejsmont A. (2025), *The digitalization process of the SME sector in the context of cooperative relationships with large economic entities* [in:] Piekut M., Knapková M. (eds.), Digital and Green Transformation in the Context of Households, Markets, and Public Policies. Kolegium Nauk Ekonomicznych i Społecznych, Politechnika Warszawska, Płock.

THE DIGITALIZATION PROCESS OF THE SME SECTOR IN THE CONTEXT OF COOPERATIVE RELATIONSHIPS WITH LARGE ECONOMIC ENTITIES

Aneta Ejsmont •

Summary

The aim of this chapter is to explain the current level of digitization of SMEs by identifying barriers and good practices related to it. The research problem addressed in this study is the excessive costs of implementing the digitization process in small and medium-sized enterprises. In view of the above, strengthening cooperative links with large economic entities seems to be an ideal solution. This chapter will apply a research method that includes analysis and synthesis of material in conjunction with the use of selected econometric tools.
Key words: digitalization, costs, company, cooperation.

Streszczenie

Celem rozdziału jest objaśnienie aktualnego poziomu cyfryzacji MŚP poprzez zidentyfikowanie barier i dobrych praktyk z tym związanych. Problemem badawczym podjętym w opracowaniu są zbyt wysokie koszty wdrażania procesu digitalizacji w działalności małych i średnich przedsiębiorstw. W związku z powyższym, idealnym rozwiązaniem wydaje się być wzmocnienie powiązań kooperacyjnych z dużymi podmiotami gospodarczymi. W niniejszym rozdziale zostanie zastosowana metoda badawcza uwzględniająca analizę i syntezę materiału w powiązaniu z wykorzystaniem wybranych narzędzi ekonometrycznych.
Słowa kluczowe: digitalizacja, koszty, przedsiębiorstwo, kooperacja

JEL: C13; D24; L14

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Introduction

Currently, the economy is undergoing many changes causing both positive and negative consequences. These changes, in particular, concern the widespread process of digitalization, which is becoming an everyday reality. In addition, it also has a huge impact on the competitiveness of businesses. That is why it is so important for SME companies to be able to adapt to new technologies, which, as is widely known, not only streamline the processes involved in doing business on a national scale, but also open up new opportunities for cooperation with large business entities operating internationally and even globally.

Unfortunately, the problem is still that on average 87% of SME companies consider digitization a priority and only half of them have basic digital tools, like website, email, etc. And only 12% use advanced solutions (Big Data, AI). Of course, this is associated with the still high cost of implementing modern technologies to support digitization, for example, such as [investments.pl; BGK 2024; biznestuba.pl]:

- cloud computing (SaaS, PaaS);
- e-commerce and B2B platforms;
- process automation (RPA);
- Data Analytics and Business Intelligence;
- Artificial intelligence (chatbots, demand prediction).

Thus, for the SME sector, digitalization means high costs. Therefore, it is necessary to look for such solutions that could reduce the cost intensity of this process. The solution could be an increased level of cooperation between these companies and large business units, which are usually large capital groups.

This is effective insofar as digitalization has a positive impact on the activities of SME companies through various forms of cooperative ties with larger entities, Through greater cooperation with SMEs, large entities will be able to automate production processes in a more advanced way, introduce digital supply chain management, or implement innovative business models based on data and artificial intelligence.

The chapter will analyze the process of digitalization of SME enterprises supported by the activities of large companies. Both the benefits and challenges faced by smaller business units wishing to be considered more competitive from the point of view of domestic and foreign market development will be discussed. In this connection, an econometric model will be estimated, taking into account the impact of various types of cooperative ties between the studied economic entities on reducing the level of costs of digitalization implemented precisely in these smaller units.

Literature review

Digitalization is increasingly becoming an integral part of our lives, accompanying us almost every day. Thus, also for entrepreneurs, it is becoming a key element that allows them to maintain their level of competitiveness at a high level against other business entities operating in the same or similar industries. In Poland, where small and medium-sized enterprises (including micro-enterprises) constitute a larger percentage compared to large business entities, the need to implement more and more

modern digitization tools becomes particularly important with regard to the SME sector.

In many scholarly studies, digitization or otherwise-digitization is defined in various ways. According to many researchers, in business operations, digitalization is "the improvement and restructuring of business models, processes and operations through the implementation of digital technologies, involving the wider use and application of digital data transformed into useful information" [Antončič et al. 2024: 3].

Digitization, then, is the process of transforming analog information that is, for example, various texts or images into a digital format that can be stored and processed by computers [harbingers.io]. In the era of Industry 4.0 and even 5.0, traditional business processes are being destroyed by new technologies, which contribute to a competitive advantage among those companies that are able to master their use, becoming technological market leaders. In addition, it is becoming known that digital technology influences the final results of both product and process innovations implemented [Ghobakhloo et al. 2023: 432-447], creating the entire process of introducing and using ICT [Lyskawa et al. 2019: 843].

The popularity of the importance of digitization comes down to defining it as a broadly defined digital transformation, which plays an important role in the activities of companies in various industries. Digitization is also a management strategy based on the Resource Based View (RBV) approach, which is widely known to be essential for achieving competitive advantage and improving the financial health of enterprises [Ramon-Jeronimo et al., 2019: 1-26]. The phenomenon under discussion is also significantly influenced by the environmental approach of SME companies, which, as a rule, can support processes that take advantage of market opportunities associated with digitization [Penco et al. 2022: 311-341; Purba and Balqiah 2024: 72].

On the one hand, it can pose a threat to existing business entities from companies bringing groundbreaking yet unique solutions to the market, especially in terms of globalization. On the other hand, the so-called "competition" stimulates these weaker entities into action. New opportunities arise that give them a chance to acquire skills to use new technologies effectively and efficiently through digitization [Xu 2014: 1-5; Schwer et al. 2018: 143]. Therefore, in this case, it becomes so important to establish cooperation between weaker SME companies and large corporations or holding companies.

Through digitalization or digitalization, smaller and less-developing business units can improve their financial performance in an effort to ensure the continuity of strategic goals by creating investment opportunities. By making effective use of digital technologies and at the same time increasing the level of not only competitiveness, but also innovation, companies can introduce new improved solutions in various areas of their business activities [Xiaohan 2023: 97].

Analysis of the cost intensity of the digitization process of the SME sector using selected econometric tools

Digitization of business operations regardless of size brings many benefits, but also many risky expenses associated with it. Digitization in its broadest sense has a very significant positive impact on [PARP 2024: 70]:

- Increasing work efficiency,
- The process of improving communication and cooperation between people,
- Better meeting customer needs.

Switching from analog to digital work means increasing the efficiency and productivity of the company, as a result of which it becomes more competitive with other business entities and thus- more noticeable by business partners operating both in the domestic and international markets. In the era of ubiquitous digitalization, failure to engage in the implementation of new technological inventions in the field of ICT in retrospect becomes tantamount to a huge loss manifested in the form of even bankruptcy of the company. So, whether we want it or not, digitization is increasingly affecting the implementation of innovations.

In the presented chapter, the author tries to prove that small and medium-sized companies even need to cooperate intensively with large economic units. This is confirmed by data on the digital intensity index and ICT expenditures incurred recorded between 2017 and 2023.

In order to analyze the cost intensity of the digitization process of the SME sector on the basis of the collected data, an econometric model carried out by means of the method of least squares, which is a standard tool used in the process of approximating the solutions of indeterminate systems, under which the final result obtained can minimize the sum of squares of errors in solving each equation. In the process of model construction, the following explanatory and explanatory variables were adopted:

y- the explanatory variable describing the digital intensity index recorded by total enterprises between 2017 and 2023;

x_1- explanatory variable describing the percentage of financial outlays allocated between 2017 and 2023 for the purchase of IT and/or telecommunications equipment for small businesses;

x_2- explanatory variable describing the percentage of financial outlays allocated in 2017-2023 for the purchase of IT and/or telecommunications equipment for business activities carried out by medium-sized enterprises;

x_3- explanatory variable describing the percentage of financial outlays allocated in 2017-2023 for the purchase of IT and/or telecommunications equipment for the business activities of large enterprises;

ICT expenditures recorded during the period under study among businesses of different sizes indicated the degree of digital intensity measuring the level of digitization of companies. The data are presented in the table below (see Table 1).

Table 1. Financial data describing the status of the digitization process of enterprises from 2017 to 2023 (%)

Years	Digital intensity index (%)	Expenditures for the purchase of IT and/or telecommunications equipment incurred by small businesses (%)	Expenditures for the purchase of IT and/or telecommunications equipment incurred by medium-sized companies (%)	Expenditures for the purchase of IT and/or telecommunications equipment incurred by large companies (%)
2017	49.5	29.1	60.5	82
2018	56.3	31.4	60.1	82.3
2019	60.4	35	60.4	81.9
2020	0	34.9	63.1	85
2021	58.7	31.6	61	82
2022	37.8	29.8	57	81.4
2023	48.5	32.2	60.2	81.7

Source: Central Statistical Office (2018-2024), Information Society in Poland. Results of statistical surveys in the years 2014-2024, Warsaw, Szczecin

Based on the data presented in the table above, it can be concluded unequivocally that the level of development of digitalization of Polish companies is not the highest. This is evidenced by the data relating to the digital intensity index.

To this end, Eurostat has introduced a digital intensity index. The methodology for estimating this indicator is to assign each company to one of four levels of digital intensity. A point is awarded for each condition met. The sum of the points scored determines the level of digital intensity of the surveyed companies [CSO 2024]. The distribution of points is presented in Table 2.

Table 2. Levels of digital intensity index

Level of digital intensity index	Range of points
Very low	0-3
Low	4-6
High	7-9
Very high	10-12

Source: Central Statistical Office (2018-2024), Information Society in Poland. Results of statistical surveys in the years 2014-2024, Warsaw, Szczecin

The above parameters describing the digital intensity index confirm the fact that throughout the entire period under study, i.e. 2017-2023, the studied volume was practically characterized by a very low level of digitization. Despite the fact that the largest expenditures on the informatization of their activities, both production and services, were made by large business entities, the level of this indicator was still very low. The results obtained, however, were underestimated by companies in the SME sector. This should be explained by the fact that the complete digitalization of processes taking place inside these companies is something very expensive for them.

Therefore, it is very important for them to be able to intensify cooperation with large capital groups in a significant way. This is the only chance to survive in such turbulent times and at the same time a chance to increase the profits they generate.

Estimation of the econometric model

Taking into account the previously described variables adopted for the presented econometric model, one can get the impression that from the point of view of the coefficient of variation, they take quite low values not exceeding the level of 10%. Although in this case, in the author's opinion, it is important to confirm that indeed large business entities spend the most money on IT processes, but this is also the case, as the size of these companies also speaks for itself. Yet the structure of the variables adopted gives rise to such a model, which is presented in the table below (see Table 3).

Table 3. Model 1: OLS, using observations 2017-2023 (T = 7). Dependent variable: y

	Coefficient	t-ratio	p-value	Level of p-value
const	1561.57	4.784	0.0174	**
x_1	0.807106	0.3444	0.7533	
x_2	7.44974	1.876	0.1574	
x_3	-24.2002	-4.245	0.0239	**

Mean dependent var	44.45714	S.D. dependent var	21.05476
Catfish squared resid	312.7031	S.E. of regression	10.20952
R-squared	0.882434	Adjusted R-squared	0.764869
F(3, 3)	7.505887	P-value(F)	0.065967
Log-likelihood	-23.23027	Akaike criterion	54.46055
Schwarz criterion	54.24419	Hannan-Quinn	51.78639
rho	0.101776	Durbin-Watson	1.511545

Source: Own elaboration based on the table 1

As a result of the reduction of the explanatory variable x_1, which had the least influence on the variable y that determines the level of digital intensity of the surveyed companies, the form of the model changed slightly. The new model structure is shown in Table 4.

Table 4. model 2: OLS, using observations 2017-2023 (T = 7). Dependent variable: y

	Coefficient	t-ratio	p-value	Level of p-value
const	1530.98	5.520	0.0053	***
x_2	7.87417	2.362	0.0775	*
x_3	-23.8260	-4.822	0.0085	***

Mean dependent var	44.45714	S.D. dependent var	21.05476
Catfish squared resid	325.0664	S.E. of regression	9.014799
R-squared	0.877786	Adjusted R-squared	0.816679
F(2, 4)	14.36476	P-value(F)	0.014936
Log-likelihood	-23.36599	Akaike criterion	52.73198
Schwarz criterion	52.56971	Hannan-Quinn	50.72635
rho	0.085822	Durbin-Watson	1.524921

Source: Own elaboration based on the table 1

The construction of the estimated econometric model made with the help of Excel and Gretl clearly indicates that in this case we are dealing with a single equation form of the model. Based on the data obtained from the estimation, this can be written in the following algebraic form:

$$Y_t=\alpha_0+\alpha_1 x_{1t}+\alpha_2 x_{2t}+\ldots+\alpha_j x_{jt}+\varepsilon_t \Rightarrow Y_t=\alpha_0+\alpha_1 x_{1t}+\alpha_2 x_{2t}+\alpha_3 x_{(3t)}+\varepsilon_t \ (t=1, 2\ldots n)$$

$$\Rightarrow$$

$$Y_t=\alpha_0+\alpha_2 x_{2(t)}+\alpha_3 x_{3t}+\varepsilon_{(t)}$$

where:
numbers: n - number of units under study,
j - number of explanatory variables,
x_t, α_0, α_1, ..., α_j *- parameters of the model,*
$_{\varepsilon(t)}$ *- random component*

Despite the rather low coefficient of variation, the parameters adopted for the estimation of the linear model confirm that the coefficient of determination R2 is quite high (88%), which speaks in favor of the explanatory variables having a significant impact on the y variable. Similarly, the process of testing the significance of explanatory variables also proceeded. Tests were conducted to confirm the impact of the percentage of financial outlays allocated to the purchase of IT/telecommunications equipment by medium (variable x_2) and large companies (variable x_3) on the percentage value of the digital intensity index in 2017-2023 (7 observations). The results obtained are as follows:

Non-linearity test (squares):
Null hypothesis: relationship is linear
Test statistic: LM = 5.24741 with p-value = P(Chi-square(2) > 5.24741) = 0.0725337

Non-linearity test (logs):
Null hypothesis: relationship is linear
Test statistic: LM = 5.24777 with p-value = P(Chi-square(2) > 5.24777) = 0.0725205

RESET test for specification:
Null hypothesis: specification is adequate
Test statistic: F(2, 2) = 2.73735 with p-value = P(F(2, 2) > 2.73735) = 0.267569

White's test for heteroskedasticity:
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 6.94197 with p-value = P(Chi-square(5) > 6.94197) = 0.224992

White's test for heteroskedasticity (squares only):
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 5.5289 with p-value = P(Chi-square(4) > 5.5289) = 0.237201

Breusch-Pagan test for heteroskedasticity:
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 0.176403 with p-value = P(Chi-square(2) > 0.176403) = 0.915576

Breusch-Pagan test for heteroskedasticity (robust variant):
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 0.222647 with p-value = P(Chi-square(2) > 0.222647) = 0.894649

LM test for autocorrelation up to order 1:
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.0174181 with p-value = P(F(1, 3) > 0.0174181) = 0.903356

Test for ARCH of order 1:
Null hypothesis: no ARCH effect is present
Test statistic: LM = 0.147188 with p-value = P(Chi-square(1) > 0.147188) = 0.701237

QLR test for structural break:
Null hypothesis: no structural break
Test statistic: chi-square(3) = 7.13268 at observation 2021 with asymptotic p-value = 0.440975

CUSUM test for parameter stability:
Null hypothesis: no change in parameters
Test statistic: Harvey-Collier t(3) = -0.489425 with p-value = P(t(3) > -0.489425) = 0.658093

The obtained results of the tests used in the estimation process of the econometric model confirm the fact that the model is not very ideal from the point of view of matching variables. Although the accepted null hypothesis H_0in the RESET RAMSEYA test, assuming that the specification is adequate due to the presented model structure, was positively verified (test statistic: F(2. 2) = 2.73735 with p-value = P(F(2. 2) > 2.73735) = 0.267569. The results of the Breusch-Pagan test for heteroskedasticity also clearly indicate that the hypothesis H_0assuming "heteroskedasticity does not occur", just as autocorrelation does not occur.

Conclusions

On the basis of the literature review as well as the estimation process of the linear econometric model, it was clear that the level of digitization of the SME sector in Poland in 2017-2023 remained at a relatively low level, as confirmed by the values of the digital intensity index. The main reasons for the situation can be attributed to the fact that the process of digitization of activities carried out by small and medium-sized companies is a high cost of digital transformation and limited technological and human resources.

The analysis of the data presented above shows that the largest financial expenditures on ICT solutions were made by large business entities, which is confirmed by the results of the econometric model - especially the x3 variable. They are the ones who act as technological leaders in the economy.

An econometric model with a high coefficient of determination $R^2$of about 88% confirms the significant impact of large and medium-sized companies' investments in ICT on the level of digitization of the entire sector. Although the model is not perfect, the statistical tests performed (Ramsey's RESET, Breusch-Pagan) do not indicate significant deviations in its structure.

Given the high cost of digitizing internal processes, collaboration between SMEs and large business units is key to accelerating digital transformation. Through it, smaller companies can gain access to know-how, infrastructure and technological solutions that they could not afford on their own. Thus, maintaining and developing cooperative cross-sector relationships can increase SMEs' competitiveness and improve their adaptability in a volatile economy and ongoing digitization increasingly supported by AI.

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FROM E-MENU TO VIRAL - AN OVERVIEW OF CREATIVE MARKETING STRATEGIES IN THE GASTRONOMY INDUSTRY

Weronika Łosiewicz •

Summary

The digital transformation of the modern economy is significantly shaping business models and marketing strategies for enterprises. The gastronomy sector provides an interesting example of an industry in which digitisation, changes in consumer behaviour and the growing importance of the experience economy influence the way communication with customers is conducted, sales processes are organised and the offer is created. The aim of this article is to analyse selected concepts of creative marketing in Polish gastronomy in the context of adaptation to the conditions of the digital economy. The article discusses how restaurants implement modern technologies and respond to changing consumer expectations, shaping new forms of relationships between gastronomy and its customers. Based on market reports and an analysis of current trends, it identifies how digitalisation redefines the restaurant-customer relationship and how the gastronomy industry serves as a micro-example of broader socio-economic transformations.

Key words: restaurant, creativity, marketing, UGC, user-generated content, creative marketing, viral, social media

Streszczenie

Transformacja cyfrowa współczesnej gospodarki w istotny sposób kształtuje modele prowadzenia działalności i strategie marketingowe przedsiębiorstw. Branża gastronomiczna stanowi interesujący przykład sektora, w którym cyfryzacja, zmiany zachowań konsumenckich oraz rosnące znaczenie gospodarki doświadczeń wpływają na sposób komunikacji z klientem, organizację procesów sprzedażowych oraz kreowanie oferty. Celem artykułu była analiza wybranych koncepcji kreatywnego marketingu w polskiej gastronomii w kontekście adaptacji do warunków gospodarki cyfrowej. W artykule omówiono, w jaki sposób restauracje wdrażają nowoczesne technologie i reagują na zmieniające się oczekiwania konsumentów, kształtując nowe formy relacji na linii gastronomia - klient. Na podstawie raportów rynkowych oraz analizy aktualnych trendów wskazano, jak cyfryzacja redefiniuje relację restauracja - klient oraz jak branża gastronomiczna staje się mikroprzykładem szerszych przemian społeczno-ekonomicznych.

Słowa kluczowe: gastronomia, kreatywność, marketing, UGC, user generated content, kreatywny marketing, viral, media społecznościowe

JEL: M14, M21, M31, M37

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Introduction

In recent years, digital transformation has profoundly reshaped the rules of the game across nearly all sectors of the economy. Not long ago, the success of a restaurant relied primarily on its location, the quality of its cuisine, and its pricing. Today, in a world dominated by social media, FOMO, and rapidly shifting trends, competitive advantage is increasingly built through experience, creativity, and the skilful use of technology. The modern consumer is a digital citizen-aware, demanding, and engaged. Before choosing a restaurant, they browse TikTok and Instagram, rely on recommendations from friends and influencers, and seek not only good food but also an immersive "experience" associated with the visit-one they are equally eager to document and share online. At the same time, restaurateurs face economic challenges, including rising operational costs, intense competition, and pressure to innovate. The response to these challenges lies in creative marketing, where technology functions as a key tool and the core currency is authenticity and customer engagement.

The aim of this article is to review inspiring and effective concepts of creative marketing in the Polish gastronomy sector, to demonstrate their role in shaping competitive potential within the digital economy, and to illustrate how the gastronomy industry serves as a case study of broader processes of digital transformation in the economy.

The gastronomy market in Poland

The gastronomy sector remains an important segment of the Polish service economy, showing signs of a clear recovery from the pandemic turbulence, but at the same time struggling with new structural and cost challenges. According to the data from the Central Statistical Office (GUS), in 2023 the market structure was made up of about 93.3 thousand gastronomy establishments, both permanent and seasonal, which means an increase of 11.2% compared to 2022 [GUS 2024]. In terms of facility types, 40.4% were foodservice outlets (e.g. . small fast food establishments), 28% restaurants, 26.2% bars and 5.4% canteens. This structure confirms the growing popularity of smaller, more flexible formats that address changing consumer preferences and cost challenges related to premises rental or staffing. Total revenues from foodservice activities, measured in current prices, amounted to approximately PLN 76.7 billion, marking an 18.6% increase compared to the previous year (in constant prices, the increase was 4.2%). This dynamic growth reflects, on the one hand, heightened demand for foodservice offerings, and, on the other hand, inflationary pressures and rising operational costs.

Transformation of the foodservice market reflects broader trends within Poland's service economy, where in 2023 gross value added from services accounted for 63.6% of the total gross value added of the national economy, and the share of the

"accommodation and food service activities" sector (section I of the Polish Classification of Activities - PKD) in the structure of service value added stood at approximately 2.7%. Although this share is relatively small, the gastronomy sector is highly fragmented and local in nature, and its role extends beyond a purely economic dimension, influencing social life, consumption patterns, and local identity.

It is worth noting the geographical diversity of the sector: revenues from foodservice activities constitute a significant component of Poland's retail sales (approximately 6% of total retail sales in commercial outlets in 2023), yet their regional distribution reflects the concentration of demand in major metropolitan areas and tourist destinations. From an economic development perspective, the foodservice sector faces challenges related to rising labour and energy costs, as well as the need to meet customer expectations in terms of quality, innovation, and sustainability. The dynamic growth in the number of establishments and nominal revenues does not eliminate potential threats. In addition to operational and staffing cost pressures (including the rising minimum wage), the sector must address the necessity of investing in digital solutions, marketing tools, and logistics systems. In this context, digital transformation and marketing creativity emerge as key determinants of the competitive capacity of Polish foodservice enterprises, enabling them not only to foster customer loyalty but also to optimise processes and improve profitability in a challenging economic environment.

New consumer exprectations and behaviors

Changing economic conditions, digitization and the evolution of lifestyles are significantly transforming the consumption patterns of gastronomy services in Poland. A particularly relevant perspective in the analysis of contemporary market phenomena, including gastronomy, is the concept of the experience economy, developed by Pine and Gilmore [Pine, Gilmore 1999: 2]. These authors argue that the economy has evolved from the simple exchange of raw materials in the agrarian era, through the production of goods in the industrial age and the provision of standard services, towards a model in which the key element of value is delivering unique, emotionally engaging experiences to the customer. In this view, the primary differentiator is not only the quality of the product but, above all, the overall set of impressions and interactions offered to the customer. It is precisely experiences and emotions that build a competitive edge and serve as the main source of customer satisfaction.

In the present day, the growing value of services and the need to deliver emotionally charged experiences to audiences are clearly visible [Stasiak 2016: 193]. Experiences are no longer an independent economic category detached from the product or service; rather, they are inseparably linked to them, adding extra value.

Experiences and emotions build competitive advantage and form the primary source of customer satisfaction [Rapacz 2021].

The principles of the experience economy find particularly strong expression in the context of the foodservice industry. Dining establishments are no longer solely places to consume meals; they have become spaces for experiencing, creating memories, and generating emotional responses that shape consumer decisions and customer loyalty. In a market characterised by saturation and growing competitiveness, advantage is gained by those entities that can give their offering a unique character aimed at delivering experiences [Kacprzak, Gralak 2021: 68].

The characteristic features of the experience economy in gastronomy take concrete, practical forms [Marciszewska 2010; Żemła 2017]:

- strong connection between experience and product consumption - in a restaurant, it is no longer just about the taste of the food but also the overall environment, such as interior aesthetics, music, customer service, dish presentation, or serving style. The experience often begins in the digital channel (e.g., through interaction with the brand on social media) and lasts until the moment the customer leaves the venue;
- creating experiences through modern technologies - e-menus with interactive dish presentations, data-driven recommendation systems, loyalty apps, or storytelling narratives;
- customer immersive experience - the modern visitor doesn't just want to "order and eat". He expects active participation, personalization, the possibility of interaction with the brand;
- personalization of the offer - guests' expectations are increasingly moving towards matching - not only in terms of diets, but also in terms of service, communication or interaction in the space of the premises.

An analysis of current data on the HoReCa market in Poland reveals clear signs of a return to real growth following the crisis period caused by the COVID-19 pandemic and inflationary shocks. According to the PMR report “HoReCa Market in Poland 2024”, key factors supporting sector growth include improvements in the macroeconomic environment, reduced inflation, recovery of tourist traffic to pre-pandemic levels, and increased household purchasing power [PMR Market Experts 2024]. At the same time, consumer habits are changing. In recent years, high inflation and rising living costs limited Poles’ propensity to spend on dining out. Currently, there is a noticeable improvement in consumer sentiment and a growing willingness to use foodservice offerings.

Table 1. Consumer expectations of contemporary gastronomy - key areas

Area of expectations	**Category Description**	**Examples of consumer requirements**	**Implications for restaurateurs**
Price and availability	attractive price, convenient locations, fast service	preference for fast food, comfort food, casual dining	the need to optimize costs and processes, standardization of the offer
Quality and hygiene	high sanitary and culinary standards	freshness of ingredients, cleanliness of the room, kitchen and bathrooms	implementation of sanitary standards, staff training, transparency
Statement and convenience	comfortable, relaxed atmosphere, aesthetic interior	cafes, confectioneries, bakeries with a cozy design	investment in design, understanding the needs of the guest
Recommendations and opinions	the impact of social media and opinion platforms on the choice of accommodation	Google Maps, TripAdvisor, Instagram	active online reputation management, word-of-mouth marketing
Uniqueness and authenticity	own recipes, local products, storytelling	homemade pastries, preserves, regional cuisine	creating a unique offer
varied menu	Responding to new lifestyles and diets	world cuisines, vegan/vegan dishes, premium dishes	flexible card planning
beverage offer	locality, non-alcoholic alternatives	homemade lemonades, home-made drinks, mocktails	cooperation with local producers
ecology	sustainable practices and transparency of activities	local suppliers, seasonality, zero waste	Supply chain alignment, environmental communication
Technology and digitalization	Modern service and ordering channels	deliveries, apps, QR menus, order kiosks	investments in IT infrastructure, integration of ordering and delivery systems

Source: own work based on ARC Rynek i Opinia, Made for Restaurant Report. Market research and report 2024/2025. An informative contribution for the future of Polish gastronomy. The perspective of restaurateurs and guests.

A broader perspective on consumers is provided by the Made for Restaurant report prepared by the research agency ARC Rynek i Opinia [ARC Rynek i Opinia, 2024]. It shows that among the key expectations of today's buyers are convenience,

affordability, and high-quality service. The areas of consumer expectations presented in Table 1 define the framework within which modern gastronomy must design its competitive strategies.

For the modern customer, affordability and convenience are of key importance. Consumers are eager to choose concepts such as fast food, comfort food or casual dining, which provide attractive prices and a relaxed atmosphere. The challenge for restaurateurs is to maintain quality under cost pressure and to provide comfortable and fast service. At the same time, guests demand high standards of quality and hygiene, which forces restaurateurs to invest in transparent processes and professionalization of staff. The growing importance of the consumption experience, understood both as a comfortable atmosphere and the aesthetics of the interior, means that premises must serve as a place that integrates guests in a friendly space. Another important aspect is the role of recommendations and online presence. Consumers base their decisions on the opinions of their friends and reviews on social media and platforms such as Google Maps or TripAdvisor. Restaurants that invest in online activity and professional review service gain an advantage in the fight for customers. At the same time, consumers appreciate the uniqueness and authenticity of the offer - they appreciate homemade pastries, homemade preserves and local ingredients that allow for culinary storytelling and building brand identity. Variety in the menu is also becoming more and more important - from classic Polish cuisine to exotic Asian, South American or premium dishes. No less important are the issues of ecology and sustainable development, which consumers notice and reward - both through their choices and recommendations. Restaurants must therefore implement strategies to reduce food waste, reduce plastic or support local suppliers. The last element among buyers' expectations remains technology. Digitization of processes, service and communication is becoming an indispensable element of modern gastronomy management, affecting the convenience, efficiency and image of the company.

In light of the above observations, it should be noted that in the foodservice industry, designing experiences that respond not only to functional needs but also to the sphere of emotions and social interaction is gaining increasing importance. Customers do not limit themselves to assessing the price or quality of dishes, but make decisions based on the atmosphere of the place, its aesthetics, image in social media or recommendations of other guests. This phenomenon is reflected in the concept of co-creation of value, in which the customer is not a passive recipient of the service, but an active participant in shaping it [Majchrzak 2014: 30].

Digital technologies as the foundation of modern gastronomy marketing

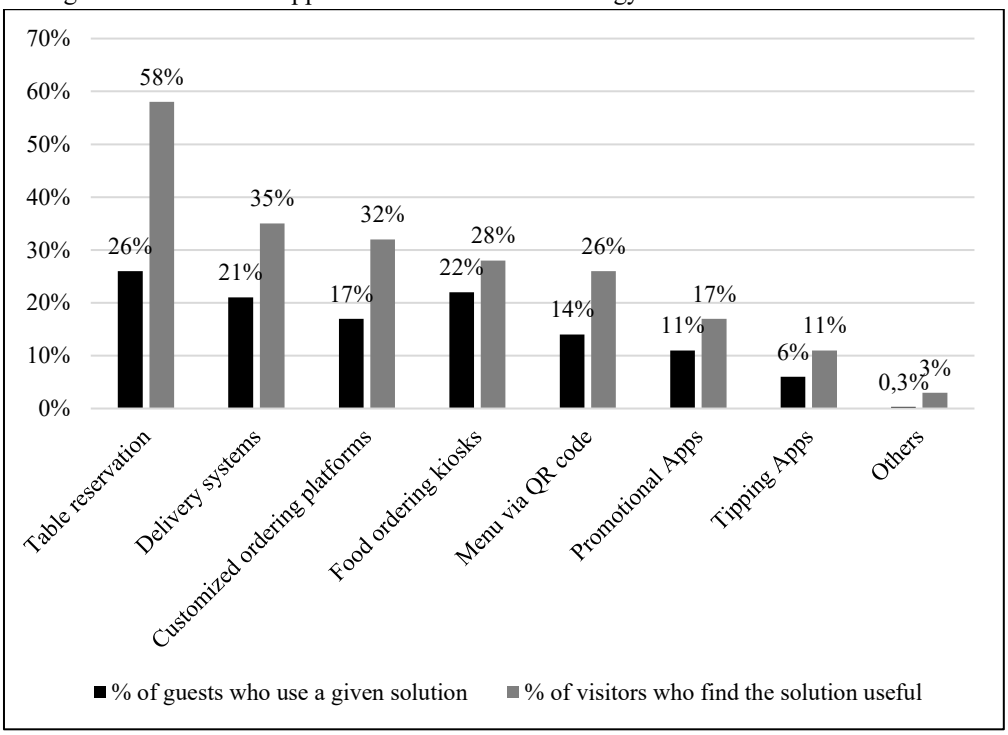
Digital transformation is redefining the way the gastronomy market operates in Poland and around the world. Digital technologies have ceased to be just an operational support, but have become a key element of the marketing strategy and a source of competitive advantage. In the literature on the subject, it is increasingly emphasized that digital innovations affect not only the efficiency of business processes, but above all the building of customer relationships and the creation of experiences [Vangjel 2021].

An analysis of contemporary consumer behaviour clearly shows that expectations towards dining establishments are no longer limited solely to product quality or affordable prices. Factors such as convenience, speed of service, online availability, and the possibility to review the offer in advance are becoming increasingly important. Thus, modern technologies are not only operational tools but also essential marketing instruments, directly shaping the customer experience and building competitive advantage in the rapidly changing gastronomy market.

In the digital economy, where the consumer has almost unlimited access to information and opinions, digital solutions gain crucial importance. According to the ARC Rynek i Opinia report, most customers today use technological solutions. This results from the fact that customers not only seek convenience and time savings but also expect smooth and integrated communication with a gastronomic venue - from the moment of discovering the offer online, through ordering and payments, to maintaining loyalty relationships.

Digitalisation has become an indispensable foundation of gastronomy marketing, enabling personalisation of the customer experience, automation of service processes, and effective use of data on buyer preferences. In this context, gastronomy marketing is no longer a one-way advertising message but becomes an interactive system of customer relations. Data from the report provide a detailed picture of this phenomenon (Figure 1).

Figure 1. Consumers' approach to the use of technology in restaurants



Source: own work based on: ARC Rynek i Opinia Made for Restaurant, Made for Restaurant Report. Market research and report 2024/2025. An informative contribution for the future of Polish gastronomy. The perspective of restaurateurs and guests

As many as 66% of guests of gastronomy establishments who took part in the survey (n = 938) declare that they use at least one technological solution during their visit to a restaurant. Analyzing detailed preferences, online booking systems came first. As many as 58% of respondents (544 people out of 938 respondents) assessed it as a useful tool, although 26% of respondents actually use it. This difference between recognized utility and real-world use can be interpreted as a signal of growth potential - customers see the value of such solutions, but not everyone has easy access to them or the habit of using them yet. The second important area is delivery systems. The usefulness of this service is declared by 35% of respondents, while 21% use it. This is due, among other things, to the growing popularity of the convenience model and the change in the lifestyle of consumers, who expect quick and convenient access to the gastronomic offer without having to leave home. Individual ordering platforms, which allow customers to place orders at the table or remotely, were considered useful by 26% of respondents, compared to 17% of respondents (160 respondents). Similar results were recorded for food ordering kiosks, where 14% actually use the solution, and 26% consider it useful in restaurants. These solutions allow for automation of service and reduction of labor costs, while increasing convenience for customers who

value independence and speed of the purchasing process. Less popular but growing services such as promotional apps (e.g., Too Good To Go, Foodsi) that reduce food waste and address customer sustainability expectations and tip apps are worth noting. Although they are not often used, more and more people decide to test such solutions, even out of pure curiosity.

It is worth noting that the difference between the percentage of people using and those who see the usefulness of technological solutions signals further growth potential. This is a clear indication for entrepreneurs about the need to invest in technologies that not only increase operational efficiency (reducing workload, speeding up service), but also build added value in the eyes of the customer.

Digitalization in gastronomy is no longer just a trend or a development option - it is a requirement of the modern market and the foundation of a marketing strategy. Restaurants that can effectively implement and use modern technologies gain a competitive advantage through a better understanding of the customer, higher process efficiency, and the ability to respond quickly to changing market conditions and consumer preferences.

Creative marketing concepts overview

In the face of increasing competition, changes in consumer preferences and the intense penetration of communication into the social media sphere, traditional marketing strategies turn out to be insufficient. To attract the attention of recipients, restaurateurs are increasingly reaching for non-standard, creative solutions that not only support sales, but also build engagement, emotional bond with the brand and consumer loyalty.

One of the most distinctive trends is designing venues with "Instagrammable" or "Pinterest-worthy" decor - shaping the space in such a way that it encourages guests to take photos and share photos on social media. In the era of visual culture, the interior of the premises has become an inseparable element of the marketing strategy (Photo 1). This is particularly evident in the specialty café segment, which, in addition to high-quality products, offer customers aesthetically pleasing spaces designed for photography. Every detail, from the color of the walls to the service to the way drinks are served, is designed to encourage guests to create and share content on social media.

Photo 1. "Instagram interiors that sell" - visualization of the interior of a café

Source: OpenAI. (2025). AI graphics generated in DALL· E (ChatGPT-4)

Specialty cafes in Poland have not only raised the standard of coffee served, but also the aesthetics of the entire experience. Every detail is to inspire you to create content. The result is organic reach generated by the customers themselves, who act as brand ambassadors and each of their posts is a form of authentic recommendation. This is a strategy based on the mechanism of the so-called *earned media* [Zhou, Li et al. 2023] and *user generated content* (UGC) [Santos 2022].

At the same time, the popularity of digital solutions such as e-menu available through QR codes, which are not only a convenience for service and the customer, but also an element of a modern, hygienic and sustainable approach to running a restaurant, is growing (Photo 2).

Photo 2. E-menu via QR code

Source: OpenAI. (2025). AI graphics generated in DALL·E (ChatGPT-4)

Such a menu allows you to dynamically update the offer, present allergens and dietary preferences, and even personalize recommendations based on previous orders. Digital solutions reduce printing costs, support ecology and build the image of an innovative brand that meets the expectations of modern customers.

Another creative concept in the marketing of the gastronomy industry is the flexible adaptation of the menu to current trends and seasonality. The gastronomy industry is increasingly acting like a fashion sector here - constantly keeping track of new inspirations and immediately incorporating them into the offer. Products such as strawberry matcha, pumpkin spice latte or Dubai chocolate are perfect examples of how a single ingredient or culinary concept can gain global popularity thanks to viral social media (Photo 3).

Photo 3. Viral dishes

Source: OpenAI. (2025). AI graphics generated in DALL·E (ChatGPT-4)

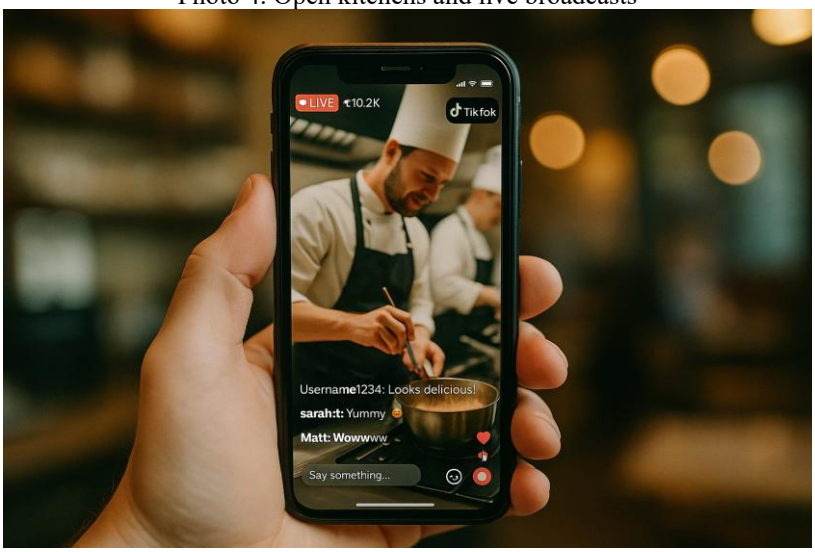
Cafes and restaurants that can quickly adapt to such a trend gain an advantage in the customer's minds as a place "up-to-date", attractive and worth visiting. The phenomenon of virals in gastronomy is increasingly cultural and social, not just qualitative [Theodorakopoulos, Theodoropoulou, Klavdianos 2025]. Contemporary consumer decisions are strongly dependent on the dynamics of popularity in social media, and the role of the main igniter is played today by influencers, celebrities and popular Internet creators. All it takes is one TikTok video, Instagram story or podcast recommendation for a specific product, regardless of its taste or quality, to become desirable in the eyes of thousands (and often millions) of recipients. Such phenomena have a huge marketing potential because they trigger strong psychological mechanisms: the desire to belong, the fear of exclusion (*FOMO*), as well as the need to participate in something current and common. Consumers, especially the younger ones, want to be part of the community, try what others are talking about, what appears on friends' stories and what is commented on online. Often, it is "being up to date" that counts more than real satisfaction with the product. It happens that even an average quality dessert, if properly presented by a famous person, will become something worth standing in queues for hours. The sooner a restaurant identifies and adapts such a trend, the greater its chance that the customer will try a viral dish in this place, because the trend has not reached competing establishments.

In practice, this means the need to constantly monitor trends in social media, analyze consumer behavior and a flexible approach to creating an offer.

Another trend in food marketing is the growing popularity of open kitchen concepts and live broadcasts from the culinary background (Photo 4). Restaurants are

increasingly abandoning the classic division into back rooms and rooms, exposing the process of preparing dishes as part of the customer experience. An open kitchen becomes a kind of "culinary show", in which the guest not only orders a dish, but also watches its creation.

Photo 4. Open kitchens and live broadcasts



Source: OpenAI. (2025). AI graphics generated in DALL·E (ChatGPT-4)

Additionally, many restaurants use social media to broadcast live from the kitchen, showing the cooking process in real-time. Such broadcasts are popular especially on TikTok or Instagram and generate huge engagement. Viewers are eager to comment, ask questions and feel part of the event, which builds emotional attachment to the brand. Such solutions work not only in terms of marketing, but also reputation, showing transparency and authenticity. For the customer, it is a signal: "We have nothing to hide, we want to share what we do." As a result, the restaurant gains trust and stands out from the competition.

Another innovative trend is the creation of spaces that combine gastronomy with other functions, such as bookstores, delicatessens or art galleries (Photo 5). Such concepts are not only a response to economic changes, but above all a well-thought-out marketing strategy.

Photo 5. A concept combining a café with a bookstore

Source: OpenAI. (2025). AI graphics generated in DALL·E (ChatGPT-4)

A café combined with a bookstore or a café where we can buy fresh products straight from a local supplier offer the customer something more than just food or a drink. They give them a reason to spend more time in the restaurant and establish a deeper relationship with the brand. These spaces also allow for storytelling. They are a place for interaction and building local identity, and additional elements, such as book sales, increase revenue and brand recognition.

Particular attention should also be paid to the concepts of marketing with a mission, which have been gaining importance in recent years. An example is the increasingly opened cafes and restaurants where elderly people or people with disabilities are employed . Such an example are cafes where the staff is mainly people with Down syndrome (Photo 6).

Photo 6. Staff of a café where people with Down syndrome are employed - an example of marketing with a mission

Source: OpenAI. (2025). AI graphics generated in DALL·E (ChatGPT-4)

It is primarily a social project that communicates values. Customers are eager to choose such places not only because of the gastronomic offer, but above all because of the need to participate in something valuable, to create a kind of mission. Visits to such establishments are eagerly reported on social media and build organic reach. What is more, the media themselves are often interested in such initiatives, which further strengthens the image of the restaurant as socially responsible and committed.

The common denominator of the presented creative solutions is the shift of emphasis from the product to experience, emotions and values. It is not only a marketing strategy, but also a response to the changing expectations of consumers, who increasingly want their choices to be conscious, meaningful and socially responsible.

Conclusions

Changing consumer expectations and behaviors force gastronomy entrepreneurs to adapt their business models to the logic of the digital economy and the experience economy. Success in the market no longer depends solely on the price or quality of the product, but also on the ability to build relationships with the customer, flexibility, the ability to respond to trends and the effective use of technology in communication

and guest service. Early adaptation of the trend allows you to gain an advantage in the customer's mind, and the name or aesthetics of the product become an element of brand storytelling and attract attention, especially of younger consumers who value "being up-to-date". In the age of the digital economy, even viral is not just a random phenomenon - it is becoming a planned and strategically used marketing tool. Quick reaction, cooperation with micro-influencers, aesthetic presentation of dishes and ease of sharing experience are becoming key elements of modern marketing.

Importantly, it turns out that the choice of restaurant is no longer random at all. It starts much earlier on the Internet - on platforms such as Google Maps, TripAdvisor or in social media, which act as a virtual website and source of recommendations.

Technological solutions are becoming an integral part of the consumer experience, enabling personalization of the offer, automation of service and building lasting relationships with customers. In practice, this means not only the possibility of faster and more convenient ordering, but also access to personalized recommendations, loyalty programs or promotions tailored to the user's preferences. Guests benefit from delivery systems, individual online ordering platforms, self-service kiosks or e-menus accessible via QR codes. In the conditions of strong competition and changing consumer moods, the skilful use of modern technologies becomes the key to building market advantage and lasting value for the customer.

The above phenomena indicate the multidimensional nature of the transformation of the gastronomy market in Poland. On the one hand, we are observing a recovery in demand and an increase in readiness to eat out, on the other hand, changes in customer expectations, who emphasize authenticity, personalization of the experience and pro-ecological practices of restaurants, are becoming increasingly important.

Modern gastronomy marketing is not limited to advertising or price promotions, but is based on creating integrated, engaging experiences and a multidimensional relationship with the recipient. Gastronomy is becoming not only a place of consumption, but also a platform for narrative, social responsibility and personalized experiences - and each of these elements is an investment in a sustainable competitive advantage in an increasingly demanding market.

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UNLOCKING THE POTENTIAL OF DIGITAL MARKETING AMONG NIGERIA'S SMALL-SCALE AGRIPRENEURS: A SURMOUNTABLE CHALLENGE?

Kassim Akanni •

Summary

Marketing of agricultural products by small-scale agripreneurs in southwest Nigeria has been predominated by a traditional approach involving physical face–to–face negotiation and payment systems with low levels of efficiency, adulteration of produce, limited market access, and low returns on investments. Thus, the digital marketing system presents a better alternative that promises high productivity, a wider customer reach, enhanced income on investment, and better economic growth. But there are challenges to achieving the full potential of digital marketing, particularly among small-scale agripreneurs. This study, therefore, investigated these challenges among 160 small-scale agripreneurs, with a view to overcoming them. Findings indicated that 75.6% of these agripreneurs had less than 4.0% of their marketing operations fully digitized, while the average rate of digital marketing application was 2.78%. Again, 76.25% of the respondents agreed that there was a positive relationship between digital marketing and the sales volume of agricultural products. Only 65.63% of the agripreneurs had up to 4 years of experience in digital marketing, while the mean period of digital skill is 3.3 years. More funding and better equipment and tools are required to further solve digital marketing challenges.

Key words: Agricultural Products; Challenges; Digital Marketing; Marketing Efficiency; Potential; Small-Scale Agripreneurs.

Streszczenie

Marketing produktów rolnych wśród drobnych przedsiębiorców w południowo-zachodniej Nigerii wciąż opiera się głównie na tradycyjnych metodach – negocjacjach bezpośrednich, mało efektywnych płatnościach, ograniczonym dostępie do rynku i niskich zwrotach z inwestycji. Marketing cyfrowy oferuje alternatywę, zapewniającą większą produktywność, szerszy zasięg klientów i wyższe dochody, lecz jego pełne wykorzystanie napotyka bariery. Badanie 160 rolników wykazało, że 75,6% z nich miało poniżej 4% operacji w pełni zdigitalizowanych, a średni poziom wykorzystania marketingu cyfrowego wynosił 2,78%. Jednocześnie 76,25% respondentów potwierdziło pozytywny wpływ digitalizacji na sprzedaż. Większość (65,63%) posiadała do 4 lat doświadczenia w tym obszarze, przy średnim poziomie kompetencji cyfrowych wynoszącym 3,3 roku. Dalszy rozwój wymaga zwiększonych nakładów finansowych oraz lepszego dostępu do sprzętu i narzędzi cyfrowych.

Słowa kluczowe: Produkty rolne; wyzwania; marketing cyfrowy; efektywność marketingu; potencjał; mali przedsiębiorcy rolni.

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Introduction

Digital Marketing and Nigeria's Small scale-Scale Agriculture

Digital marketing is broadly defined as a marketing method which leverages on online tools and platforms. With these tools, farmers can access wider markets, improve product visibility, and enhance sales of goods and services. Digital marketing holds significant potential for agribusiness development and rural economic growth in Nigeria because it is capable of boosting the productivity, incomes, and the Gross domestic product of the nation. More specifically, digital marketing expands the market reach and sales of the Nigerian agripreneurs. It allows farmers to connect with buyers beyond their immediate geographical areas, and thus, significantly expanding their market reaches. Online platforms are able to facilitate direct sales to consumers, bypassing the traditional intermediaries and by so doing increasing farmers' profits. Online platforms and social media are also able to increase the visibility of agricultural products, making them more accessible to a wider range of customers.

Digital marketing also improves agriprenuers' efficiency and reduces costs. Transportation costs and time spent in traditional marketing activities such as warehousing and insurance costs are largely reduced since agricultural commodities may not necessarily be moved to the doorsteps of the customers before selling them. Similarly, digital marketing allows for targeted campaigns, ensuring that marketed products reach the desired audience, with the hope of maximizing returns on business investments. Digital platforms also provide information on consumer preferences and market trends. This information is capable of shaping the agripreneurs' production and marketing decisions. Again, digital marketing enhances the economic activities of the small-scale agripreneurs, usually through increased incomes and improved livelihoods. The growth of digital marketing can also create new jobs and economic opportunities among small-farm holders. Finally, digital marketing helps to improve food security status of the nation by connecting the farmers and the markets, thus enhancing people's access to food.

In spite of the numerous benefits of digital marketing, many small-scale agripreneurs in southwest Nigeria are still having huge challenges accessing digital marketing especially in the agricultural sector, because of the striking limitations in the industry. This study therefore, investigated the challenges that confront scale-scale agripreneurs in digital marketing of agricultural commodities and established the pathway for a prosperous future for the stakeholders in agrifoods industry in southwest Nigeria.

Nigeria's agricultural marketing space: A Preview

Marketing of agricultural commodities in Nigeria is confronted with huge challenges such as poor and inadequate rural infrastructures (like silos, cribs and yam barns),exorbitant transportation costs,inefficienct packaging and processing facilities, lack of uniform weighing/measuring apparatus, adulteration of produce and instability of prices, among others [Abbott, and Makeham,1979,61-68; Adeyokunnu,1969,88-115; Adegeye and Dittoh, 1985,33-36].These challenges often limit the marketing efficiency of agricultural products within the distribution space and thus constitute a hindrance to food security status of the nation [Adeyokunnu,1969,88-115].Nigeria is largely endowed with lots of agricultural commodities which are distinctly spread across its geographical space. The types, quantities and quality of these commodities which are produced at a particular locality are often determined by the agro-ecology and the predominant human factors in the environment. The nature and texture of the soil, topography, vegetation, climate, water bodies, and floodplains, among other factors, make up the agro-ecology while activities such as animal husbandry, fish farming, and road construction, mining and lumbering are common human efforts that influence the level of output of agricultural produce.

Major agricultural commodities in Nigeria include cocoa, coffee, cashew nut, kolanut (*cola nitida*),fruits (such as *amaranthus spp.,celocia spp*.and okra), fish and shrimps, oil and oil seeds, foodgrains (such as maize, millet, soybean, beniseed, sorghum and cowpea).Others include root and tubers (such as cassava, yam, potato, and cocoyam) and spices (such as ginger, turmeric, onion and garlic).In addition, Nigeria has livestock products, (such as pork, beef, mutton, egg, chevon, chicken and turkey),among others. There are also forest products,(such as *gmelina spp*, mahogany, *obeche* and iroko) and non-timber forest products (such as leafy vegetables, and mushrooms, *irvingia garbonensis*) and wild games like antelope, monkey, grass cutter, snails and snake, among others

The consumption of these animals and plant products provides Nigerians the nutrients required for growth, energy for work and quick recovery from disease attack and infections. Again, the production, processing and marketing of these products serve as major sources of employment, and income for many people. However, the places of production and consumption of the products are separated across long distances. Thus, seller and buyers need to ensure an effective marketing system to make the exchange of the commodities possible among the consumers. Again, since most of these agricultural commodities are produced by small-scale agripreneurs who are often located in the rural areas, a lot of resources need to be deployed ,through effective transportation, storage/warehousing and processing to move the items to the markets, which are usually located in the urban centres, where increased aggregate demand is better assured. Marketing of agricultural commodities generally entails all activities that are involved in the process of moving the commodities from the point

of production, through intermediaries, to the point of consumption or retailing. During this process, various forms of utility (or satisfaction) are derived by the consumers of the products. This utility could be in terms of form, time, place, and possession and they are achieved by processing, storage, transportation and change of ownership respectively. Akanni [2021, 92-103] viewed a market as a location, time or place where people money for goods and/or services. It could be a face-to-face contact, by mail, through telecommunication, telegramme, facsimile, Facebook, *whatsApp*, electronic mails (e-mail), *Tiktok,* and so on. In all these instances, agreements need to be reached between the sellers and buyers on the prices of the commodities for effective transaction to take place.

For most agricultural commodities in Nigeria,, the market prices increase as the distance between the point of production (usually in the rural areas), and the market (in the urban centres), increase. In other words, consumers that are closer to the sources of production often pay less per unit of item compared to those residing far off. Cash trading is again, a common feature in agrifoods trade in Nigeria, especially, among small-scale agripreneurs since physical exchanges of commodities are done with cash payments. Major reasons for this scenario include high level of illiteracy in computer education, especially among the consumers in rural areas, high cost of data and lack of ICT equipment and materials among the stakeholders in agrifoods marketing. Other reasons include lack of stable energy supply, uneven distribution of modern sale depots and mega stores/supermalls for agrifoods, limited support from government in resource networking and inadequate personnel in digital marketing.

Literature Review

Nigeria has a huge variety of agricultural products across its geographical space. However, there is high level of inefficiency in the transportation, processing, marketing and distribution of these products hence many of these products cannot reach their target locations in the desired quantities and quality. Again, many of these products are sourced far away from their points of consumption (usually in the urban centre) and agro-industries which use them as basic raw materials. Thus, there is the need for more serious approaches to the marketing of the commodities. This therefore underscores the necessity for digital marketing of the agricultural products, especially the small-holders (agripreneurs) who form the bulk of the stakeholders, in the Nigeria's agricultural sector. The growth of the sector further calls for a more committed support for a digital marketing approach as against the traditional methods of marketing [Ebarefimia et al, 2024,30-45].Thus, digital marketing of agrifoods offers the opportunity to increase visibility and generate business-to-business leads which brings a higher level of efficiency [Bahn et al, 2021,68-74; Fountas et al, 2020,24-28; Lajore-O 'Malley, 2020,48-53].

No doubt, the traditional marketing channels, such as print and electronic media, are reshaping the agricultural sector, but the sector has a low adoption of the digital marketing. There is therefore the need to improve the organic site traffic, search engine rankings, and industry expertise. Digital agriculture generally offers advantages such as increased productivity, better market transparency, (with little or no intermediaries and market distortions), and more effective logistics. It has also helped nations to overcome their periods of emergencies such as the effect of COVID-19 on the marketing and distribution of agricultural commodities across the food chains. It needs to be mentioned that the traditional marketing channels, are still largely in use while fully digitized agriculture is still a work-in progress in Nigeria [Ebarefimia et al, 2024,30-45; Trendov, 2021,223-227; Ogunniyi and Oyebuyi,2012,172-187]. Digitization is capable of solving the challenges posed by climate change (such as flooding, desertification, heat waves, and earthquakes/tremors), and boost production, but it is crucial to overcome the obstacles faced by small holder farmers because they constitute the chunk of the players in the agrifoods industry in Nigeria.

Methodology

Study Area and Sample size: The study area for this study is Ogun, Oyo and Osun States in southwest Nigeria [Figure 1]. The study area is popular for agricultural production and marketing activities in Nigeria. The agro-ecology is suitable and there is huge participation by many small- scale agripreneurs. Many of these agripreneurs are the primary producers (farmers) who also handle the processing and marketing/distribution of agricultural commodities. Specifically, 56 small-scale agripreneurs were randomly sampled from Ijebu North local government area (Ogun State), 57 and 47 samples were also drawn from Oluyole and Boripe local government areas of Oyo and Osun States respectively [Table 1].

Figure 1 Map of Southwest Nigeria showing the study area

Table 1 Sample and Sampling procedure

State	Local Government	Location of study	Sample size
Ogun	Ijebu North	Ijebu-Igbo,Ago-Iwoye,Awa	57
Oyo	Oluyole	Idi-Ayunre,Onipe	56
Osun	Boripe	Iragbiji	47
TOTAL			**160**

Source: Survey data, 2024

These samples (respondents), totaling 160, comprised small-scale agripreneurs who specialized in the production and marketing of poultry products such as chickens-layers and broilers (hybrid), local chickens, rabbit, guinea fowl, duck and geese. These respondents also handle animals such as sheep and goats, local rams, pig and pork and fishery products such as tilapia, croaker and catfish. Food crops such as maize, yam, cocoyam, vegetables, potato, cassava, plantain and banana are also being produced and marketed by these farmers. Similarly, these respondents handle tree crops such as cocoa, colanut, coconut, cashew nut and *citrus spp*, among others. Non-timber forest products such as teak leaves (for wrapping some agrifoods like palp and colanuts),

mushrooms, snails and fruits such as African cherry, *irvingia* and walnut are common agricultural products among these agripreneurs. Data was gathered [February-April, 2024] on the socio-economic characteristics of the agripreneurs in the area of study. Specifically, information were obtained on the respondents' age, household sizes, household income, years of experience in agripreneurship, scale of agribusiness operation, Volume of sales, level of digitization in marketing of agricultural commodities, customer portfolio, challenges to effective marketing digitization and supposed solutions to marketing digitization challenges. The set of data, which were obtained through the use of pre-tested structured questionnaire, was analyzed by descriptive statistical method.

Results and Discussion

Age Distribution of the small-scale Agripreneurs

Age of the agripreneurs often determines the capabilities in farm operations, adoption of research innovations, resilience and marketing activities. One hundred and thirty-five (or 67.25 %) of the investigated agripreneurs are aged between 31 and 60 years while the mean age is 44.06 years. This is slightly different from the earlier findings of Ebarefimia *et al*, [2024,30-45], which put the average age of these small-scale operators at 37 years as the chunk were between 36-55 years age bracket.

Household size of the Small-scale agripreneurs

Farmers' households is a major source of farm labour for the smallholders in southwest Nigeria as most farming families provide cheap labour supplies for the production, processing and marketing activities[Nebo and Ejionueme,2017,4-17].In this study,140 (or 87.5%) agripreneurs had their household sizes between 5 and 20 members while the average household size was 14 members. This confirmed earlier findings [Borjas, 2019] that many small-scale operators, especially in the rural areas sourced their farm business labour from their families.

Years of Agripreneurship and Digital Marketing skill

Years of experience in agripreneurship and digital marketing often determine the success level in the business. This study indicated that 100 of the respondents had less than 4 years of experience in digital marketing while the mean years of experience for these agripreneurs was 3.5 years [Table 2].

Table 2 Years of Agripreneurship and Digital Marketing skill

Class Interval (Years)	Frequency(fi)	%	Class midpoint(xi)	fixi
<2.0	71	44.37	1	71
2.0 ≤ 4.0	29	18.13	3	87
4.1≤ 6.0	24	15.00	5	120
6.1 ≤ 8.0	21	13.13	7	147
8.1 ≤ 10.0	15	9.37	9	135
>10.0	0	0	11	0
	160	100		Σ=560
			Mean (years)	3.5

Source: Survey Data, 2024

This further confirmed that digital marketing is a new innovation among these agripreneurs. This finding aligns with the earlier position of Deichmann *et al*, [2016, 21-33] and Fountas *et al*,[2020,24-28].

5.4 Scale of Agribusiness Activities

In this study, 139 of the respondents (or 86.88%) had between N20.0 million and N60.0 million as working capital while the average working capital was N37.13 million [Table 3].

Table3 Scale of Agribusiness Activities (N' million)

Class Interval	Frequency(fi)	%	Class midpoint(xi)	fixi
<20	35	21.88	10	350
20 ≤ 40	68	42.50	30	2040
41 ≤ 60	36	22.50	50	1800
61 ≤80	10	6.25	70	700
81≤ 100	8	5.00	90	720
> 100	3	1.87	110	330
	160	100		Σ=5940
			Mean value	37.13

Source: Survey Data, 2024

These agripreneurs need more financial support from to further expand the scale of their business operations. Cooperative societies, microfinance banks and other credible and accessible credit sources can help these farmers out.

5.5 Sales volume of Agripreneurs

A chunk (83%) of the investigated agripreneurs were able to sell agricultural products that were valued between N500,000.0 and N1,500,000.0 per month while average sales volume was N1,176,250.0 per month [Table 4].

Table 4 Sales volume of Agripreneurs per month (Naira)

Class Interval	Frequency (fi)	%	Class midpoint(xi)	fixi
<500,000	29	18.12	300,000	8,700,000
500,001 ≤ 1,000,000	46	28.75	750,000	34,500,000
1,000,001 ≤ 1,500,000	37	23.13	1,300,000	48,100,000
1,500,001 ≤2,000,000	27	16.87	1,800,000	48,600,000
> 2,000,000	21	13.13	2,300,000	48,300,000
	160	100		Σ=188,200,000
			Mean value	1,176,250

Source: Survey Data, 2024

More funding and enlightenment of these farmers on digital marketing will help them further expand their business operations, especially and those customers who are located in distant markets. Access to more digital tools and broadening the marketing platforms can further strengthen the customer base of these agripreneurs.

5.6 Rate of Digitization in Marketing of Agricultural Products

Limited skill and short period of experience in digital marketing is a bane of optimal performance among the small-scale agripreneurs in southwest Nigeria. The findings of this study indicated that 121 (or 75.6%) of the agripreneurs had less than 4.0% of their marketing operations fully digitized. The average rate of digital marketing among these respondents was 2.78% [Table5].

Table 5 Rate of Digitization in Marketing of Agricultural Products (%)

Class Interval (%)	Frequency(fi)	%	Class midpoint(xi)	fixi
<2.0	88	55.0	8	88
2.0 ≤ 4.0	33	20.62	3	99
4.1≤ 6.0	17	10.62	5	85
6.1 ≤ 8.0	13	8.13	7	91
8.1 ≤ 10.0	9	5.63	9	01
>10.0	0	0	11	0
	160	100		Σ=444
			Mean rate	2.775%

Source: Survey Data, 2024

Inadequate access to digital marketing tools and equipment, high cost of data and limited knowledge of ICT techniques were among the major excuses that the farmers gave for their low level participation in digital marketing of agricultural products in southwest Nigeria.

Relationship between Digitization of Marketing process and sales volume

A fully digitized market is expected to open greater opportunities for the agripreneurs to sell their wares to members of the public. This is because more customers, especially in distant locations will be informed about the products being marketed and therefore may develop interest in such products. In this study, however, 122 of the respondents (or 76.25%) indicated that there was a relationship between digital marketing and sales volume of agricultural products in southwest Nigeria. The average perception rate was 72.25% of the population of the investigated farmers in the study area [Table 6].

Table 6 Perceived Relationship between Digitization of Marketing process and sales volume

Rate of Perception (%)	Frequency(fi)	%	Class midpoint(xi)	fixi
<20	10	6.25	10	100
20 ≤ 40	12	7.5	30	360
41≤ 60	16	10	50	800
61 ≤ 80	34	21.25	70	2380
81 ≤ 100	88	55.0	90	7920
>100	0	0	110	0
	160	100		Σ=11560
			Mean rate	72.25%

Source: Survey Data, 2024

Customer Portfolio-Distance from major market (Km)

Huge numbers of the small-scale agripreneurs operate in the rural areas in southwest Nigeria, but, many (131 or 81.88%) of their clients are located some 100km away while the mean distance between the agripreneurs and the clients in the major markets was 173.53km [Table 7].

Table 7 Customer Portfolio-Distance from major market (Km)

Class Interval Distance (Km)	Frequency(fi)	%	Class midpoint(xi)	fixi
<50	12	7.5	30	360
51 ≤ 100	17	10.63	75	1275
101≤ 150	21	13.13	130	2730
151 ≤ 200	38	16.0	180	6840
> 200	72	45.0	230	16560
	160	100		Σ=27765
			Mean distance	173.531

Source: Survey Data, 2024

To supply these distant markets, therefore, the agripreneurs need to further strengthen their transportation system, open more digital marketing outlets and

embark on more aggressive campaign on the need for an effective use of digital marketing of agricultural product among their customers. The government also needs to spend more on the acquisition of necessary equipment and software on digital marketing and employment of professionals who can help impact the digitization process of agricultural products among small-scale agripreneurs.

Customer Portfolio- Number of Customers in Agribusiness

Large number of customers is required to further broaden the market base for agricultural products in order to increase the profit levels of the agripreneurs. In this study, 100 agripreneurs (or 62.5%) had between 5 and 15 customers to whom they sell their products, 38 (or 23.75%) had between 16 and 20 customer base [Table 8].

Table8 Customer Portfolio- Number of Customers in Agribusiness

Class Interval	Frequency(fi)	%	Class midpoint(xi)	fixi
<5	13	8.13	3	39
5 ≤ 10	42	26.25	7.5	315
11≤ 15	58	36.25	13	754
16 ≤ 20	38	23.75	18	684
> 20	9	5.62	23	207
		100		Σ=1999
			Mean	12.494

Source: Survey Data, 2024

It is believed that the respondents can further widen their customer base by strengthening their digital marketing through more funding, training and awareness/sensitization programmes.

Digital Marketing skills of customers

Customers' digital marketing skills are required to further strengthen the sales volumes of agricultural products among the small-scale agripreneurs. More sales outlets could be open at the near and far markets so that customers can access the products. Broad- based and sustainable training programmes on digital marketing should be put in place by the market associations, government and the customers too so that everyone in the marketing and distribution chains is actively involved. In this study,105 (or 65.63%) of the agripreneurs have maximum of 4 years of experience in digital marketing while the mean period of digital skill is 3.3 years [Table 9].

Table 9 Digital Marketing skills of customers

Class Interval (years)	Frequency(fi)	%	Class midpoint(xi)	fixi
<2.0	78	48.75	1	78
2.0 ≤ 4.0	27	16.88	3	81
4.1≤ 6.0	22	13.75	5	110
6.1 ≤ 8.0	19	11.87	7	133
8.1 ≤ 10.0	14	8.75	9	126
>10.0	0	0	11	0
		100		Σ=528
			Mean (years)	3.3

Source: Survey Data, 2024

Longer periods of digital marketing skills will further widen the market access base for the agricultural products and the level of accruable profits will increase.

5.11 Challenges to Effective Digitization of Marketing of Agricultural Products

According to this study, digital marketing activities among small-scale agripreneurs in southwest Nigeria are confronted with several challenges such as digital divide, infrastructural deficiencies, insufficient digital skills and security and mistrust of the customers Table 10.

Table 10 Challenges to Effective Digitization of Marketing of Agricultural Products

S/N	Challenge	Frequency(fi)	%
1	Digital Divide	95	59.38
2	Infrastructural Deficiencies	132	82.5
3	Insufficient digital skills	160	100
4	Security and Mistrust of customers	92	57.5

Source: Survey Data, 2024

Access to internet digital literacy, especially among small scale agripreneurs is a huge barrier to effective marketing of agricultural commodities in many parts of the study area while poor and ineffective internet services are also common features in most rural areas where agricultural products are largely produced. This thus hampers an efficient digital marketing of the products. Again, the dearth of stable internet connectivity and power supply is a bane of effective digital marketing of agricultural products. Small-holder farmers, again, do not possess adequate skills and training in digital marketing hence, their inability to use digital marketing tools and platforms for their products. However, with better funding by government, improved provision of digital marketing tools and platforms, better digital training and strong digital marketing education coupled with stiff penalty for offenders in digital trade will be workable solutions to the challenges in digital marketing business [Table 11].

Table 11 Suggested solutions to Challenges in Digitizing Marketing of Agricultural Products

S/N	Challenge	Suggested Solution
1	Digital Divide	Better funding by government and stakeholders in digital marketing investment and data sourcing.
2	Infrastructural Deficiencies	Improved provision of digital marketing tools and equipment.
3	Insufficient digital skills	Better digital training for customers and agripreneurs.
4	Security and Mistrust of customers	Strong digital marketing education and stiff penalty for offenders in digital trade.

Source: Survey Data, 2024

Conclusions

Digital marketing has immense benefits for the market expansion for agricultural products among small-scale agripreneurs in southwest Nigeria. But the recurring issue of digital divide, infrastructural deficiencies, insufficient digital skills and security and mistrust of customers appear as stumbling blocks. Having realized the importance of digitization as against the traditional trading (manual) method of marketing, the federal government of Nigeria, created the ministry of communications, innovation and digital economy in 2023.This ministry, under the leadership of Dr. Olatubosun Tijani, oversees the development, implementation, and regulation of policies related to communications, innovation and the digital economy sector in Nigeria. Since inception, the ministry has recorded giant strides in revolutionizing digital trade in Nigeria. These brilliant efforts have cut across the banking, agriculture, real estate fisheries, water resources and forestry, among other sub-sectors in this country. Lately, startups, investors, technology professionals and policy leaders are being mobilized through workshops and conferences to ensure that digital economy enjoys the support of all. The achievements of the ministry in digital marketing have also increased the nation's Gross Domestic Product (GDP).To further help achieve greater feat in digitizing the economy, the Nigeria government, small-scale agripreneurs, customers and indeed, all stakeholders in the agribusiness subsector, should provide more funding for the development of digital marketing investment and data sourcing.

There is also the need to improve the digital marketing tools and equipment and provide better digital training for customers and agripreneurs. Again, stakeholders must ensure strong digital marketing education and stiff penalty for offenders in digital trade. These steps are already being taken but, further serious efforts could be intensified and replicated at the state and local government levels. It this is done, Nigeria may just be on its way towards surmounting the challenges facing digital

marketing of agricultural products by small-scale agripreneurs in the study area and indeed, in Nigeria.

Recommendations

Based on the findings of this study, the following recommendations are made:

i. The small-scale agripreneurs should further expand their digital marketing innovations so as to remain competitive in the global digital marketing environment.

ii. Cooperative societies, microfinance banks and ministries of agriculture, telecommunication and digital economy, should increase their support for the small-scale agripreneurs so that they can further elevate their skills in digital marketing of agricultural produce.

iii. The Nigerian government and NGOs should do more in their efforts at deploying and expanding the use of digital marketing tools and equipment to the small-scale agripreneurs.

Suggestion for further studies: Further studies should focus on the use of digital marketing among commercial agripreneurs in Nigeria

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PART III

PUBLIC POLICIES TOWARDS GREEN AND DIGITAL TRANSFORMATION

Yavuzaslan K.,Bölükbaş M. [2025], *Implementations of Green Central Banking Policies: A Behavioural Economics Approach* [in:] Piekut M., Knapková M. (eds.), Digital and Green Transformation in the Context of Households, Markets, and Public Policies. Kolegium Nauk Ekonomicznych i Społecznych, Politechnika Warszawska, Płock.

IMPLEMENTATIONS OF GREEN CENTRAL BANKING POLICIES: A BEHAVIOURAL ECONOMICS APPROACH

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Summary

This study explores how green central banking policies influence financial market behaviour through behavioural economics. It examines cognitive and psychological factors shaping responses to instruments like green credit incentives, climate-adjusted collateral, and sustainable bonds. Comparing the EU and Türkiye, it assesses institutional capacity and investor reactions. In a consumer society increasingly driven by symbolic consumption, behavioural dynamics play a key role in the effectiveness of green monetary interventions. Based on international practices and empirical research, the paper offers policy recommendations to enhance behavioural impact and support sustainable finance through central banking frameworks.

Keywords: Green Central Banking, Behavioral Economics, Monetary Policy, Climate Finance, EU-Türkiye Comparison

Streszczenie

Badanie analizuje wpływ zielonej polityki banków centralnych na zachowania rynków finansowych z perspektywy ekonomii behawioralnej. Uwzględnia czynniki poznawcze i psychologiczne, które kształtują reakcje na instrumenty takie jak zielone kredyty, zabezpieczenia klimatyczne i obligacje zrównoważone. Porównując Unię Europejską i Turcję, ocenia zdolność instytucjonalną oraz reakcje inwestorów. W społeczeństwie konsumpcyjnym, coraz bardziej napędzanym konsumpcją symboliczną, czynniki behawioralne odgrywają kluczową rolę w skuteczności zielonych interwencji monetarnych. Na podstawie praktyk międzynarodowych i badań empirycznych, artykuł przedstawia rekomendacje polityczne wspierające zrównoważone finanse poprzez ramy bankowości centralnej.

Słowa kluczowe: Jelona polityka banków centralnych, Ekonomia behawioralna, Polityka monetarna, Finansowanie działań na rzecz klimatu, Porównanie UE–Turcja

JEL: E71; F45; E58

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Introduction

Climate change represents a systemic risk with profound implications for financial stability, monetary policy, and long-term macroeconomic dynamics [Batten et al., 2016; Carney, 2015]. In response, central banks have begun integrating climate considerations into their operational frameworks, giving rise to the concept of "green central banking." This transformation encompasses monetary tools, supervisory practices, and institutional mandates aimed at promoting sustainable finance and mitigating environmental risks [Campiglio, 2016; ECB, 2021a].

The crisis of climate change must be regarded as a multidimensional issue, with consequences for social, political, and economic systems. Increasing global temperatures, extreme weather events and disruptions in natural cycles have serious impacts on macroeconomic variables. In this context, Türkiye, with its geographical diversity and transition economy structure, constitutes a significant case study for the analysis of these complex dynamics.

In recent decades, there has been a paradigm shift in the role of central banks in addressing climate change. In contrast to the historical focus on price and financial stability, contemporary institutions are increasingly acknowledging the imperative to integrate environmental considerations into their policy frameworks. This development, termed "green central banking," signifies a mounting cognizance of the manner in which ecological risks converge with macroeconomic and financial vulnerabilities [Spinaci, & Höflmayr, 2022]. The prevailing perspective on climate change has evolved from considering it an externality to acknowledging its role as a structural force with the potential to compromise monetary credibility and economic resilience [Schnabel, 2021].

It is evident that increases in global temperature and climate change have ramifications for the environment, society and the economy. In addition, it is evident that climate change-induced shocks have the potential to exert influence on price levels, thereby impacting the monetary policy of central banks. International coalitions that have been formed with the objective of promoting the environmentally sustainable management of financial systems include the Network for Greening the Financial System [NGFS], which was established in 2017 by central banks and supervisors. In 2021, the European Central Bank [ECB] under the leadership of President Christine Lagarde established a dedicated Climate Change Centre with the objective of coordinating climate-related work across all policy areas [ECB, 2021c]. The NGFS commenced operations with a membership of eight entities; this number has increased significantly to exceed one hundred central banks and supervisory agencies worldwide. The Central Bank of the Republic of Türkiye [CBRT] became a member of this network in 2022. The significance of climate change for central banking has now been widely recognized, with climate considerations being

integrated into monetary policy frameworks, financial supervision, and central bank asset portfolios [Batten et al., 2016; Campiglio, 2016].

The social dimension of climate-responsive monetary and financial policy design is a critical aspect that must not be overlooked. In the contemporary context of the widespread adoption of social networks and the perpetual nature of digital interaction, it has become increasingly evident that economic agents do not invariably adhere to the principles of rational choice models. Despite the considerable progress made in economic theory over the course of centuries, recent developments have necessitated a re-evaluation of the fundamental assumptions underlying economic modelling. In particular, the incorporation of psychological and behavioural variables into the study of decision-making processes has enabled scholars to identify patterns that standard economic frameworks frequently fail to capture. In the context of accelerating technological innovation, there is an increasing need to integrate the dynamic nature of human behaviour into economic analysis. This integration has become an indispensable element of policy research [Akerlof & Shiller, 2009].

Indeed, it has become analytically insufficient to generalize outcomes by assuming homogeneous behaviour among the global population of nearly three billion economically active individuals. This recognition has prompted economists to re-evaluate and revise established theories. The global financial crisis of 2008 exposed the inadequacies of models predicated on the assumption of fully rational agents. The mounting evidence for the significance of optimism bias and confirmation heuristics in precipitating the crisis has given rise to a growing call to incorporate behavioural insights into financial and macroeconomic models [Thaler, 2016; Shiller, 2015].

Consequently, a plethora of interdisciplinary subfields, including behavioural economics, experimental economics, neuroeconomics and agent-based computational economics, have emerged to challenge or extend the restrictive assumptions of neoclassical theory. It has been increasingly recognized that economic decision-making is not solely governed by computational optimization, but also by biologically and socially embedded cognition. Technical and policy-oriented decision-making now requires consideration of uncertainty stemming from not only economic parameters but also sociocultural, environmental, and institutional contexts.

This study extends the green central banking literature by exploring the behavioural underpinnings of policy effectiveness. While structural tools are critical, their real-world efficacy often hinges on the behavioural responses of market actors. Cognitive biases, limited information-processing capacities, and status quo preferences can significantly shape policy outcomes [Simon, 1955; Kahneman & Tversky, 1979]. This behavioural economics perspective has received insufficient attention in the context of climate-related central banking interventions.

Literature Review

Green central banking refers to the integration of environmental sustainability into the mandates and tools of monetary authorities [Matikainen et al., 2017]. This encompasses climate-adjusted collateral requirements, targeted green lending facilities, and preferential treatment for sustainable financial instruments [Dikau & Volz, 2021].

Campiglio [2016] emphasizes that central banks can redirect credit flows toward low-carbon investments, thereby supporting ecological transitions without undermining monetary stability. Dafermos et al. [2018] demonstrate through post-Keynesian modeling that ignoring climate risks can induce systemic instability, whereas proactive green strategies can reconcile environmental and financial objectives.

In practice, several central banks have begun implementing green policies, especially since the late 2010s. Research by Dikau and Volz [2018] documented early adopters of green central banking in emerging economies – for example, the People's Bank of China's green credit guidelines and refinancing facilities, and Bangladesh Bank's targeted refinancing for renewable energy – showing that even outside advanced economies, central banks have used policy levers to encourage sustainable finance. In advanced economies, much scholarly attention has focused on the European Central Bank and Bank of England. The Bank of England was an early mover in studying climate risks [Bank of England, 2015] and in 2021 was given an explicit secondary mandate to support environmental sustainability, prompting research on how its corporate bond purchase scheme could be tilted towards greener assets [Täger, 2021]. The ECB, for its part, incorporated climate considerations into its monetary policy strategy review in 2021, committing to integrate climate risk into risk assessments, collateral frameworks, corporate bond purchases, and disclosures [ECB, 2021b; Papoutsi et al., 2022]. Schnabel [2021] notes several channels through which climate change affects central banks' work: more frequent supply shocks and commodity price swings can raise inflation volatility; climate-related credit risks can impair banks and thus the monetary policy transmission; and the uncertainty around climate policy can influence longer-term investment and output. These insights have spurred central banks to act within their mandates – for example, by conducting climate stress tests on banks [as the ECB did in 2022], and by developing climate scenario analyses for macroeconomic forecasting [NGFS, 2019]. On the regulatory side, authorities are increasingly issuing guidelines for climate risk disclosure and management in the financial sector [BIS, 2020]. The literature highlights a common constraint, however: central banks are typically bound by mandates that prioritize price stability and market neutrality, which may limit how far they can go in actively reallocating capital [Dikau & Volz, 2021; Parajon-Skinner, 2021].

In practice, several central banks have begun implementing green policies, especially since the late 2010s. Research by Dikau and Volz [2018] documented early adopters of green central banking in emerging economies – for example, the People's Bank of China's green credit guidelines and refinancing facilities, and Bangladesh Bank's targeted refinancing for renewable energy – showing that even outside advanced economies, central banks have used policy levers to encourage sustainable finance. In advanced economies, much scholarly attention has focused on the European Central Bank and Bank of England. The Bank of England was an early mover in studying climate risks [Bank of England, 2015] and in 2021 was given an explicit secondary mandate to support environmental sustainability, prompting research on how its corporate bond purchase scheme could be tilted towards greener assets [Täger, 2021]. The ECB, for its part, incorporated climate considerations into its monetary policy strategy review in 2021, committing to integrate climate risk into risk assessments, collateral frameworks, corporate bond purchases, and disclosures [ECB, 2021; Papoutsi et al., 2022]. Schnabel [2021] notes several channels through which climate change affects central banks' work: more frequent supply shocks and commodity price swings can raise inflation volatility; climate-related credit risks can impair banks and thus the monetary policy transmission; and the uncertainty around climate policy can influence longer-term investment and output.

In this regard, recent literature has highlighted the inflationary consequences of green transition policies and climate-induced supply shocks, often referred to as climateflation. The concept captures how climate-related disruptions [e.g., droughts, energy shocks, and carbon pricing] contribute to persistent upward pressures on consumer prices [NGFS, 2022; McKibbin et al., 2020]. Bölükbaş [2023a, 2023b, 2024a] emphasizes that climateflation not only challenges the inflation-targeting mandates of central banks, but also requires them to rethink price stability in the context of climate-adjusted macroprudential frameworks. His work underlines that the effective control of climateflation demands coordination between monetary, fiscal, and green industrial policies.

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In recent years, the interaction between climate change and monetary policy has garnered increased attention in both academic research and policy discourse. This growing body of literature suggests that climate-induced supply and demand shocks

can distort macroeconomic dynamics and affect the conduct of monetary policy, particularly through their influence on inflation and output gaps [Cœuré, 2018; Batten et al., 2016]. The ECB and European central banks, have begun integrating climate risk into asset purchase programs, stress testing, and risk disclosure protocols [ECB, 2021]. In contrast, neither engagement of the CBRT remains limited to structural alignment and capacity building nor Turkish academic literature is limited about the green banking implementation.

Recent studies in Türkiye argued that the climate crisis "requires a climate-active central bank in Türkiye," calling for the CBRT to incorporate climate risks into its policy framework and support green financing initiatives. This emerging local discourse is in line with global calls for central banks in emerging markets to address climate risks [Dikau & Volz, 2018; Hallegatte et al., 2017]. However, awareness of climate–economy linkages and the need for green finance has grown in Türkiye, the academic literature on green central banking is still nascent. Isiksal et al. [2019] found a unidirectional causality from real interest rates and energy consumption to CO_2 emissions, stressing the importance of monetary stability for environmental outcomes. Arı [2024], through a panel data approach, highlighted the adverse effects of excessive money supply on environmental degradation across upper-middle-income countries. Therefore Arı [2024] investigates the effects of macroeconomic policies on environmental degradation and similarly suggests that monetary policy can influence carbon emissions in developing economies. Bölükbaş [2024b], examined the relationship between climate change and monetary policy in Türkiye. The empirical evidence provides that climate change developments are causally linked with Türkiye's monetary policy outcomes [Bölükbaş, 2024b]. This suggests that climate-related shocks [such as agricultural output losses from droughts or energy price volatility from decarbonization policies] have impacted price stability and thus influenced the policy decisions of the CBRT. These findings are same as international studies [Annicchiarico & Di Dio, 2017; Cantelmo et al., 2019] that show climate factors can create supply-demand disturbances affecting inflation, thereby making a case that central banks cannot ignore climate change if they are to fulfill their mandates.

The Green Central Banking Scorecard: The Comparison of The ECB and CBRT

The Green Central Banking Scorecard, developed by Positive Money and updated annually, serves as a benchmark tool for evaluating the extent to which central banks across G20 countries integrate climate-related considerations into their mandates, operations, and communication strategies [Livingstone et al., 2024]. The index, which was first introduced in 2021, emerged in response to growing concerns that central banks were lagging behind in adapting to the systemic risks posed by

climate change. As of 2024, the scorecard evaluates central banks based on four primary dimensions: [i] monetary policy alignment with climate goals, [ii] financial supervision incorporating climate risks, [iii] portfolio management practices, and [iv] transparency and research engagement.

In the Green Central Banking Scorecard, research and advocacy scores are assigned a value of 10, monetary and financial policy scores are assigned a value of 50, leadership scores are assigned a value of 20, and the total score is assigned a value of 130, with letter grades ranging from A+ to F.

The Green Central Banking Scorecard 2024 data indicates that the majority of G20 countries attained high scores in climate-compatible financial policies. Conversely, Argentina and Saudi Arabia received zero points, while Mexico and the Republic of Korea attained the lowest scores. France, Germany, Italy and the EU demonstrated the highest levels of commitment to monetary policy practices within the scope of climate green central banking, while also attaining high scores in the research-advocacy and leading by example categories. In the context of the Turkish economy, it can be posited that the practice of green central banking activities is in its nascent stages. An examination of the aggregate scores indicates that France has the highest green central banking score, with Germany and Italy following in succession. While these countries have obtained high ratings in the area of green central banking, Saudi Arabia, Argentina and Türkiye have unfortunately obtained the lowest possible ratings. A notable outcome of the Green Central Banking Scorecard is that central banks implementing green monetary policies have witnessed substantial enhancements in their green central banking scores. The adoption of a green monetary policy entails the integration of climate-related impacts within the monetary policy process, thereby ensuring consideration of environmental considerations within the overarching framework of sustainable development. Green monetary policies are comprised of a variety of different monetary measures. Instruments that priorities sustainability are also of significance in the context of green investments and green finance. In instances where central banks seek to promote climate-friendly investments or initiatives centered on energy efficiency, they have the capacity to reduce interest rates.

Consequently, central banks have a role to play in promoting sustainability by addressing environmental risks in the emerging global context, where the repercussions of climate change are profoundly felt. In the contemporary financial landscape, central banks have the capacity to offer low interest rates not only for conventional loans but also for green loans. By supporting the green money policy process with green interest rates, they contribute to the development of green central banking. However, the actions that central banks can undertake in the context of the climate change process are not confined to these.

The Green Central Banking Scorecard 2024 report indicates that the ECB has demonstrated 87/100 green central banking performance in 2024 [Livingstone et al., 2024]. This performance is consistent with significant policy reforms, including the ECB's incorporation of climate considerations into its Monetary Policy Strategy Review [ECB, 2021], the introduction of sustainability-linked instruments within its collateral frameworks [ECB, 2022], and its pioneering role in initiating climate stress tests for the banking sector.

Conversely, the performance of the CBRT has been persistently substandard. In the 2024 assessment, Türkiye's central bank received a score of 10/100, placing it among the least successful G20 central banks. Despite the establishment of a Green Economy and Climate Change Department in 2021 and subsequent accession to the Network for Greening the Financial System [NGFS] in 2022, the CBRT has yet to implement binding climate-related frameworks within its monetary operations or supervisory responsibilities [CBRT, 2022]. In contrast to the ECB, the CBRT has not yet implemented climate-adjusted collateral policies, nor has it developed forward-looking macro-financial models that incorporate carbon price dynamics or transition risks.

The ECB benefits from a dual mandate structure and political endorsement for environmental responsibility. Its Climate Change Centre, established in 2021, coordinates interdisciplinary strategies. Conversely, the CBRT's climate agenda is nascent and primarily focused on research and discourse participation [CBRT, 2022].

Table 1 summarizes key institutional and policy divergences. While the ECB has introduced climate stress tests, collateral policy adjustments, and green asset purchase strategies, the CBRT has yet to operationalize such tools. Institutional inertia, macroeconomic volatility, and a narrower policy mandate constrain Türkiye's progress [Livingstone et al., 2024].

This divergence reflects both structural and institutional differences. The ECB, supported by the EU’s supranational climate agenda and taxonomy regulation, benefits from political alignment and technical capacity. Türkiye, on the other hand, faces more immediate macroeconomic constraints such as inflation volatility and currency depreciation, which limit the scope for policy experimentation in green finance. However, the gap in performance also signifies a missed opportunity: inaction in integrating sustainability criteria into central banking risks exacerbating long-term financial instability and weakens Türkiye’s credibility in meeting its 2053 net-zero commitments.

Table 1. Green Central Banking Measures: European Union vs Türkiye [as of 2024]

Policy/Measure	European Union [ECB]	Türkiye [CBRT]
NGFS Membership	Yes [since 2017]	Yes [2022]
Dedicated Climate Unit	Yes [Climate Change Centre, 2021]	Yes [Green Economy Dept, 2021]
Climate in Mandate	Partially integrated	No
Green Credit Guidelines	Limited national programs	No
Carbon Pricing Integration	Yes [EU ETS]	Planned
Climate Stress Testing	Conducted in 2022	Not yet
Collateral Adjustment	Implemented [2022]	Not implemented
Asset Purchase Tilt	Yes [e.g., greener bonds]	Not applicable
Public Communication on Climate	Extensive [Lagarde speeches]	Emerging
Scorecard Rating [0–100]	87	10

Source: ECB [2021], CBRT [2022]

Furthermore, broader international comparisons are instructive. In the 2024 Scorecard, other central banks, including the Bank of England, Banque de France and Sveriges Riksbank, also received high scores [graded A or B], largely due to their proactive approaches in applying green regulatory standards and greening their asset purchases. In contrast, countries such as Saudi Arabia and Russia persist in the lower echelons, signifying pervasive disparities in green central banking preparedness among G20 nations [Livingstone et al., 2024].

In conclusion, the Green Central Banking Scorecard fulfils dual roles as both a diagnostic instrument and a normative mechanism for peer accountability. The ECB's consistent leadership underscores the potential of monetary authorities to act as catalysts in the low-carbon transition, while the CBRT's lagging score highlights the urgent need for strategic alignment, technical capacity-building, and political will. It is imperative that this gap is bridged in order to ensure that Türkiye can avoid climate-related financial disruptions and establish itself within a globally converging green finance architecture.

The Applicability of Policy Instruments for Climate-Sensitive Central Banking Using Behavioural Economics Models

Central banks worldwide are increasingly exploring monetary instruments that incorporate environmental sustainability objectives. These tools—ranging from sustainability-linked lending facilities to carbon risk integration and collateral frameworks—aim to redirect credit, mitigate climate-related risks, and enhance green financial flows. This section examines how policy tools developed for green central banking can be supported by behavioral economics models.

Green TLTROs and Dual-Rate Mechanisms

Targeted longer-term refinancing operations [TLTROs] with green conditionality—commonly referred to as Green TLTROs—represent a monetary innovation gaining traction in European policy circles. Under such schemes, central banks would offer concessional funding to commercial banks contingent on the disbursement of loans to environmentally sustainable sectors such as renewable energy or energy efficiency. Non-compliance would trigger higher interest costs, introducing a sustainability-linked interest rate structure [Jourdan et al., 2021; van Tilburg et al., 2020]. While the ECB has yet to pilot such instruments, legal and technical reservations are gradually diminishing, particularly with the EU Taxonomy's formalization. Theoretically, Green TLTROs can internalize behavioural incentives by financially rewarding green lending, thereby accelerating the transition without fiscal interventions.

In Türkiye, the CBRT possesses a history of differentiated liquidity tools, such as the late liquidity window and selective credit programs. Although macroeconomic volatility has constrained experimental policymaking in recent years, the CBRT could adapt a simplified version of a Green TLTRO. For instance, it might provide discounted repo rates to commercial banks proportionally increasing green loan portfolios. However, implementation would require macroeconomic stabilization and regulatory coordination, especially given Turkish banks' sensitivity to exchange rate fluctuations and external borrowing conditions.

Carbon Pricing and Monetary Transmission

While carbon pricing is primarily a fiscal instrument, it has indirect yet significant implications for monetary policy. The EU Emissions Trading System [EU ETS] has established a strong carbon price signal, which the ECB now incorporates into its forecasting and scenario analysis. Rising carbon prices—reaching €80 per ton by 2022—affect inflation through energy costs and input prices. The ECB's 2021 macroeconomic projections included carbon tax scenarios to assess "climateflation"—the inflationary consequences of climate policy [ECB, 2021; NGFS, 2022]. While the ECB has not formally adjusted its interest rate decisions based on carbon prices, acknowledging them in forecasting is an important step toward climate-aligned policy calibration [McKibbin et al., 2020].

Türkiye has yet to implement a national carbon pricing mechanism, though plans are underway following its ratification of the Paris Agreement. A prospective emissions trading scheme could introduce new inflationary pressures, particularly in energy and transport sectors. For the CBRT, this underscores the need to develop forward-looking analytical capacity within its Climate Change Department and coordinate closely with fiscal authorities to mitigate abrupt price effects.

Sustainability-Linked Instruments and Collateral Frameworks

Sustainability-linked financial instruments align financial incentives with environmental targets. The ECB has taken modest but meaningful steps toward incorporating such instruments into its operations. Within the Corporate Sector Purchase Programme [CSPP], the ECB began tilting asset purchases toward greener firms and accepting sustainability-linked bonds [SLBs] as collateral. Bonds with variable coupons tied to environmental performance—i.e., increasing interest payments when targets are missed—are incentivized through this preferential treatment [ECB, 2022]. Moreover, the ECB introduced "penalty haircuts" on assets lacking adequate climate disclosures and announced that banks failing to integrate climate risks by 2024 may face higher Pillar 2 capital requirements, creating de facto sustainability-linked incentives [ECB Banking Supervision, 2022].

Türkiye's current framework does not yet include such linkages. However, Turkish banks have accessed sustainability-linked syndicated loans from global markets, and the Banking Regulation and Supervision Agency [BRSA] has signalled interest in differentiated prudential treatment for green assets [BRSA, 2021]. In parallel, Türkiye's Ministry of Treasury and Finance published a Sustainable Finance Framework in 2021, with plans to issue sovereign green bonds. The CBRT could support this development by assigning preferential collateral status or repo eligibility to such instruments.

The behavioral consequences of these biases are also supported by the Green Central Banking Scorecard 2024. This evaluation, published by Positive Money [Livingstone et al., 2024], revealed that the ECB received a score of 87 out of 100—earning a "B" grade—reflecting active implementation of green central banking tools in three domains: monetary policy, financial supervision, and central bank portfolio management. In stark contrast, the CBRT scored just 10/100, graded "D–", signifying its institutional infancy in incorporating climate policies. This striking disparity is too profound to be explained by institutional capacity or policy timing alone; the persistence of behavioral response patterns further reinforces the gap [Annicchiarico et al., 2024].

In the same 2024 Scorecard, several central banks—including the Bank of England, Banque de France, and Sveriges Riksbank—also achieved high scores [grades A or B], primarily due to their proactive integration of climate considerations into regulatory standards and asset purchase frameworks [Livingstone et al., 2024]. By contrast, central banks in countries such as Saudi Arabia and Russia remain positioned at the bottom of the ranking, highlighting enduring asymmetries in green central banking preparedness across G20 economies. These lower scores may be attributed not only to institutional conservatism and insufficient transparency, but also to political resistance against environmental policy mainstreaming and culturally

embedded uncertainty avoidance, which collectively inhibit behavioral adaptation to global green finance norms.

Indeed, in Europe, banks modified their behavior following clear policy signals and supervisory threats from the ECB—such as the introduction of capital requirements for banks that fail to internalize climate risk by the end of 2024. Consequently, institutions increased their staffing for green risk management and reoriented portfolios toward greener assets [DNB, 2022]. In Türkiye, however, a concrete behavioral shift is yet to be observed. Green finance remains largely project-based and externally funded rather than driven by central bank policy.

In conclusion, the success of green central banking instruments depends not only on technical design but also on accurate anticipation of cognitive and cultural responses. As exemplified by the ECB, behaviorally informed policy strategies—such as incentive structures that offset perceived losses, timeline-specific communication, and default-nudging mechanisms [e.g., treating green assets as default collateral]—can mitigate bias-driven resistance [Tversky & Kahneman, 1991]. For Türkiye, pilot programs based on incentives, technical support, risk-sharing mechanisms, and strategic communication may help overcome behavioral barriers. In this context, analyzing behavioral responses within the institutional framework constitutes an indispensable strategic requirement for enhancing the effectiveness of green central banking.

Conclusions and Policy Recommendations

The divergence in implementation between the ECB and CBRT is substantial regarding green central banking. While the ECB has advanced in integrating climate risks across its monetary, supervisory, and operational domains, the CBRT remains in a foundational phase. According to the Green Central Banking Scorecard [Livingstone et al., 2024], the ECB scored 87/100, reflecting a strong institutional commitment, while the CBRT scored just 10/100. This gap reflects not only institutional maturity but also differences in macroeconomic priorities, regulatory frameworks, and fiscal–monetary coordination capacities. Recent initiatives by the ECB and members of the Network for Greening the Financial System [NGFS] signal a paradigmatic shift in how financial stability is conceptualized in light of ecological threats. Türkiye, meanwhile, has taken preliminary steps, including the establishment of a Green Economy and Climate Change Department at the CBRT in 2021 and joining the NGFS in 2022. However, the depth and breadth of implementation remain limited compared to the EU [CBRT, 2022; Livingstone et al., 2024].

Nevertheless, Türkiye's recent institutional developments—such as the establishment of the CBRT's Climate Change Department and emerging regulatory dialogue—create a strategic window to align green finance with monetary operations. Piloting simplified green tools, integrating climate variables into macro-models, and

gradually adapting supervisory guidance could position the CBRT to play a more active role in the country's low-carbon transition.

- Behavioural factors play a decisive role in shaping the efficacy of green central banking policies. To enhance policy effectiveness, especially in emerging market contexts, the following strategies might be recommended:
- Behaviourally Informed Design: Embed insights from behavioural economics in policy architecture, such as reward-based schemes [e.g., green TLTROs].
- Capacity Building: Develop institutional expertise in climate risk modeling.
- Clear Communication: Reduce uncertainty through transparent taxonomy and forward guidance.
- Phased Implementation: Gradual policy rollouts to mitigate loss aversion effects.

While the EU provides a benchmark in green central banking innovation, Türkiye must navigate structural and behavioural constraints to close the implementation gap. This paper contributes to the emerging discourse by underscoring the role of behavioural dynamics in climate-aligned financial governance.

In conclusion, aligning behavioural design with climate-aligned policy objectives can enable central banks to act not only as financial stabilizers but also as catalytic agents in the transition toward a low-carbon economy.

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GREEN FISCAL POLICY: ITS PRINCIPLES AND FEATURES IN THE CONTEXT OF THE DIGITAL ECONOMY

Myroslava Bublyk •

Summary

In the context of digital economy challenges, green fiscal policy is becoming an important tool for promoting sustainable economic development. Its implementation is closely tied to transforming export structures toward high-tech, eco-friendly products. This enhances countries' economic resilience and global competitiveness amid rising demand for green goods. The study reviews international best practices, demonstrating the effectiveness of green tax and customs tools in supporting ecological and high-tech exports. Recommendations are offered for adapting Ukraine's fiscal policy to international environmental standards, including green tax incentives for low-impact exporters, support for R&D in eco-technologies, development of a support ecosystem for green exports, and improved monitoring of fiscal policy impacts on trade and the environment.

Key words: digital economy, sustainable development, green fiscal tools, eco-technological change, export diversification, high value-added exports.

Streszczenie

W kontekście wyzwań gospodarki cyfrowej zielona polityka fiskalna staje się istotnym narzędziem wspierania zrównoważonego rozwoju gospodarczego. Jej wdrażanie jest ściśle związane z koniecznością transformacji struktury eksportu w kierunku produktów zaawansowanych technologicznie i przyjaznych dla środowiska. Działania te zwiększają odporność gospodarczą państw oraz ich konkurencyjność na rynkach światowych w warunkach rosnącego popytu na ekologiczne dobra. W badaniu przeanalizowano najlepsze praktyki międzynarodowe, które potwierdzają skuteczność narzędzi podatkowych i celnych ukierunkowanych na wsparcie eksportu ekologicznego i zaawansowanego technologicznie. Zaproponowano rekomendacje dotyczące dostosowania polityki fiskalnej Ukrainy do międzynarodowych standardów środowiskowych, w tym wprowadzenie zielonych ulg podatkowych dla eksporterów o niskim wpływie na środowisko, wsparcie B+R w dziedzinie ekotechnologii, rozwój ekosystemu wsparcia eksportu ekologicznego oraz poprawę monitorowania wpływu polityki fiskalnej na handel i środowisko.

Słowa kluczowe: gospodarka cyfrowa, zrównoważony rozwój, zielone instrumenty fiskalne, zmiany ekotechnologiczne, dywersyfikacja eksportu, eksport o wysokiej wartości dodanej.

JEL: H23, Q58, Q56, O33, O35, O38, F18, H25, L51, L86, M15, E62

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Introduction

In the 21st century, the global community is facing an unprecedented advancement of digital technologies, which necessitates the transformation of economic development models towards sustainability, environmental responsibility, and high-tech production. In this context, green fiscal policy gains particular importance as an effective instrument for stimulating environmentally safe and technologically advanced manufacturing. It aims to reorient fiscal mechanisms from traditional revenue collection towards the support of innovation, energy efficiency, resource conservation, and the development of a high-tech export structure. This enhances countries' economic resilience and global competitiveness amidst growing demand for green goods.

The issue of implementing green fiscal policy is examined through the case of Ukraine, where it is particularly relevant due to the high dependence of national exports on raw materials, especially products from the agricultural sector, metallurgy, and extractive industries, sectors that have suffered significant losses during the russia - Ukraine war. Such an export profile limits the economy's adaptive capacity to global market changes, hinders the growth of added value, and reduces the chances of integration into global eco-product supply chains. At the same time, the growing consumer demand for green and technological goods is forming a new logic of global trade oriented towards climate neutrality.

International experience shows that countries with developed economies are actively employing green fiscal policy tools, from tax incentives for eco-product manufacturers to carbon taxation and export subsidies for innovative companies. The effectiveness of these measures is confirmed by the examples of Germany, the Netherlands, South Korea, and the United States, where a combination of financial incentives and state support for R&D has facilitated the establishment of green production and export ecosystems.

The aim of this study is to identify the principles and characteristics of green fiscal policy in the world under the conditions of rapid development of information technologies and the formation of the digital economy. The object of the study is the formation of green fiscal policy within the digital economy. The subject of the study comprises the concepts, methods, fiscal instruments, and mechanisms for stimulating environmentally oriented exports with high added value.

Green fiscal policy as a tool for structural transformation of exports in the context of the digital economy

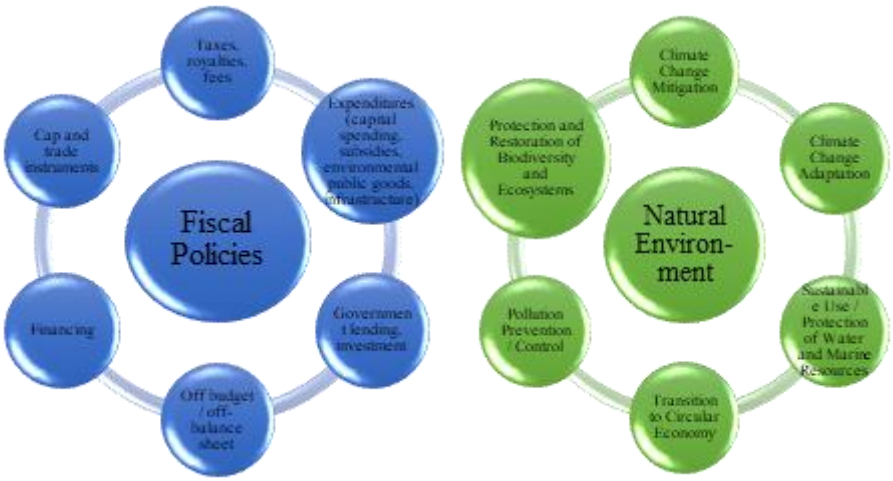
Today, the problem of climate change and environmental degradation has acquired the status of one of the main challenges for the global community. In response to these challenges, governments are increasingly actively integrating environmental priorities into fiscal strategies, forming the so-called «green fiscal policy» [OECD 2022: 22]. It is a set of tax, customs and budgetary instruments that contribute to reducing the negative impact on the environment, stimulating the development of sustainable production and consumption, reducing the carbon footprint and transforming economic models towards climate neutrality [Arroyo, Fatas and Vasishtha 2024:760].

In the current context of global climate challenges, green fiscal policy is gaining particular importance as an effective tool for the transition to sustainable economic

development. Climate change, environmental degradation, and increasing demands for environmental safety products from international partners require governments to rethink traditional approaches to fiscal policy formation. In this context, green fiscal policy is a key lever that can not only reduce the environmental burden, but also activate the structural modernization of the economy, particularly its export sector.

The main purpose of green fiscal policy is to reorient the economy towards an eco-efficient development model, ensuring not only environmental but also economic feasibility, including GDP growth, creation of new jobs in the green sector, and expansion of export potential [Botta, Porcile and Spinola et al. 2023: 177]. In this context, fiscal levers become not just a tool of fiscal regulation, but a means of systemic eco-transformation of the economy [Petrie, 2021: 104] (Figure 1).

Figure 1. Fiscal policies and the environment: two-way interactions



Source: [Petrie, 2021: 104]

Countries that have implemented such policies, Germany, the Netherlands, South Korea, the United States, demonstrate a steady trend of increasing the competitiveness of their economies based on environmentally friendly products with high added value. Therefore, green fiscal policy is seen not only as a mechanism for environmental protection, but also as a strategy for long-term economic growth in line with the UN Sustainable Development Goals [Zhang 2024: e33466]; [UNEP (2021)].

In the context of the digital economy, scholars are examining how green fiscal policy facilitates the shift from a raw material-based export model to one that is high-tech and environmentally oriented. The author [Watson 2021: 700] emphasize that, under digital economic conditions, fiscal instruments, such as tax incentives, carbon taxation, export subsidies for eco-friendly products, and support for R&D, can stimulate the production of goods with high added value. This approach enhances a country's competitiveness, promotes sustainable development, and aligns with the global trend towards climate neutrality. The specific characteristics of the Ukrainian economy underscore the urgency of fiscal policy reform to lay the groundwork for transforming a resource-based economy into a digital one.

Ukraine, as a country with an open economy and an export-oriented growth model, currently remains vulnerable to global changes in the foreign trade environment. Its commodity structure of exports is still largely dependent on the supply of raw materials, in particular products of the agro-industrial complex, metallurgy and mineral raw materials [Bublyk, Petryshyn and Medvid 2019a: 7; 2019b: 50]. This export model creates significant risks to economic sustainability, as raw material dependence increases vulnerability to price fluctuations on world markets, weakens the motivation for innovation and hinders the formation of a high-tech sector.

Ukraine's export policy remains focused primarily on the supply of raw materials: products of the agro-industrial complex, metallurgy, and mineral raw materials. This export structure indicates a high level of export dependence on raw materials and a low level of added value [World Bank 2020: 20]. This creates several problems: 1) low economic resilience to price shocks on world markets, 2) restrictions on the development of the high-tech sector, 3) increased negative environmental impact due to the dominance of energy- and resource-intensive industries. The absence of green fiscal policy as a systemic component of fiscal regulation only deepens the above-mentioned imbalances. The consequences are lack of incentives for green production, loss of positions in EU markets, where environmental barriers are increasing, and limited access to green financing [Golpe, Sánchez-Fuentes and Vides 2023: 1029]. Therefore, the transition to a green fiscal policy for Ukraine is not just an environmental initiative - it is a key direction for increasing competitiveness and export potential [Ministry of Energy of Ukraine 2023: 23]; [CMU 2025: 5].

The lack of an effective green fiscal policy in Ukraine has a few negative consequences. First, it leads to limited economic sustainability in the context of the growing instability of the global economic environment. Second, it loses competitive advantage in the markets of countries where the environmental safety of products has become one of the key criteria for consumers and businesses. Third, the state does not use fiscal instruments as a mechanism to support innovations that contribute to the development of industries with high added value and a low carbon footprint. As a result, without adapting to the new requirements of the global market, Ukraine risks losing the opportunity to fully integrate into global value chains [MFU 2023: 23].

The experience of leading countries shows that green fiscal policy can be an effective means of solving the above problems. Germany actively uses the carbon tax mechanism, which simultaneously performs both environmental and fiscal functions. The Netherlands has developed a system of green tax benefits for enterprises implementing environmental innovations. South Korea and the United States are implementing fiscal incentive programs for clean technologies, providing financial support to export-oriented high-tech companies. All these measures have allowed not only to reduce the harmful impact on the environment, but also to form competitive industries focused on environmentally demanding markets.

Defining Green Fiscal Policy are following: «…a whole range of tax and price measures that can increase fiscal revenues while contributing to the achievement of environmental goals», «…can contribute directly to poverty reduction by helping to address environmental problems… and indirectly by generating or freeing up resources for poverty reduction programs… or for investment in the poor…», «...an important part of the development policy toolbox» [OECD/DAC, 2025: 5].

Among the key instruments of green fiscal policy that have already proven their effectiveness in international practice, we highlight the following (Table 1).

Green tax breaks are an exemption from certain types of taxation or reduction of rates for enterprises that produce environmentally friendly products or implement energy-efficient technologies [Golpe, Sánchez-Fuentes and Vides 2023: 25]. Carbon taxation is the imposition of taxes on greenhouse gas emissions, which creates incentives to reduce harmful emissions and transition to low-carbon technologies [Mazzola and Gambina 2025: 100078]. Fiscal incentives for clean technologies and eco-innovations – providing subsidies, grants, tax credits for investments in scientific research and development, and environmental modernization of production. Export subsidies for environmentally friendly industries – financial support for the export of environmentally friendly products with high added value [Brown and Troutt 2018: 421].

Table 1. Features of the application of green fiscal policy instruments

Green fiscal policy tool	Functions	Methods of application	International experience (country)	Prospects for Ukraine
Green tax breaks	Reducing tax burden for environmentally friendly enterprises	Reduced VAT rates, tax credits	Germany, Netherlands	Reducing costs for greening your business
Carbon taxation	CO_2 emission charge	Introduction of a tax per ton of CO_2	Sweden, Canada	Shaping the decarbonization market
Eco-subsidies	Support for clean technologies	R&D funding, capital grants	USA, Korea	Increasing innovation potential
Export incentives for eco-industries	Stimulating ecological exports	Customs benefits, cost compensation	Netherlands, Canada	Expanding the market for organic products
Plastic packaging tax	Waste reduction	Fee for using single-use plastic	Great Britain	Reducing the burden on the environment

Source: own elaboration

The results of the study showed that the implementation of these tools allowed leading countries to significantly expand their share of environmentally friendly products in exports, intensify the development of green technologies, and reduce the carbon footprint per unit of output.

Ukraine has the potential to adapt a similar model of green fiscal policy, given its strategic aspiration for European integration and the need to modernize the export sector. To do this, it is necessary to: improve tax legislation, provide benefits for environmentally responsible exporters; create an effective institutional infrastructure to support green exports; ensure the harmonization of fiscal mechanisms with European standards and climate goals.

Current state of the commodity structure of exports in Ukraine and the need for fiscal reform in the conditions of the global green transition

Let's analyze the current state and trends of the commodity structure of Ukraine's exports in comparison with the leading countries of the world. Ukraine remains an agrarian and raw material economy. The basis of exports is agricultural products (grains, oilseeds, oil), metallurgy (ferrous metals, metal products), as well as mineral raw materials [Bublyk, Udovychenko and Medvid 2019: 57].

High value-added products are poorly represented (less than 5% are aircraft manufacturing or IT services). The main trading partners are the EU countries, China, Turkey, and Egypt.

In leading countries with a high-tech export structure (USA, Germany, Japan, South Korea), the basis of exports is high-tech goods: electronics, software, pharmaceuticals, cars [McKenna, Le Heron and Roche 2001: 160]. A significant share of spending is directed at R&D, which is supported by tax incentives. Long-term strategies for the development of the innovation sector and the digital economy prevail. China and India have achieved a breakthrough thanks to export reforms. China has successfully transitioned from exporting raw materials to products with high added value (electronics, machines) thanks to subsidies and an export-oriented tax policy. India has developed the IT sector and pharmaceuticals, which have become significant export items [Zhang 2024: e33466). Table 2 shows the main differences between Ukraine and leading countries with a high-tech export structure. Among the positive trends in the commodity structure of Ukraine's exports, we see an increase in the role of the IT sector. The share of IT services in total exports is growing, but in absolute terms it remains insignificant compared to leading countries. The agricultural component is also strengthening. However, expanding the production of grains and oilseeds only increases the raw material orientation of exports.

Table 2. The main differences between Ukraine and leading countries

Parameter	Ukraine	Leading countries
Main export goods	Raw materials, agricultural products	High-tech products
Share of R&D in GDP	~0.4%	2–4%
Export of services	IT services are developing	High share of services in the structure
Fiscal incentives	Insufficient, limited access to benefits	A wide range of tax tools

Source: own elaboration

Among the negative trends, there is a low level of diversification, as Ukrainian exports remain dependent on a small number of product groups. Thus, the main problem of Ukraine is the low share of high value-added products due to insufficient support for innovation and weak fiscal incentives. In the future, the development of a cluster approach, support for the IT industry, and the introduction of modern green taxation tools can improve it. Let us analyze the dynamics of the geographical structure of foreign trade in goods in the period 2013-2023 (Table 3). As can be seen from Tables 3, between 2013 and 2023, Ukraine's exports fell from $63.3 billion to $36.2 billion, mainly due to war, territorial loss, and structural weaknesses. Imports

in 2023 reached $63.6 billion, creating a negative trade balance. Trade with CIS countries declined sharply, while exports to the EU rose from $17.1 billion in 2013 to $24.9 billion in 2023, driven by EU integration. However, exports to Asia and Africa declined due to market loss and logistical challenges, while imports from Asia remained stable. Ukraine's export structure remains dominated by raw materials, grain, metals, and ore, representing low added value and limited integration into global value chains. This model is vulnerable to price volatility and impedes innovation and green transformation. As global markets move toward climate neutrality, Ukraine risks falling behind due to outdated industrial processes, low eco-standards, and limited green investment. Exporters face increasing barriers from international carbon regulations like the EU's CBAM (Carbon Border Adjustment Mechanism).

Table 3. Dynamics of the geographical structure of foreign trade in goods in the period 2013-2023 (export), million USD

Year	Total	CIS countries	Other countries of the world	Europe	EU countries	Asia	Africa	America	Australia and Oceania
Export									
2013	63320.7	22077.3	41243.4	17064.2	16048.4	16813.0	5094.7	2163.6	40.1
2014	53901.7	14882.3	39019.4	17122.1	16413.7	15350.9	5098.2	1372.2	23.5
2015	38127.1	7806.1	30321.0	13248.3	12647.3	12378.9	3803.3	785.6	13.6
2016	36361.7	6031.5	30330.2	13790.1	13178.5	11796.3	3865.1	735.2	18.3
2017	43264.7	6916.4	36348.3	17901.9	17053.4	12967.3	4047.7	1207.9	71.9
2018	47335.0	7025.2	40309.8	20606.0	19572.8	13754.1	4127.0	1620.0	48.6
2019	50054.6	–	–	26739.5	20122.7	16646.1	4971.5	1467.9	59.0
2020	49191.8	–	–	23736.1	17938.1	19699.0	4048.0	1548.9	67.1
2021	68072.3	–	–	34213.6	26793.0	24762.1	5626.8	3258.5	73.9
2022	44135.6	–	–	30271.7	27890.7	10467.7	2129.8	1190.6	29.0
2023	36182.9	–	–	24889.8	23392.1	8811.4	1677.9	754.3	21.3
Import									
2013	76986.8	27941.6	49045.2	28566.2	25640.3	15237.3	749.8	4339.9	93.7
2014	54428.7	17276.9	37151.8	22383.0	20377.1	10848.3	679.9	3021.5	182.2
2015	37516.4	10485.5	27030.9	16665.3	14760.0	7235.8	601.7	2336.6	169.6
2016	39249.8	8565.4	30684.4	18470.2	16431.6	8920.5	553.9	2594.8	120.6
2017	49607.2	11477.9	38129.3	22922.4	20000.4	10679.4	719.0	3615.6	151.4
2018	57187.6	13209.1	43978.5	25370.8	22324.4	13617.3	757.9	4110.6	69.3
2019	60800.2	–	–	38001.9	24242.3	17394.5	819.2	4397.7	116.8
2020	54336.1	–	–	32811.9	23125.5	16390.0	810.3	4239.0	45.8
2021	72843.1	–	–	44327.7	28954.3	22244.6	1213.1	4833.1	178.1
2022	55295.7	–	–	32427.1	26962.4	18839.4	596.8	3165.1	230.6

2023	63567.0	–	–	35384.1	32487.3	23296.9	713.9	4046.5	102.1

Source: [State Statistics Service of Ukraine 2024]. Data from 2019 are not filled in and do not take into account the territories temporarily occupied by the russian federation and parts of the territories where hostilities were underway.

To address this, Ukraine must diversify trade, develop high-value, eco-friendly exports, and integrate into global supply chains. This requires fiscal reform, green incentives, R&D support, and institutional capacity-building to meet environmental and technological standards.

This study aims to identify ways to improve Ukraine's green fiscal policy to promote exports of high value-added, eco-friendly products. Key recommendations include introducing tax benefits for companies using energy-saving technologies or producing environmentally safe goods, as practiced in Germany. To support high-tech exports, Ukraine should develop startup ecosystems through fiscal incentives for public and private venture funds, following Israel's model.

Harmonising tax policy with EU and WTO standards is vital, especially as Ukraine moves toward EU membership. Lack of export diversification, highlighted during russia's full-scale war, demands urgent development of long-term strategies to support high-tech production, like South Korea's model.

Specific measures include R&D tax incentives, the creation of innovation zones with reduced taxes, and export-oriented tax policies such as Ireland's 12.5% corporate rate for exporters. Digitalising tax and customs systems, drawing on Estonia's success, would cut bureaucracy and corruption.

Currently, Ukraine lacks effective tools like carbon taxes or eco-export incentives. Without reform, it risks losing access to key markets such as the EU under mechanisms like CBAM. A modern green fiscal policy is essential for transitioning Ukraine's economy toward sustainability, innovation, and stronger global competitiveness.

Improvement of green fiscal policy in Ukraine as a factor of greening foreign trade

In the current conditions of increasing global climate challenges and aggravation of environmental safety problems, green fiscal policy is gaining special importance as a tool of state influence on economic activity considering the principles of sustainable development. For Ukraine, whose economy has long been oriented towards the export of raw materials, an important task is the transformation of fiscal policy in the direction of stimulating an environmentally oriented economy with high added value.

Key problems that need to be addressed are low level of taxation of harmful emissions, lack of sufficient tax incentives for environmentally friendly businesses, weak integration of environmental indicators into budget policy.

Promising areas for improving green fiscal policy in Ukraine are [25-33]:

1. Introduction of a comprehensive system of environmental taxation, which involves revising environmental tax rates, expanding the tax base by including new sources of pollution (carbon emissions, noise pollution, water pollution).
2. Integration of carbon taxation elements into the tax system with a gradual transition to a national greenhouse gas emissions trading mechanism, aligned with the European system (EU ETS).

3. Creation of a special state green fund, which will be replenished at the expense of environmental taxes, excise duties and fines, and the funds will be directed to the development of clean technologies, modernization of enterprises and support for ecological exports.

4. Development of a system of fiscal incentives for enterprises that produce environmentally friendly products, including tax breaks, accelerated depreciation of eco-technologies, and investment tax credits.

5. Harmonization of Ukrainian legislation with EU requirements, in the field of CO_2 emission taxation, implementation of directives on energy taxation and environmental labeling of goods.

6. Digitalization of environmental tax administration and reporting, creation of open online resources for monitoring revenues and use of environmental payments.

7. Increasing the transparency and efficiency of the use of environmental taxes, which should be reflected in the reporting of the State Tax Service, as well as in the inclusion of the public in decision-making processes.

8. Supporting environmental exports by introducing subsidies for enterprises that are focused on producing products in accordance with international environmental standards (ISO 14000, EU Ecolabel, etc.).

Given the challenges and international experience, it is advisable for Ukraine to reform fiscal policy through the institutionalization of green fiscal policy, adoption of an appropriate strategy, and amendments to the Tax and Budget Codes. The introduction of green tax benefits includes reducing tax rates for enterprises that export environmentally friendly products or have ISO 14001 certification.

The introduction of a carbon tax covers the promotion of energy efficiency and the development of low-carbon production. The stimulation of clean technologies and eco-innovations is associated with the provision of tax credits for R&D in the field of eco-innovations. The creation of export-oriented ecological clusters includes customs and tax incentives within the framework of industrial parks. Harmonization with EU requirements for CBAM will allow access to European markets.

Green fiscal policy instruments are divided into two main groups: tax -based instruments) and budgetary (expenditure-based instruments). The first include environmental taxes, carbon taxation, and tax breaks for environmentally friendly businesses. The second includes government subsidies, grants, and financing of projects to improve environmental efficiency (Table 4). The comprehensive table of instruments provides an assessment of the availability of legislation and international practices for the application of these instruments (Table 5).

The effectiveness of green fiscal policy instruments is monitored through a few quantitative and qualitative indicators that allow us to assess how effectively tax and budgetary mechanisms stimulate the greening of the economy, in the field of exports. Let’s detail the key approaches to assessing effectiveness. Macroeconomic indicators demonstrate the impact of green fiscal policies on overall trends in the economy, especially regarding sustainable growth. Growth rates of exports of environmentally friendly products: the dynamics of export volumes of goods that meet environmental criteria (according to the OECD or EU classification) are monitored.

Table 4. Effectiveness of green fiscal policy instruments

Green fiscal policy tool	Functions	Methods of application	International experience (country)	Prospects for Ukraine
Carbon taxation	Reducing CO_2 emissions	Emissions tax, carbon pricing	Sweden, Germany	Introduction of a carbon tax with benefits for low-emission enterprises
Tax benefits for eco-enterprises	Stimulating innovation	Profit deductions, VAT, excise duties	USA, Netherlands	Encouraging investment in green technologies and production
Export subsidies for eco-products	Increasing the share of environmental exports	Partial reimbursement of costs, grants	South Korea, Norway	Development of the export ecosystem
Digital environmental reporting and control	Transparency of use of funds	Electronic accounting and control system	Estonia, Canada	Strengthening the trust of business and society

Source: own elaboration

Table 5. Features of the application of green fiscal policy instruments

Green fiscal policy tool	Legislative framework in Ukraine and the world	Application examples	Advantages	Disadvantages
Carbon tax	Partially (CO_2 eco-tax) / Adopted in over 40 countries	Pilot projects, CO_2 tax in Sweden	Emission reduction, budget revenue	Business resistance due to the risk of reduced competitiveness of enterprises
Tax breaks for environmental investments	Limited, partially (project initiatives) / Yes (EU)	Benefits for energy-saving equipment	Stimulating modernization	High administration costs
Financing clean technologies	No system/ Yes (EU)	Some SFRD programs	Economic and environmental efficiency	Lack of stable funding
Export subsidies for environmentally friendly production	Limited / Widely used in OECD countries	No precedents/ Green grants in the USA	Export Development, Acceleration of Innovation	Possible conflicts with WTO norms, High budget cost
Export incentives for eco-industries	Absent / Common in OECD countries	Customs benefits in Canada	Increased exports	Possible violations of WTO rules
Plastic packaging tax	Absent / Present in EU, UK	UK Plastic Packaging Tax	Eco-efficiency	Administrative complexity
Green tax breaks	Partially (project initiatives) / Yes (EU)	EcoVAT in the EU	Reducing business costs	Difficulty of administration

Source: own elaboration

Structural transformation of exports: reducing the share of raw materials and increasing production with high added value and low carbon footprint. The volume of investments in clean technologies and R&D: growth of private and public investments in innovations in the field of energy efficiency, recycling, renewable energy, circular economy.

Fiscal indicators allow us to assess how effectively the state manages tax and budget incentives in a green context. The amount of environmental tax collected and

its share in GDP or total tax revenues. Number of enterprises that have taken advantage of green tax breaks. The effectiveness of tax expenditures is the ratio of benefits provided to the effect obtained (for example, emission reduction, growth in exports of eco-products).

Environmental indicators capture the real environmental effect of the use of fiscal instruments such as reduction of greenhouse gas (GHG) emissions per unit of production or per unit of exported goods, increasing the share of renewable energy sources in industry, and circular economic indicators (e.g., the number of materials reused in production).

Socio-economic effects demonstrate how green fiscal policy impacts employment, inclusion, and human capital development by creating new jobs in green sectors, increasing in salaries and qualifications in the areas of ecological production, and reducing energy poverty through increased energy efficiency.

Institutional and behavioral changes indicate a long-term transformation of economic models, for example changing corporate strategies towards sustainable development, ESG orientation, and climate reporting, integrating sustainable development criteria into public procurement, dissemination of voluntary environmental certification among exporters.

There are e few methods of assessing effectiveness such as Cost-Benefit Analysis (CBA) – the ratio of costs for implementing tools and benefits (economic, social, environmental), Input-Output Analysis – assessment of the impact of green investments on related sectors of the economy, Carbon Pricing Readiness Index – an index of a country's readiness for the effective implementation of carbon taxation, and Multiplicative effect assessment – analysis of how tax incentives stimulate investment, employment, and GDP.

In summary, the effectiveness of green fiscal policy instruments should be assessed not only by economic outcomes, but also by the depth of environmental and social transformations. It is important to create a monitoring system that is based on integrated indicators and provides feedback to adapt policies to changing conditions.

Therefore, green fiscal policy in the face of environmental challenges should become a priority of state policy to ensure sustainable development of Ukraine. Improving tax instruments will not only reduce the negative impact on the environment but also stimulate the production and export of products with high added value. Ukraine should borrow the best international practices and adapt them to its own conditions, considering European integration priorities.

Thus, general recommendations for Ukraine to implement a green fiscal policy are the need to introduce carbon taxation in accordance with the «polluter pays» principles, create a system of financial support for environmental exports, integrate environmental criteria into the public procurement system, expand the digital platform for environmental administration, and harmonize environmental tax legislation with EU Directives [GFEA, 2021:12]; [EEA, 2025: 25].

The prospect of further research is to study the complex impact of green fiscal policy on regional development, industry competitiveness and socio-economic aspects of employment in the context of the transition to a low-carbon economy. Of note is the analysis of the fiscal multiplier of green investments, the implementation of a system for monitoring the effectiveness of environmental tax benefits, as well as

an assessment of the potential for integrating environmental financing instruments into mechanisms for state support for exporters. It is equally important to study the impact of free trade agreements and international obligations of Ukraine (in particular, within the framework of the European Green Deal) on the transformation of the national fiscal architecture in an environmental context.

Conclusions

In the face of global climate change, green fiscal policy is both an environmental necessity and an economic strategy for sustainable development and increased competitiveness. Ukraine's current export structure is dominated by raw materials that are energy- and resource-intensive, making the economy vulnerable to external shocks and increasing its carbon footprint.

International experience shows that green fiscal tools—such as tax incentives, carbon taxes, eco-export subsidies, and clean technology support—can boost exports of high-value-added, low-impact goods. Countries like Germany, South Korea, the Netherlands, and the USA have successfully used these tools to modernize their economies and integrate into global green value chains.

For Ukraine, systemic fiscal reform in a green direction is essential. Key recommendations include introducing green tax incentives, supporting eco-innovation and energy efficiency, developing green export infrastructure, aligning legislation with EU standards, and establishing systems to monitor fiscal impacts on trade and the environment.

Green fiscal policy should become a core instrument for Ukraine's transition to an environmentally responsible, innovative, and competitive economy. Its effective implementation will help Ukraine meet the demands of the global green transition and secure a stable position in eco-product markets.

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