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Demographic and Socio-Economic Factors as Barriers to Robo-Advisory Acceptance in Poland

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Abstract

Theoretical background: One manifestation of the use of artificial intelligence technology in financial services is robo-advisory. Automated assistants are used in the area of communication with consumers and the sale of financial products. The development of robo-advisory services may contribute to increasing the availability of financial services and the cost efficiency of banks' operations. So far, however, robo-advisory has not been widely used in bank services, and the reasons for this can be seen in the lack of wide acceptance of robo-advisory by bank customers, among other things.

Purpose of the article: The aim of this paper is to identify barriers to the acceptance of robo-advisory in the services of banks operating in Poland. Variables relating to the demographic and socio-economic characteristics of consumers were analysed. Knowledge in this area can provide banks with a practical guideline for activities aimed at increasing acceptance of artificial intelligence technology and wider use of robo-advisory in financial services.

Research methods: The paper uses the results of a survey conducted in October 2020 regarding the application of artificial intelligence technology in the banking sector in Poland. The survey included a representative

sample of 911 Polish citizens aged 18–65. A multinomial logit model was employed to identify variables that represent significant barriers to robo-advisory acceptance in financial services.

Main findings: The conducted research helped identify the barriers to acceptance of robo-advisory among consumers in Poland. A low propensity to use robo-advisory in bank services is characteristic of respondents from older age groups, as well as those who do not show a predilection for testing new technological solutions. Lack of experience in using investment advisory services and customer concerns about the misuse of personal data by banks are also significant barriers.

Introduction

The digital transformation of banking, which has been implemented for several decades, has mainly involved the extensive use of computers and the Internet (Pramanik et al., 2019; Füller et al., 2022; Polasik & Piotrowski, 2016). However, in recent years, significant changes in banks' operations have been linked to the increasing use of artificial intelligence technology (Krasonikolakis et al., 2020). This technology is indicated as a breakthrough invention affecting various spheres of societies (Go et al., 2020). Nonetheless, unlike previous significant achievements in the development of civilisation, the implementation of artificial intelligence technology by banks may go almost unnoticed by the customers of these institutions. This is because artificial intelligence algorithms, such as Artificial Neural Networks, Backpropagation Neural Networks, Multilayer Perceptron, and Probabilistic Neural Networks (Bahrammirzaee, 2010), are applied in areas of bank activity such as data analytics, reporting and records management, risk management, compliance, anti-money laundering, fraud detection, and control of processes, which are carried out in the middle and back office. Robo-advisory, which is provided as part of the front office, stands out against this background. With this type of service, customers have direct contact with artificial intelligence (OECD, 2021).

According to the definition adopted by the financial market supervisor in Poland, robo-advisory is a form of automated investment advice using advanced artificial intelligence algorithms, machine learning, and tools for analysing large data sets (UKNF, 2020). Calzolari (2021) understands robo-advisory as the use of artificial intelligence algorithms to provide customers with recommendations relating to financial markets. Van Raaij (2017), on the other hand, highlights the use of behavioural data in robo-advisory for better matching of financial products or portfolios.

Artificial intelligence algorithms used in robo-advisory allow us to identify customers (know your consumer) and learn about their preferences for financial products (consumer profiling). They are also used to assess financial standing (credit scoring), make decisions in the financial area (mortgages choice decision), and for ongoing analysis and forecasting of financial market behaviour (stock exchange prediction, exchange rates forecasting, economic growth forecasting, sentiment and intention analysis, modelling social influence, and portfolio selection and management) (FSB, 2017). In robo-advisory, artificial intelligence is also applied in the process of robot-human communication. Artificial intelligence techniques such as

Natural Language Processing and Natural Language Understanding are used for this purpose (Schöler et al., 2020; Kidd & Saxena, 2021).

Robo-advisory in financial services in Poland is at an early stage of development and is practically limited to the possibility of choosing a specific investment strategy (Warchlewska & Waliszewski, 2020). In the future, however, it can be expected to include savings, investment, insurance, and financing products. Spreading the use of robo-advisory requires banks and other financial institutions not only to implement new technological solutions, but also to learn more about customers, their expectations, preferences, and experiences.

Literature studies carried out in the subsequent part of the paper have shown negligible interest of the representatives of science in Poland in the application of robo-advisory in financial services. There are very few works based on empirical studies presenting the consumers' point of view. The novelty of this work is the focus on consumers and, in particular, the analysis of the factors that limit their interest in practical robo-advisory capabilities.

The aim of this paper is to identify barriers to the acceptance of robo-advisory in the services of banks operating in Poland. Variables relating to the demographic and socio-economic characteristics of consumers were analysed. The assumed barriers to the acceptance of robo-advisory are, in particular, a lack of sufficient skills in using new technological communication solutions, limited use of financial advice services, and fear of misuse of personal data that are the input for artificial intelligence technologies. With this in mind, the author formulates the following research questions:

RQ1: Does active use of e-banking reduce the barrier to robo-advisory acceptance?

RQ2: Does active use of social media make consumers pay less attention to the processing of personal data?

A literature study is conducted in the subsequent part of the paper, focusing on the factors of robo-advisory acceptance. The author then shows how the primary material was obtained, presents a statistical description of the data and the research method used. The next section presents the results of the logit model estimation, which form the basis for the discussion and allow the research hypotheses to be verified. The conclusions summarise the considerations regarding the barriers to the acceptance of robo-advisory in Poland, as well as formulate practical guidelines directed at banks to reduce the negative impact of the factors identified in the paper on the development of automated advice based on artificial intelligence technology.

Literature review and hypotheses development

Robo-advisory is a technology in the area of artificial intelligence that has been gaining importance in the financial world (ZBP, 2020). The speed with which banks implement this solution depends on multiple factors. The determinants include: the

degree of technological sophistication of financial institutions and their environment, access to funding sources, the impact on banks' operational and financial efficiency, and the degree to which customer expectations are met (Deloitte, 2020). The literature studies carried out show that empirical research on the acceptance of robo-advisory in finance has analysed factors relating to the technology and its attributes as perceived from the consumer's perspective, and to consumers' attitudes, behaviours, and experiences towards robo-advisory. Hohenberger et al. (2019) showed that willingness to use robo-advisory depended on factors such as self-assessed financial experience, the type of emotions that using robo-advisory evokes, and the level of self-enhancement. Elsewhere, Belanche et al. (2019) demonstrated that the intention to use robo-advisory depended on consumers' attitudes towards robo-advisors, which were in turn shaped by the perceived usefulness and perceived ease of use of the technology under analysis. Interpersonal and external subjective norms were also important factors in technology adoption. The moderating role of familiarity with robots was further demonstrated. Research by Rühr (2020) focused on robo-advisory attributes such as degree of automation, level of control, and transparency. It analysed the effect of the configuration of the above characteristics on the intention to use robo-advisory. The study results indicated that respondents using this form of advice preferred hybrid automation combined with high levels of control and transparency.

The research carried out in this article focuses on identifying the demographic and socio-economic characteristics of respondents that negatively influence their intention to use robo-advisory. The study specifically analyses categories such as the age of respondents, use of modern information and communication technologies, use of financial advisory services, and trust in banks in the area of personal data processing.

In the first phase after ground-breaking technological innovations are introduced to the market, they are used by a small group of users referred to as innovators and early adopters (Rogers, 2003; Laukkanen & Pasanen, 2008). Research by Black et al. (2002) and Karjaluoto et al. (2002) among early e-banking adopters showed that a feature of those belonging to the groups mentioned above was young age. Young people are perceived to be more innovative, willing to accept new technologies, and more socially influenced than older people (Yang & Forney, 2013). As shown in studies by Brenner and Meyll (2020) and Fulk et al. (2018), the main users of robo-advisory in the US are precisely young people.

Reports produced by the Australian Council for Educational Research (2016) and Klapper et al. (2015) found that the problem of insufficient financial literacy and e-literacy skills mainly affected older people. Elsewhere, a study by Gerlach and Lutz (2021) found that the level of digitisation knowledge significantly affected the propensity to use innovative technological solutions in the area of finance, including robo-advisory. Königsheim et al. (2017) proved the positive impact of financial knowledge on the likelihood to use digital financial services. They also showed a lower propensity of older respondents to choose a digital service provider. Liao et al. (2022) identified low skills in using ICT devices as the main challenges related to

digital exclusion, as well as the limited range of communication infrastructure and the lack of appropriate behaviour of a given person on the Internet.

The results of a number of empirical studies indicate that trust is an important factor in the acceptance of technological innovations. It was considered in relation to the technology and the ICT-enabled service provider (Dutot, 2015; Sinha & Mukherjee, 2016). Research by Gan et al. (2021) and Lourenco et al. (2020) shows that trust in robo-advisory positively influences the intention to take automated financial advice. This factor is particularly relevant for consumers with little investment experience, little amount of savings, and a low level of risk tolerance (Jung et al., 2018). In other studies, Liang et al. (2020) and Lee et al. (2017) highlighted a correlation indicating that trust in technology declines as the age of respondents increases. In their analysis, Bruckes et al. (2019) found that high intention of using robo-advisors was influenced by trust in robo-advisory, which was in turn determined by high levels of trust in banks.

Due to the marginal importance of robo-advisory in the services of banks operating in Poland, the study carried out in the following part of the paper does not address the issue of customers' trust in information technology used in robo-advisory, but focuses on customers' experiences of using bank services. Special attention was given to the issue of financial advice and the management of customers' personal data.

Financial advice services are valued because of advisers' expertise and its impact on shaping consumers' financial literacy (Harlow et al., 2020; Balasubramnian & Brisker, 2016). The advantage of financial advisors over automated advisors is reflected in their ability to take a broader view of consumers' financial situations and needs (Abraham et al., 2019), as well as read and respond to consumer emotions (Huang et al., 2019). It should also not be forgotten that for some consumers, the advantage of human advisory services is the physical presence of bank staff (Buvat et al., 2018). In contrast, the literature states that robo-advisory's advantage is the ability to avoid conflicts of interest and biased financial advice, which are barriers to the use of human financial advisors (Lachance & Tang, 2012; Calcagno & Monticone, 2015). Also of interest are the results of Brenner and Meyll's (2020) study identifying a negative relationship between the intention to adopt robo-advisory and willingness to take human financial advice. It can be assumed that regardless of which form of financial advice service is rated higher by consumers – automated or provided by bank employees – it is important to have a customer experience in this area. The lack of need for investment advice may therefore be a barrier to robo-advisory adoption.

The artificial intelligence technology used in robo-advisory works on the basis of the data it receives. These data should be abundant enough and they should concern as many different aspects of consumer functioning as to allow artificial intelligence algorithms to discover behavioural patterns suitable for the provision of financial services (Königstorfer & Thalmann, 2020). Artificial intelligence in banking uses data from customer bank accounts and other financial service providers. Banks' mobile applications (Mhlanga, 2020) and social media (Bartlett, 2021) are a source of much valuable customer data. Consumers, while agreeing to share a lot of data about

themselves, expect in return the protection of their privacy, i.e. protection against unauthorised use of personal data (Muravyeva et al., 2020). However, this does not mean that the outcome of artificial intelligence in banking is always in line with customers' expectations and supports their interests. The issue of proper processing of personal data takes on particular importance when considering the findings of van Rooy and Bus (2010) indicating that ensuring privacy is very important for customer trust in banks. At the same time, privacy was also identified by Seiler and Fanenbruck (2021) as a key factor in the acceptance of automated investment advisory. It can therefore be assumed that consumers' negative experiences with the processing of personal data, as well as their expressed reluctance to provide banks with a wide range of personal data, may constitute a barrier to the acceptance of robo-advisory.

Due to the aim of the paper, special attention during the literature study was paid to the issue of robo-advisory in Poland. Research has shown that robo-advisory in financial services does not generate much interest, either among academics or consumers. Rogowski (2017), Nowak (2017), and Dziawgo (2018) presented theoretical considerations regarding robo-advisory, as well as the applicability of this service in the international financial market. Among the identified works relating to the topic of robo-advisory in Poland, it is worth noting the study by Waliszewski (2020), which presents the state and prospects for the development of this market and discusses the issue of robo-advisory regulation. The paper by Warchlewska and Waliszewski (2020) is important due to the empirical character of the analyses. It shows the results of a survey of 114 respondents actively using robo-advisory. However, it should be added that the questions addressed to individual investors originating from Poland focused almost exclusively on robo-advisory issues. Interesting conclusions about the attitudes of Polish consumers towards the use of robo-advice in making investment decisions and the analysis of spending habits are also presented in Waliszewski and Warchlewska (2020). The work uses data obtained as part of the ING International Survey – New Technologies 2019 covering 1,016 respondents from Poland. The study includes variables such as: age, gender, education, economic activity, household and income, but it does not take into account factors relating to the use of ICTs and financial services. In addition, the conducted analysis is aimed at indicating the relationships between the selected variables, but did not include the identification of factors influencing the intention to use robo-advisory.

In summary, the literature studies conducted have identified a research gap in terms of knowledge of the demographic and socio-economic characteristics of respondents considering or already using robo-advisory services. With this in mind, the paper formulates research hypotheses that relate to factors such as: the age of respondents, experience in using modern digital technologies, experience in the area of investment advice, and attitudes towards the processing of personal data.

H1: Older people show a low propensity to accept robo-advisory in bank services.

H2: Scarce experience in the use of ICTs is a barrier to the acceptance of robo-advisory in bank services.

H3: A lack of customer experience in the area of investment advice is a barrier to the acceptance of robo-advisory in bank services.

H4: Negative consumer assessments of banks' handling of personal data are a barrier to the acceptance of robo-advisory.

Research methods

The empirical research conducted in this paper was based on the results of a project on the application of modern information and communication technologies in the banking sector in Poland. The collection of primary data was commissioned to a professional research agency – Interactive Research Center Sp. z o.o. A survey questionnaire developed by the author was used in the survey conducted by means of computer-assisted telephone interview. The preparation of the questions addressed to the respondents was preceded by an in-depth literature review. A pilot study conducted in September 2020 verified the comprehensibility and completeness of the questions in the questionnaire. The full-scale survey took place in October 2020. It covered a sample of 911 Polish citizens aged 18–65 representative with respect to the age, sex and place of residence. Table 1 presents the basic characteristics of the respondents to the survey.

Table 1. Characteristics of respondents ($N = 911$)

Variable		Percentage of response
Gender	Female	50.2
	Male	49.8
Age Group	18–24	8.5
	25–34	23.9
	35–44	24.7
	45–54	20.0
	55–65	22.9
Education	Primary and below	2.0
	Lower secondary and basic vocational	18.5
	Secondary	40.4
	Higher	39.1
Residence	Village	28.8
	Village-suburban area	7.9
	Town with a population up to 20,000	13.3
	City with a population up to 100,000	20.2
	City with a population up to 500,000	17.8
	City with a population over 500,000	12.0

Source: Author's own study on the basis of research results.

Table 2 shows the variables used in the further analysis along with their description and the structure of the responses given by the respondents. With the aim of the paper in mind, Robo Intention was adopted as the dependent variable. This variable reveals respondents' attitudes towards the possibility of using robo-advisory in bank

services within five years following the survey. It is worth mentioning that the study
defines robo-advisory broadly, as automated advice used when applying for credit
or in making stock market investment decisions, employing artificial intelligence
technology to analyse the customer's financial situation, the situation in the economy
and financial markets, in order to make a recommendation or take an appropriate
decision in the area of finance.

Table 2. Characteristics of variables and the structure of responses obtained in CATI

Variable	Variable description	Available answers	%
Robo Intention	Intention of using robo-advisory in banks' services in next 5 years	1 – Definitely not	18.8
		2 – Rather not	28.1
		3 – It's hard to say	29.1
		4 – Rather yes	20.0
		5 – Definitely yes	4.0
Age Group	Age group	1 – 18–24	8.5
		2 – 25–34	23.9
		3 – 35–44	24.7
		4 – 45–54	20.0
		5 – 55–65	22.9
Social Media Using	Frequency of using social media	1 – No or less than once a year	22.5
		2 – Several times a year	1.3
		3 – Several times a month	5.9
		4 – A few times a week	15.2
		5 – Several times a day	55.1
Test New Technology	Passion for testing new technological solutions, devices and applications	1 – Definitely not	6.7
		2 – Rather not	18.7
		3 – It's hard to say	17.8
		4 – Rather yes	39.6
		5 – Definitely yes	17.2
E-banking Using	Frequency of using e-banking services (Internet or mobile banking)	1 – No or less than once a year	15.5
		2 – Several times a year	0.9
		3 – Several times a month	18.7
		4 – A few times a week	40.0
		5 – Several times a day	24.9
Honest Advisory	Banks advise honestly	1 – Definitely not	3.5
		2 – Rather not	12.9
		3 – It's hard to say	26.0
		4 – Rather yes	50.0
		5 – Definitely yes	7.6
Investment Advisory	Use of bank advisory services related to financial investment	0 – No	66.5
		1 – Yes	33.5
Data Sharing	Consent for the bank to analyze the content posted by me on social media	1 – Definitely not	71.7
		2 – Rather not	16.4
		3 – It's hard to say	7.6
		4 – Rather yes	3.0
		5 – Definitely yes	1.3
Personal Data Using	Banks use clients' personal data properly	1 – Definitely not	3.8
		2 – Rather not	9.9
		3 – It's hard to say	19.5
		4 – Rather yes	51.6
		5 – Definitely yes	15.1

Source: Author's own study on the basis of research results.

Tables 3 provides a statistical description of the variables used in the empirical analysis conducted in the paper. Tables 4 and 5 present more detailed information on respondents' experience with ICTs and their attitudes towards sharing personal data.

Table 3. Summary statistics of the demographic and socio-economic variables

Variable	Mean	Standard Deviation	Min.	5th Percent.	Median	95th Percent.	Max.
Robo Intention	2.6246	1.1201	1.000	1.000	3.000	4.000	5.000
Age Group	3.2503	1.2783	1.000	1.000	3.000	5.000	5.000
Social Media Using	3.7903	1.6270	1.000	1.000	5.000	5.000	5.000
Test New Technology	3.4204	1.1683	1.000	1.000	4.000	5.000	5.000
E-banking Using	3.5807	1.3000	1.000	1.000	4.000	5.000	5.000
Honest Advisory	3.4533	0.9316	1.000	2.000	4.000	5.000	5.000
Investment Advisory	0.3348	0.4721	0.000	0.000	0.000	1.000	1.000
Data Sharing	1.4599	0.8620	1.000	1.000	1.000	3.000	5.000
Personal Data Using	3.6432	0.9806	1.000	2.000	4.000	5.000	5.000

Source: Author's own study on the basis of research results.

Table 4. Information and communication technology use by age group (in %)

Variable		Age Group				
	Available answers	18–24 (N = 77)	25–34 (N = 218)	35–44 (N = 225)	45–54 (N = 182)	55–65 (N = 209)
Social Media Using	No or less than once a year	3.9	6.9	18.7	35.7	38.3
	Several times a year	1.3	0.9	1.8	1.1	1.4
	Several times a month	3.9	2.8	4.4	6.0	11.5
	A few times a week	11.7	17.4	16.4	15.4	12.4
	Several times a day	79.2	72.0	58.7	41.8	36.4
E-banking Using	No or less than once a year	13.0	7.8	8.0	22.0	26.8
	Several times a year	1.3	0.0	0.9	0.0	2.4
	Several times a month	14.3	11.9	19.6	21.4	23.9
	A few times a week	40.3	47.2	40.0	39.6	33.0
	Several times a day	31.2	33.0	31.6	17.0	13.9
Test New Technology	Definitely not	1.3	2.8	6.7	11.5	8.6
	Rather not	10.4	12.8	17.3	20.3	27.8
	It's hard to say	22.1	9.6	17.8	22.5	20.6
	Rather yes	46.8	51.8	37.3	32.4	33.0
	Definitely yes	19.5	22.9	20.9	13.2	10.0

Source: Author's own study on the basis of research results.

Table 5. The use of social media and the readiness to provide the bank with personal data posted on social media accounts (in %)

Variable		Data Sharing				
	Available answers	Definitely not	Rather not	It's hard to say	Rather yes	Definitely yes
Social Media Using	No or less than once a year	81.5	12.2	4.4	1.0	1.0
	Several times a year	66.7	16.7	0.0	8.3	8.3
	Several times a month	68.5	22.2	3.7	3.7	1.9
	A few times a week	72.5	19.6	2.9	3.6	1.4
	Several times a day	74.7	16.5	4.0	3.6	1.2

Source: Author's own study on the basis of research results.

A multinomial logit model was used to identify statistically significant variables that constitute a barrier to the acceptance of robo-advisory in bank services. Such a model is applicable when the dependent variable is qualitative. In addition, this variable can take one of a small number of possibilities, higher than two, which can be logically ordered. The multinomial logit model is represented as follows (Powers & Xie, 2008; Cameron & Trivedi, 2009; Bąk & Bartłomowicz, 2014):

$$P_{ki} = \frac{\exp(x_k^T \beta_i)}{\sum_{l=1}^{n} \exp(x_k^T \beta_l)}$$

where:

P_{ki} – the probability of choosing the i-th category at the k-th state of the explanatory variables describing consumers,

x_k^T – the vector representing the k-th row of the matrix X (the values of the explanatory variables for the k-th consumer),

β_i – the parameter vector associated with the i-th category of the dependent variable.

Results and discussions

A preliminary analysis of the data in Table 2 indicates a predominance of those who have no intention of using robo-advisory in bank services within five years of the survey (46.9%) over those more or less likely to use this form of financial service provision (24%). Taking into account the initial stage of development of the robo-advisory market in Poland and poor knowledge of this issue in the society, which may be manifested by a significant percentage of people who do not have an opinion in this regard (29.1%), the result obtained in the survey should be assessed as moderately optimistic.

Most of the respondents participating in the study can be described as active users of modern technological solutions. As many as 70.3% of them indicated that they used social media at least several times a week, 56.8% of respondents declared that

they liked to test new technological solutions, while 64.9% used electronic bank-ing functionalities (online and/or mobile) at least several times a week. It is worth mentioning here that a more in-depth analysis based on cross-tabulations (Table 4) showed that the vast majority of respondents from each age group were familiar with the functioning of the mentioned digital technologies. The lowest levels of ICT usage were found in the 55–65 and 45–54 age groups.

The analysis of the subsequent variables indicates that the respondents' opinion on the ethicality of banks operating in Poland is overwhelmingly positive. Only 16.4% of respondents indicated doubts about the fairness of banks' financial advice covering savings and investment products, and sourcing of funding. At the same time, however, only 33.5% of respondents used investment advisory services pro-vided by banks.

The issue of the processing of personal data is the second area of banks' activ-ities besides financial advice that inspires consumer confidence. The vast majority, 66.7% of respondents, were convinced that banks handled customers' personal data correctly. At the same time, only 4.3% of respondents consented to the bank ana-lysing the content they posted on social media. Therefore, it can be concluded that consumers' belief that banks behave professionally when processing personal data is not a sufficient reason for most respondents to give up a part of their privacy by providing a broader catalogue of personal data. Moreover, the data in Table 5 indicate that active use of social media (at least several times a week), where the respondents share information about themselves with other users, also does not increase the will-ingness to share personal data held on individual social media accounts with banks.

The estimation of the logit model (Table 6) identified barriers to the acceptance of robo-advisory in financial services of banks operating in Poland (Table 3). The first statistically significant variable is Age Group (r_S = -0.162; p-value < 0.001). The result obtained indicates that the increase in the age of the respondent has a negative effect on the intention to use robo-advisory services of banks. It can therefore be assumed that there are no grounds to reject H1.

Of the three variables analysed relating to ICT use, two – Social Media Using (r_S = 0.068; p-value = 0.041) and E-banking Using (r_S = 0.158; p-value < 0.001) – were found to be statistically insignificant. Thus, in answering the research question formulated in the introduction, it should be concluded that active use of e-banking does not significantly increase the willingness to use robo-advisory. The situation is similar in terms of active use of social media. The estimation of the model showed statistical significance only for the variable Test New Technology, which indicates the following relationship: an increase in the propensity to test new technologies has a positive effect on the intention to use robo-advisory in bank services. In view of the above, it can be assumed that there are grounds to reject H2.

Table 6. Estimation of a multinomial logit model

Dependent Variable: Robo Intention					
Variable	Coefficient	Std. Error	Z	*p*-value	Significance[a]
Age Group	-0.184210	0.052424	-3.514	0.0004	***
Social Media Using	-0.036320	0.042429	-0.856	0.3920	
E-banking Using	0.088699	0.054069	1.640	0.1009	
Test New Technology	0.313552	0.058745	5.337	<0.0001	***
Honest Advisory	0.171460	0.071091	2.412	0.0159	**
Investment Advisory	0.450515	0.133349	3.378	0.0007	***
Data Sharing	0.267459	0.071355	3.748	0.0002	***
Personal Data Using	0.186240	0.067802	2.747	0.0060	***

[a]*** statistically significant at the 1% level; ** statistically significant at the 5% level; * statistically significant at the 10% level.

Source: Author's own study on the basis of research results.

Two further variables referred to the use of financial (investment) advice: Honest Advisory ($r_S = 0.112$; *p*-value = 0.001) and Investment Advisory ($r_S = 0.099$; *p*-value = 0.003). Estimation of the model showed them to be statistically significant. Thus, the existence of a conviction that the financial advice of banks is fair, as well as having experience in the use of investment advice, positively influences the intention to use robo-advisory services of banks. It can therefore be assumed that there are no grounds to reject H3.

The last group of variables analysed presents respondents' attitudes towards the sharing of personal data. Both the Personal Data Using variable ($r_S = 0.151$; *p*-value < 0.001) and the Data Sharing variable ($r_S = 0.097$; *p*-value = 0.003) were found to be statistically significant. The estimation results can be interpreted as follows: an increase in respondents' belief that banks properly manage personal data has a positive effect on the intention to use robo-advisory in bank services. Considering that the vast majority of respondents (88.1%; Table 2) would not consent to bank's analysis of social media content posted about them, the estimation result can be interpreted as follows: the increase in customer opposition to sharing personal data posted on social media with banks has a negative impact on the intention to use robo-advisory in bank services. Therefore, it should be assumed that there are no grounds to reject H4.

The presented estimation results allow the author to identify the characteristics of consumers who do not show an intention to use robo-advisory. The first identified barrier to the acceptance of robo-advisory in bank services is older age. Previous literature studies have shown that older people are characterised by low levels of financial literacy, technological skills, as well as a limited propensity to take risks. These characteristics have a strong negative impact on the willingness to accept technological innovation. This relationship was also confirmed in the case of robo-advisory services of banks operating in Poland.

The transformation towards a digital society, reinforced by the impact of the COVID-19 pandemic, has resulted in the widespread use of digital technologies in Polish society. However, estimation of the model has shown that active use of social media and e-banking does not significantly support the decision to seek robo-advisory. The significance of the Test New Technology variable indicates that a barrier to the adoption of robo-advisory may be a lack of interest, curiosity accompanying the use of the latest technological solutions, and a limited willingness to take the associated risks. The results of the survey indicate that the respondents perceive robo-advisory as a service that involves more competences than those required when using services provided via the e-banking channel.

Another barrier to the acceptance of robo-advisory is the lack of consumer use of advisory services provided by banks, particularly in the area of financial investments. As the preliminary analysis of the results showed (Table 2), more than 66% of the respondents did not take investment advice from banks. This result may indicate that consumers are not interested in investment advice at all, or that they seek it from non-bank providers such as brokerage houses and offices.

The last identified barrier to the acceptance of robo-advisory in the services of banks operating in Poland is respondents' concerns about the proper management of personal data. The issue of the processing of customers' personal data and trust in banks in this area takes on particular importance in view of the increasing use of artificial intelligence technology in banking. It is in the interest of banks to increase the willingness of customers to share personal data from a variety of sources, including those found on social media accounts. However, it seems that consumers' fears of their privacy being breached underlie a huge reluctance to share a wider catalogue of personal data with banks. Furthermore, the data in Table 5 indicate that respondents' high social media activity does not equate to a willingness to accept banks' use of personal data held on social media accounts. With this in mind, it can be assumed that consumers differentiate access to data found on social media depending on the nature of the entity. The processing of personal data by acquaintances is accepted, whereas the same behaviour of banks may be perceived as an invasion of privacy.

The challenge for banks in processing personal data obtained from external sources, including social media, lies not only in the reluctance of customers to share such data, but also in compliance with legal regulations on the processing of personal data. In addition to obtaining explicit consent from customers to process their personal data contained in their social media accounts, banks are required to demonstrate that the process respects the principles of purpose limitation, data minimisation, correctness, storage limitation, integrity and confidentiality, and accountability (GDPR, 2016).

Conclusions

The study conducted in this paper aimed to identify barriers to the acceptance of robo-advisory in the services of banks operating in Poland. The analysis focuses on the consumer, their experiences of using banking services as well as those related to the use of modern technological solutions. The results of the study fill a research gap in the field of demographic and socio-economic factors negatively influencing consumers' willingness to use robo-advisory in Poland. Knowledge of consumer behaviour and attitudes towards ICT, as well as experiences and constraints in using financial services can provide practical guidance for banks. If they take into account the results of the study during the planning and implementation of outreach activities, it may contribute to the reduction of barriers to acceptance of artificial intelligence technology and wider use of robo-advisory in the services of banks operating in Poland. Despite the fact that the research refers to Poland, in the author's opinion, some of the conclusions formulated in the study can also be applied to banks operating in countries where societies present a level of financial knowledge and technological skills similar to those in Poland.

Considering the first identified barrier – the age of consumers – banks should consider whether the target group for robo-advisory services will be young people, open to new technologies, or whether promotional activities should also include older people that have experience in using financial instruments and a certain level of physical and financial assets.

The importance of the second barrier – little experience in using investment advice – can be reduced by increasing customer interest in financial advice services provided by banks. Banks should promote their advisory services more widely, both those provided through personal contact with a bank employee and those provided through automated assistants. Messages addressed to consumers should emphasise the professionalism of banks, demonstrated by their knowledge of the functioning of the financial market, as well as their ethical conduct in relations with customers. In order to reduce consumer fear of robo-advisory, banks should emphasise the technological accessibility of the solutions used, supporting the message by introducing demos for this type of service.

Customer privacy protection was identified in the study as the third barrier to the acceptance of robo-advisory in bank services. The result of the estimation indicates that consumers are very negative about the possibility of banks to expand the pool of personal data by obtaining it from social media. They also show great sensitivity to the misuse of their personal data by banks. In view of the above, when processing personal data, banks should reassure customers that they are acting in accordance with the law, emphasise the benefits in terms of improved quality of service and better matching of financial products to customers' needs, and stress the issue of respect for ethical principles. The business ethics of banks require that the artificial intelligence technologies used should counteract discrimination, bias, and prejudice

(Balcewicz, 2019). It is equally important to build awareness among consumers that customer behaviour patterns detected by artificial intelligence can positively, as well as negatively, affect the decisions made towards them.

The literature study conducted and the empirical survey carried out allowed the author to see new directions for future research related to robo-advisory in bank services. The following areas seem to be of particular interest: to study of the willingness of consumers in Poland to use robo-advisory focusing on the technical and operational features of the robo-advisory service, to analyse banks' attitudes towards the implementation of robo-advisory, and to tackle the issue of privacy in the digital age.

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