European Research Studies Journal
Volume XXIV, Special Issue 3, 2021

pp. 50-67

Economic Aspects of Population Aging. Modeling Senior Household Ependiture

Submitted 13/07/21, 1st revision 04/08/21, 2nd revision 26/08/21, accepted 15/09/21

Iwona Bąk[1], Beata Szczecińska[2]

Abstract:

Purpose: *The purpose of the present article is to model senior citizens' household expenditure and try to identify factors that influence consumer behavior in this social group. Analyses of Polish households were used as a case study.*
Design/Methodology/Approach: *The study used selected structure description parameters to characterize the studied population synthetically. Power-exponential econometric models were used to characterize consumer goods and services expenditure in households headed by persons aged 65+.*
Findings: *The power-exponential models used in the article proved to be a valuable tool in the research into spending on consumer goods and services. In all the models, the level of the overall income per capita was found to have a significant positive impact. Another important finding was that the preferences differed depending on the class of the locality of residence, the subjective assessment of the material situation of one's household, the number of persons in the household, and the level of educational background, and the age of the person heading the household.*
Practical Implications: *The research results presented in the paper are of considerable importance for developing a policy addressing the needs of the elderly, including, for example, creating appropriate marketing instruments and preparing an offer aimed at the ever-growing group of senior citizens.*
Originality/Value: *The present article contributes to the most recent European and global scientific discussions on the significance of the elderly for the development of economies from the perspective of their impact on the markets for goods and services.*

Keywords: *Aging population, household expenditure, power-exponential models,*

JEL classification: *C5, H31, J14.*

Paper Type: *Research study.*

Acknowledgment: *Ageing societies: The benefits, and the costs, of living longer. 2009. World of work, 67, 9 12. This is the leading US government research agency dealing with the widely defined labor economics and statistics and the leading agency of the US Federal Statistical System. The BLS collects, processes, analyzes and distributes primary statistical data to the US public.*

[1]*West Pomeranian University of Technology, Szczecin, Poland, iwona.bak@zut.edu.pl;*
[2]*West Pomeranian University of Technology, Szczecin, Poland, beata.szczecinska@zut.edu.pl;*

1. Introduction

The current aging of the world population is probably the most severe demographic change in the history of humanity. This is a long-term trend that started in Europe several decades ago. It entails transforming the population age structure and is reflected in the increasing share of the elderly accompanied by the declining share of working-age people in the total population. Without a doubt, this process is influenced by the progress in health care and the improved living conditions of the population. Forecasts clearly show that this trend will not change in the coming decades. This, in turn, will lead to increased social expenditures borne by the working-age population that the aging population will require about several related services. It turns out that the proportion of people aged 65 or more is expected to triple in the less developed countries over the next 40 years, from 5.8 to 15% of the total population, and to rise from 16 to 26% (by over 60%) in the more developed countries1. In other words, every third person living in a developed country will be a pensioner. In 2019, the proportion of the elderly in Europe (aged 65 or more) was 20.3%, increasing 2.9 percentage points compared to 10 years back. There are slightly more than three working-age persons per person aged 65 years or more.

Demographers are increasingly talking about the so-called double aging, as well. The leading indicators of such aging are an increase in the number and share of the elderly in the total population and an increase within a subpopulation of the elderly – that of the so-called "very old people" (Frątczak and Sobieszak, 1999).

The last stage of life is the focus of interest for many scientific disciplines, each of which attempts to valorize old age. The demographic changes that are taking place today have many implications in different spheres of life and have an impact on the dynamics and structure of production and consumption, the structure of budgetary expenditure, the labor market, the social security, and benefits system, investment, saving, social, family and lifestyle (Calvert, 1977; Scholfield, 2000; Nazareth, 2007; Bąk, 2013; Sudbury-Riley, Kohlbacher, and Hofmeister, 2014; Aksoy *et al.*, 2015; Piekut, 2020; Bąk and Szczecińska, 2020). The increasing percentage of older people translates into their growing social, economic, and political importance. Their role as consumers is also growing.

Despite the increasing importance of the market for senior citizens, both in its volume and purchasing power, it remains largely uncharted territory. Given the small number of existing publications explaining the complexity of consumer behaviors in the different types of households, the present paper attempts to evaluate these consumption patterns. The present article aims to model senior citizens' household expenditure and try to identify factors that influence consumer behavior in this social group. Analyses of Polish households were used as a case study. The study focused on 2018, and the integrated dataset covered 10,472 households headed by a person aged 65 years or more (which will be from now on referred to as 65+ households).

The overall goal of the research is to fill the gap in the knowledge caused by the lack of comprehensive studies in this area. Detailed research is of considerable importance for developing a policy addressing the needs of the elderly, including, for example, creating appropriate marketing instruments and preparing an offer aimed at the ever-growing group of senior citizens.

Since the article's goal can only be achieved using statistical analysis methods, it is essential to determine the correct age limit for the elderly. In pursuance of the UN classification (World Population Prospects, 2005), most of the statistics are based on professional activity; 65 years old is assumed as the age limit in the present study.

As for its layout, this article starts with an introduction setting out the paper's main goal and explaining the authors' primary motivations for researching the modeling of elderly household expenditure. This is followed by a review of the literature on elderly consumer behavior and expenditure. Subsequently, statistical data used in the study is presented, and the research procedure applied in the paper is described. The article concludes with a presentation of the results, a discussion, and conclusions drawn from the study.

2. Literature Review

In economic sciences, population aging is most often looked at through the prism of income, spending. The purchasing behavior of the elderly as consumers, as well as social security, the housing situation, the degree to which educational needs are met, the availability of health services (care and nursing), age management, and the decreasing workforce, and is thus seen as posing a considerable challenge to any social and economic policy (Zalega, 2016).

For the vast majority of the elderly, the primary source of income (and most often the only one) is their social benefits, among which retirement benefits prevail. The level and structure of income determine the extent and degree to which household needs are met according to a defined hierarchy. The level and structure of household expenditure are closely correlated with the income that the household generates (Bąk, 2013).

The elderly are a specific consumer category, as they typically have medium or low income at their disposal, which reduces their purchasing power. Their changed socio-economic status (that takes place upon retirement) has an adverse effect on their lifestyles. Losing their income status and social recognition may lead to developing low self-esteem (Lena *et al.*, 2009).

Until recently, most businesses and marketing researchers have virtually ignored the senior market. This negligence may have resulted from the inaccurate stereotypes about senior consumers, which routinely considered them inferior, too thrifty, or already adhering to specific brands. However, these stereotypes seem to be slowly disappearing (Yoon and Cole, 2008). The older consumer group is not homogeneous,

as it includes people in the prime of their lives who are still professionally and socially active, elderly persons who are doing well but would embrace some assistive aids tailored to their needs, and physically-impaired persons requiring specific products and services (Szczecińska, 2020). In addition, many older people are affluent and have no debts, which can be taken advantage of by producers and service providers.

Therefore, it is an oversimplification to treat this social group as showing similar characteristics and behavior, including identical consumption patterns (Bałady nowicz-Panfil, 2012). As the culture changes, contemporary societies are going beyond the assumed roles, and people have stopped behaving as would otherwise be expected of their age. This phenomenon is referred to as age complexity and is mainly caused by changes in the various social groups' lifestyles (Styś, 2006; Piotrowska, 2018). This has led to a situation where it is becoming increasingly difficult to attribute market behavior or typical products to a specific age group. Therefore, it is appropriate e to conduct detailed studies describing senior consumers' behavior and its impact on the markets for goods and services.

Buying decisions are affected by a large number of both consumer and supply-side factors. These determinants can be divided into internal and external. The former group of factors includes one's sex, age, educational background, interests, locality of residence, the extent to which their needs have been satisfied, their material situation, lifestyle, etc. In addition, the final stage of making purchase decisions witnesses the involvement of such internal determinants as one's emotions, motives, perceptions, engagement in the purchasing process, personal preferences, self-confidence, willingness to take a risk and the speed with which they make decisions (Adamczyk, 2014).

The latter group of factors affecting consumer behavior is external determinants. These include economic factors such as the supply of goods and services, the scope and attractiveness of the offer, the prices, the means of promoting sales, and the locations of sales. These are accompanied by social factors, including family, social groups, benchmark groups, opinion leaders, fashion, and imitation. These determinants are complemented by cultural considerations that affect many spheres of life and activities such as, for example, one's diet, style of dress, the way people spend their leisure time, and their attitudes to other people, objects, values, stances, and beliefs (Adamczyk, 2014).

Most models describing informed purchasing choices identify at least two types of decision-making processes. The first is a cautious shopping experience with the five classic stages: problem recognition, search for information, assessment of alternatives, purchase decision, and post-purchase behavior. Such decision-making processes are perceived as conscious, analytical, reasonable, and relatively slow. In contrast, the second type of decision-making process is affective and empirical and includes intuitive, automatic, associative, and quick shopping. Consumers can move directly from problem recognition to a purchase decision (Yoon and Cole, 2008; Ajzen, 2008).

Hess, Rosenberg, and Waters (2001) have proposed a resource allocation hypothesis that states that the elderly have limited cognitive capabilities and tend to make intuitive purchases. However, this hypothesis also suggests that seniors may, where necessary, apply conscious information processing before making a decision. According to many researchers, seniors spend less time searching for information before buying than younger consumers, especially when buying durable products (Lin and Lee, 2004; Lambert-Pandraud, Laurent, and Lapersonne, 2005).

Purchasing decisions affect the structure of individual and household expenditure alike. Household expenditure is the amount of final consumption expenditure incurred by resident households to meet their daily needs, such as food, clothing, housing (rent), energy, transport, durable goods (especially cars), health costs, enjoyment, and various services.

The fact that expenditure falls after retiring has been documented by, among others, Hamermesh (1984); Bernheim, Skinner, and Weinberg (1997). They have shown that household spending falls by 12% as the head of the household retires. Other researchers, such as Ameriks, Caplin, and Leahy (2002), and Hurd and Rohwedder (2005), have found that these expenses decrease by up to 20% compared to the period immediately before retirement. Although retirees' expenses are lower, this does not necessarily mean that their living standards and well-being worsen (Burham, 2007). It is possible to maintain a certain standard of living, as the reduction in expenditure is a result of their manufacturing of particular goods by themselves and taking care of services which would otherwise have been purchased from stores or subcontractors (e.g., meals are now cooked at home, home renovations are no longer outsourced). In addition, the reduced spending is linked to the fact that retirees do not incur work-related costs, such as commuting expenses or the costs of appropriate outfits.

Burham (2007) and Foster (2016) have studied a sample group of US senior households for their spending patterns. The primary study group included persons aged 65 or more, with an additional three age groups used for benchmarking: 55-64 years old, 65-74 years old, and persons aged 75 or more. The age of 55 was chosen as the intention was to identify the changes in spending patterns that occurred as household members grew older, both before and after retirement. Understanding the structure of expenditure is crucial for assessing financial security in retirement. The results showed that expenditure on housing maintenance accounted for the largest share of the total senior household spending. This expenditure was followed by transport and food expenses. It turned out that the older the age group, the less is spent on eating out, on clothing and transport, and the more it spent on health care.

Similar studies were also carried out in 2019, except that the average annual 65+ household expenditure was benchmarked against all households in the United States (Bowser, 2020). As shown in Table 1, senior households spend on average approx. 20% less than an average American household. More than a third of the expenditure is related to maintaining one's home. It should be noted that senior household

expenditure on housing, transport, food, utility bills, and public services is at least several percent lower than the expenditure on the same goods by households in general. The most significant difference is in transport costs (30% lower), and the smallest in utilities and public services (approx. 6% lower). Health care expenditure is an example of spending that grows as people retire. According to data from the Bureau of Labor Statistics2 concerning consumer expenditure for 2019, US households headed by a person aged 65 or more spend on this purpose an average of USD 6,833 per year compared to USD 5,193 for all households, i.e., 31.6% more. Medicines and medical products account for the largest share of health spending, as 65+ households spend over 50% more on those than an average household does.

Table 1. *The average annual expenditure of all US households and 65+ households in 2019 (USD)*

Type of expenditure	Average household	65+ household	65+/average household ratio
total	63036	50220	79.67
housing	20679	17472	84.49
transport	10742	7492	69.74
food	8169	6599	80.78
utilities and public services	4055	3810	93.96
health care	5193	6833	131.58
medical services	984	1054	107.11
medicines	486	737	151.65
medical products	194	293	151.03
health insurance	3529	4748	134.54

Source: *Developed by the authors based on Bowsher, K. 2020.*

The results of studies conducted in the USA correspond to studies by other experts on the subject. According to the OECD report, 40-50% of the overall spending by people aged 65+ is on health, while their health care costs per capita are three to five times higher than in the case of people under 65. There are concerns that public spending may increase as OECD countries grow older (Dang, Antolin, and Oxley, 2001). According to Frąckiewicz (2001), population aging generates growing expenditure on retirement pensions and welfare. Among the numerous consequences of the increasing participation of the elderly in the overall population structure, caused by the growing life expectancy, one of the essential elements is the ever-growing demand for medical care provided to at least one-fourth of the overall population representing the third and fourth generations. It should also be added that due to the significant difference between the life expectancy of women and men, the problems faced by the older generation are mainly the problems of older women.

Their deteriorating health adds to the financial management challenges they face (MacLeod *et al.,* 2017). According to Deaton (2008), without health, there is very little that people can do and, without income, health alone does little to enable people to lead a good life. Other factors, such as education, or the ability to participate in

society, are essential, although income and health tend to get the primary attention in most human wellbeing evaluations (Deaton, 2008). For economists, who usually assume that higher incomes represent a gain to the satisfaction of individuals, the role of income is of particular interest. It is often argued that income is relatively unimportant and relatively transitory than family circumstances, unemployment, or health. After middle age, happiness drops, as the continuing decline in satisfaction with one's health is accompanied by a decreasing satisfaction with one's family and work circumstances. However, these negative trends are primarily offset by a significant increase in people's satisfaction with their material situation in later life (Yeh, 2003; Easterlin, 2006). Zalega is of a similar opinion (2016), arguing that for people aged 65+, material and financial conditions are the most important determinants of mental wellbeing.

3. Research Methodology

Households are the leading entities in the consumption domain. Any evaluation of their material situation depends on the characteristics of the data set used. In Poland, the household budget studies carried out annually by Statistics Poland (GUS) are the primary source of such information. These studies explore the volumes of revenue and expenditure (both monetary and non-monetary) of all the members of the given household and analyze the quantitative consumption of selected goods and services.

The present analysis of the expenditure in 65+ households (i.e., headed by an individual aged 65 or more) was performed based on separate non-identifiable representative data on household budgets made available against a fee by GUS. The study focused on the year 2018, and the integrated data set covered 10,472 households.

The study made use of selected structure description parameters that were used to characterize the studied population synthetically. The measures of central tendency, dispersion, and asymmetry, which are most frequently used in such research, were calculated.

Econometric models were used to characterize consumer goods and services expenditure in households headed by persons aged 65+. The average monthly spending on a selected group of goods and services per household member was the dependent variable. The set of independent variables included the monthly disposable income per person, the number of persons in the family, the age of the head of the household, and dummy variables indicating the household's class of the locality of residence, the educational background of the head of the household, and their subjective assessment of their material situation. The general form of the power-exponential function of demand – expenditure or consumption – was assumed as the basis for the considerations (Kurzawa and Wysocki, 2007; 2010; Podolec, Ulman, and Wałęga, 2008):

$$LNWYD_{ri} = \alpha_{0\mathrm{r}} + \alpha_{1\mathrm{r}} LNDOCH_i + \alpha_{2\mathrm{r}} LNLOS_i + \alpha_{3\mathrm{r}} LNWIEK_i + \Sigma_{k=2}^{6} \gamma_{rk} MZ_{ik} + \Sigma_{p=2}^{5} \gamma_{rp} WYKSZ_{ik} + \Sigma_{s=2}^{4} \gamma_{rs} OS_{is} + \varepsilon_{ri}, \quad (1)$$

where:
WYD_{ri} – average monthly spending on the *r*-th consumer goods and services per person in the *i*-th household;
$DOCH_i$ – average monthly total income per person in the *i*-th household;
LOS_i – number of persons in the *i*-th household;
$WIEK_i$ – age of the head of the *i*-th household;

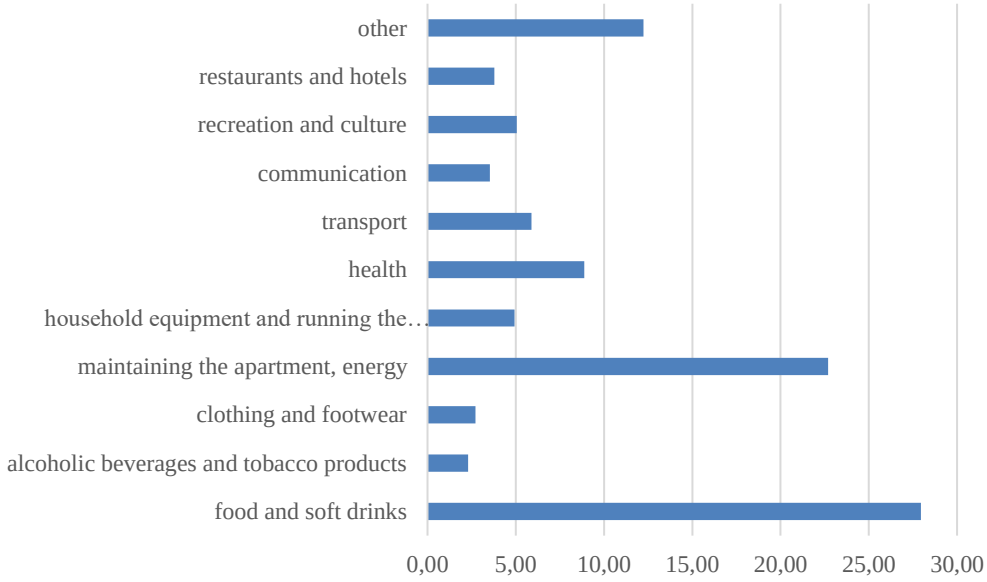
MZ_{ik} – dummy variables identifying the class of the locality of residence and assuming the value of 1 if the *i*-th household belongs to the *k*-th class of locality of residence: *k*=2 for cities with a population of over 500,000, *k*=3 for cities with a population of 200-499 thousand, *k*=4 for cities with a population of 100-199 thousand, *k*=5 for cities with a population of 20-99 thousand, *k*=6 for towns with less than 20,000 inhabitants, with countryside as the basis for comparison;
$WYKSZ_{ik}$ – dummy variables identifying the educational background of the head of the household and assuming the value of 1 if they have an educational background *p*: *p*=2 for college/university education, *p*=3 for upper secondary vocational education, *p*=4 for high school, *p*=5 for basic vocational education, with the basis for comparison being the head of the household having junior high school education at the most;
OS_{is} – dummy variables created with regard to a household's subjective assessment of its own material situation and assuming the value of 1 if the *i*-th household belongs to the *s*-th group assessing its situation: *s*=2 for a good material situation, *s*=3 for a rather good material situation, *s*=4 for a rather bad material situation , *s*=5 for a bad material situation, with the basis for comparison being an average material situation;
α, γ – structural parameters of the model;
ε_{ri} – random component.

The estimated parameter α_1, known as the income elasticity coefficient, informs by what % the monthly expenditure will change on average with a 1% increase in monthly income per person, assuming that the other variables are constant. The evaluation of the parameter α_2 denotes the elasticity of expenditure about the number of household members and determines the effects of the management scale depending on the size of the family. The estimated parameter α_3 informs of changes in the average monthly expenditure as the age of the head of the household increases. However, the parameters γ show differences in preferences relating to the class of the locality of residence, the educational background of the head of the household, and the households' subjective assessment of their material situation. Stepwise regression was used to make a final selection of independent variables for the model. The model parameters were evaluated using the classical least squares method. A description of this method and its applications in scientific research can be found, among other things, in the papers by Wolberg (2006), Cantrell (2008), Kong, Li, and Zhang (2019), Usakli and Kucukergin (2018).

4. Results and Discussion

Expenditure on food and soft drinks accounted for the largest share in the total expenditure (Figure 1). 65+ households allocated almost 28% of all their spending to these purchases. The next group was that of housing and energy expenses (22.7%). As in households globally, Polish seniors were shown to spend a significant proportion of their funds on health care (approx. 9%) and occasionally on education (0.04%). The so-called other expenditure, which includes expenses related to insurance, loans, savings, and investments, accounted for more than 12% of total expenditure.

Figure 1. *Structure of expenditure (%) in Polish 65+ households in 2018*



Source: *The authors' own calculations based on separate non-identifiable data made available by Statistics Poland.*

Table 2 presents selected descriptive parameters for disposable income per person, total expenditure, and expenditure by source of spending per capita. Both the distributions of disposable income and total expenditure were characterized by a high variance exceeding 50%. Moreover, these distributions were characterized by a very large positive asymmetry, which means that the monthly income and expenditure fell below the mean value in most households. The most significant variance and, thus, asymmetry pertained to education and transport expenses, while the lowest parameter values referred to spending on food, soft drinks, and communication.

Due to the high variance and the extreme asymmetry for all the categories examined, it was decided that measures of location should be determined in this respect. Our analysis of these groups within a restricted area of variability pointed to a slightly different distribution pattern for the groups studied. The distribution of disposable

income within the restricted area of variability, i.e., with the extreme values rejected, was characterized by a very weak positive asymmetry, which means that the households' incomes concentrated around the median. The highest variance pertained to spending on clothing and footwear (465.1%) and transport (320%). These distributions were also characterized by the highest positive asymmetry, excluding expenditure on restaurants and hotels, where the extreme asymmetry resulted from the fact that only a small number of households spent money on such purposes. Of consumer goods and services expenses, the least varied were those on essential goods, i.e., food and soft drinks, as well as housing and energy.

Table 2. *Selected descriptive parameters for disposable income and expenditure on consumer goods and services in Polish 65+ households in 2018*

Item	mean	V_s	A_s	M	V_q	A_p
	PLN	%	-	PLN	%	-
Disposable income per capita	1821.0	52.1	8.27	1672.0	23.9	0.10
Total expenditure per capita	1399.6	64.9	5.87	1215.7	31.9	0.16
Expenditure on consumer goods and services, including:	1311.8	63.2	5.83	1146.6	31.0	0.16
food and soft-drinks	391.2	42.6	1.34	363.3	27.8	0.13
alcoholic beverages and tobacco products	32.2	203.2	4.58	6.7	259.2	0.61
clothing and footwear	38.0	219.4	6.11	4.6	465.1	0.79
maintaining the apartment, energy	317.7	90.6	5.32	260.9	43.3	0.15
household equipment and running of the household	69.1	243.3	11.79	28.4	92.5	0.36
health	124.3	173.9	15.46	75.1	85.1	0.22
transport	82.5	481.2	26.17	15.0	320.0	0.69
communication	49.6	97.4	2.76	40.0	62.2	0.16
recreation and culture	70.8	191.2	7.17	34.0	95.3	0.30
education	0.5	2072.2	39.14	0.0	-	-
restaurants and hotels	52.9	248.2	6.42	0.0	-	1.00

Source: *The authors' own calculations based on separate non-identifiable data made available by Statistics Poland.*

Tables 3-8 summarize the evaluation of the parameters of the power-exponential models of spending on selected consumer goods and services in 65+ households. The variables for the models were selected using stepwise regression. The coefficients of determination of the estimated models ranging from almost 40% to 59.4% meant that the model explained almost half of the total observed variance of the dependent variable. This result could be considered unsatisfactory, but given the fact that the study focused on the single household. Therefore there was a significant degree of individuality in deciding on goods and services in the given month; this result can be deemed satisfactory. Such a large sample of households brought down the coefficient of determination (with a given number of independent variables) on the one hand but resulted in relatively high t-Student statistics and low parameter standard errors on the other.

Our analysis of the estimated models of expenditure on food and soft drinks showed that its level was primarily influenced by income, and a 1% increase in income resulted in the expenses growing by an average of 0.407%, assuming that the other variables were constant (Table 3). However, the number of family members had a negative impact on such expenses. This meant that the average food expenditure per person fell as the family grew, which was in line with the so-called management scale. These expenses dropped, too, as the age of the head of the household increased. Urban households showed a lower propensity to spend on food, with values ranging from 5.4% to 9.5% (depending on the population size), than rural households. The expenditure was also affected by the households' subjective assessment of their material situation. Those that assessed their situation as good spent 3.8% more than households perceiving their situation as average. Households in a rather dire situation and a bad situation spent 5.5% and 15.2% less, respectively.

Table 3. *Evaluation of the parameters of the power-exponential model of expenditure on food and soft drinks in 65+ households*

Item	Parameter	Standard error	t statistics	Level of *p*
Intercept parameter	4.0776	0.1880	21.6924	0.0000
LN DOCH	0.4069	0.0077	52.7589	0.0000
LN LOS	-0.1583	0.0090	-17.5585	0.0000
LN WIEK	-0.2251	0.0399	-5.6376	0.0000
City of over 500k	-0.0999	0.0117	-8.5318	0.0000
City of 200-499k	-0.0588	0.0129	-4.5404	0.0000
City of 100-199k	-0.0788	0.0134	-5.8981	0.0000
City of 20-99k	-0.0753	0.0098	-7.7189	0.0000
Town under 20k	-0.0554	0.0115	-4.8154	0.0000
Rather good material situation	0.0378	0.0091	4.1357	0.0000
Rather bad material situation	-0.0566	0.0126	-4.4856	0.0000
Bad material situation	-0.1652	0.0235	-7.0163	0.0000
$R=0.771$; $R^2=0.594$; $F=4263.2$; $P<0.0000$				

Source: *The authors' own calculations based on separate non-identifiable data made available by Statistics Poland.*

Expenditure on maintaining the apartment and running the household increased as income per capita, the age of the head of the household, and the number of household members, grew (Table 4). There is no doubt that such expenditure is higher in cities than in the countryside, as demonstrated by the positive parameter evaluations. In addition, the educational background of the head of household has a significant impact on this expenditure.

A 1% increase in income resulted in a 1.106% increase in transport expenses (Table 5). These expenses, too, grew as the number of household members increased and where the household perceived its material situation as good or somewhat good. The aging of the head of the household reduces their mobility, which translates into lower

transport costs. Urban 65+ households spent more funds than those located in the countryside.

Table 4. *Evaluation of the parameters of the power-exponential model of expenditure on maintaining the apartment and running the household in 65+ households*

Item	Parameter	Standard error	t statistics	Level of *p*
Intercept parameter	-1.0545	0.3210	-3.2850	0.0010
LN DOCH	0.7426	0.0135	54.8544	0.0000
LN LOS	0.2900	0.0151	19.1469	0.0000
LN WIEK	0.2860	0.0679	4.2139	0.0000
City of over 500k	0.3189	0.0201	15.8870	0.0000
City of 200-499k	0.2988	0.0218	13.7212	0.0000
City of 100-199k	0.3089	0.0225	13.7580	0.0000
City of 20-99k	0.2840	0.0164	17.3539	0.0000
Town under 20k	0.2340	0.0194	12.0911	0.0000
College/university	-0.0401	0.0185	-2.1667	0.0303
High school	0.0649	0.0225	2.8888	0.0039
Basic vocational education	0.0601	0.0143	4.1981	0.0000
$R=0.622$; $R^2=0.387$; $F=544.35$; $P<0.0000$				

Source: *The authors' own calculations based on separate non-identifiable data made available by Statistics Poland.*

Table 5. *Evaluation of the parameters of the power-exponential model of expenditure transport in 65+ households*

Item	Parameter	Standard error	t statistics	Level of *p*
Intercept parameter	0.3760	0.7894	0.4763	0.6339
LN DOCH	1.1064	0.0333	33.1861	0.0000
LN LOS	0.3572	0.0378	9.4441	0.0000
LN WIEK	-0.9942	0.1698	-5.8542	0.0000
City of over 500k	-0.2253	0.0476	-4.7312	0.0000
City of 200-499k	-0.2616	0.0517	-5.0620	0.0000
City of 100-199k	-0.3274	0.0541	-6.0570	0.0000
City of 20-99k	-0.2363	0.0396	-5.9658	0.0000
Town under 20k	-0.2067	0.0469	-4.4114	0.0000
College/university	0.1592	0.0390	4.0779	0.0000
High school	-0.1079	0.0550	-1.9626	0.0497
Good material situation	0.1435	0.0405	3.5451	0.0004
Rather good material situation	0.1089	0.0362	3.0078	0.0026
Rather bad material situation	-0.1645	0.0578	-2.8473	0.0044
$R=0.642$; $R^2=0.412$; $F=501.65$; $P<0.0000$				

Source: *The authors' own calculations based on separate non-identifiable data made available by Statistics Poland.*

As the parameter evaluations indicate, the total income per capita had the most significant effect on expenditure on communication (Table 6). Its 1% increase resulted in a 0.453% growth in expenditure on communication on average, assuming that the other variables were constant. The expenditure is negatively affected by the age of the head of the household and the number of household members. The head of the household having graduated from a college/university or high school had a positive impact on the expenditure compared to the households where the head had no more than a junior high school background. The dummy variable of living in cities of various sizes had a positive impact, as well, when compared to living in rural areas. Households in a bad or a rather lousy material situation incurred lower expenses than those constituting the reference framework by an average of 8.4% and 12.8%, respectively. In contrast, households in a good or a relatively good situation spent more on communication by an average of 11.1% and 7.0%, respectively.

Table 6. *Evaluation of the parameters of the power-exponential model of expenditure on communication in 65+ households*

Item	Parameter	Standard error	t statistics	Level of *p*
Intercept parameter	3.2064	0.3732	8.5910	0.0000
LN DOCH	0.4529	0.0164	27.6558	0.0000
LN LOS	-0.2098	0.0179	-11.6932	0.0000
LN WIEK	-0.6188	0.0787	-7.8584	0.0000
City of over 500k	0.2461	0.0229	10.7214	0.0000
City of 200-499k	0.2600	0.0239	10.8599	0.0000
City of 100-199k	0.1413	0.0254	5.5554	0.0000
City of 20-99k	0.1234	0.0180	6.8666	0.0000
College/university	0.2173	0.0204	10.6687	0.0000
High school	0.0585	0.0254	2.3024	0.0213
Good material situation	0.1050	0.0214	4.9061	0.0000
Rather good material situation	0.0680	0.0183	3.7124	0.0002
Rather bad material situation	-0.0882	0.0253	-3.4926	0.0005
Bad material situation	-0.1372	0.0483	-2.8390	0.0045
$R=0.684$; $R^2=0.469$; $F=798.55$; $P<0.0000$				

Source: *The authors' own calculations based on separate non-identifiable data made available by Statistics Poland.*

The expenditure on health was significantly positively affected by the person's age heading the household, followed by the available size of disposable income (Table 7). Other variables that significantly affected the dependent variable had a negative impact on this group of expenses.

As the parameter evaluations indicate, the household's material situation significantly affected expenditure on recreational and cultural purposes (Table 8). A 1% increase in total income was accompanied by a 1.138% growth in expenditure on leisure on average, assuming that the other variables were constant. The expenses of households in a suitable material situation were higher compared to the households constituting

the reference framework by 24.0% on average, and the expenses of those in a relatively good situation by 10.7%. Also, the head of the household having graduated from a college/university had a positive impact on the expenditure on leisure compared to the households where the head had no more than a junior high school background. In turn, the age of the head of the household had a negative impact on this type of expenditure.

Table 7. *Evaluation of the parameters of the power-exponential model of expenditure on health in 65+ households*

Item	Parameter	Standard error	t statistics	Level of *p*
Intercept parameter	-9.4834	0.5774	-16.4230	0.0000
LN DOCH	0.9430	0.0243	38.7860	0.0000
LN LOS	-0.1552	0.0280	-5.5364	0.0000
LN WIEK	1.6896	0.1224	13.7993	0.0000
City of 200-499k	-0.1489	0.0369	-4.0372	0.0001
Good material situation	-0.1112	0.0330	-3.3733	0.0007
Rather good material situation	-0.0892	0.0287	-3.1108	0.0019
$R=0.634$; $R^2=0.402$; $F=724.34$; $P<0.0000$				

Source: *The authors' own calculations based on separate non-identifiable data made available by Statistics Poland.*

Table 8. *Evaluation of the parameters of the power-exponential model of expenditure on recreational and cultural purposes in 65+ households*

Item	Parameter	Standard error	t statistics	Level of *p*
Intercept parameter	-2.7203	0.6068	-4.4829	0.0000
LN DOCH	1.1377	0.0248	45.8517	0.0000
LN WIEK	-0.4414	0.1325	-3.3317	0.0009
College/university	0.2714	0.0335	8.0931	0.0000
Good material situation	0.2153	0.0352	6.1222	0.0000
Rather good material situation	0.1016	0.0305	3.3287	0.0009
$R=0.630$; $R^2=0.397$; $F=970.3$; $P<0.0000$				

Source: *The authors' own calculations based on separate non-identifiable data made available by Statistics Poland.*

5. Conclusion

The current aging of the world population is probably the most severe demographic change in the history of humanity. This is a ubiquitous and genuinely global phenomenon. The seriousness of this demographic change is and will continue to be affecting economic growth, labor markets, pensions, health care, housing, migration, politics, and, of course, consumption.

The present article contributes to the most recent European and global scientific discussions on the significance of the elderly for the development of economies from

the perspective of their impact on the markets for goods and services. It is noted that despite the increase in the market relevance of this segment, manufacturers have yet to fully account for senior citizens and their growing needs in their development strategies. Therefore, such analyses as the present one may highlight this phenomenon and impact developing new supply-side solutions.

The power-exponential models used in the article proved to be helpful in the research into spending on consumer goods and services. In all the models, the level of the overall income per capita was found to have a significant positive impact. Another important finding was that the preferences differed depending on the class of the locality of residence, the subjective assessment of the material situation of one's household, the number of persons in the household, and the level of education and age of the person heading the household.

The study results presented herein coincide with research carried out in other regions of the world. For example, Barigozzi *et al.* (2009) explored the statistical properties of household consumption-expenditure budget share distributions – defined as the share of total household expenditure spent for purchasing a specific category of commodities – for a large sample of Italian households in the period 1989-2004. They showed the impact of an increasing income and expenditure on various commodity categories on the conditional distribution of shares in the household budget. Battese and Bonyhady (1979) used the heteroscedastic regression model considered by Amemiya (1973) to estimate the expenditure functions using Australian data. Total expenditure on food in 5,437 households in Australia was modeled. The variables included in the empirical study were: the annual household expenditure on the given category, the total annual household expenditure, and the number of persons in the household.

Because they need to ensure a dignified life, health, and care for the elderly requires a growing number of state and local government interventions, analyses such as the present one are a valuable contribution to the development of a policy addressing the needs of the elderly. There is also a need for further, primarily qualitative, studies to obtain a deep insight into the problems faced by the elderly.

References:

Adamczyk, G. 2014. Wybrane aspekty zachowań młodych konsumentów w nowych realiach rynkowych. Handel wewnętrzny, 1(354), 5-16.

Ageing societies: The benefits, and the costs, of living longer. 2009. World of Work, 67, 9-12.

Ajzen, I. 2008. Consumer Attitudes and Behavior. In: Haugtvedt, C.P., Herr, P.M., Cardes, F.R. (Eds.), Handbook of Üonsumer Psychology. New York: Lawrence Erlbaum Associates, 525-548.

Aksoy, Y., Basso, H.S., Grasl, T., Smith, R.P. 2015. Demographic Structure and Macroeconomic Trends. Manuscript, University of London: Birkbeck.

Amemiya, T. 1973. Regression Analysis when the Variance of the Dependent Variable is Proportional to the Square of its Expectation. Journal of the American Statistical Association, 68, 928-934.

Ameriks, J., Caplin, A., Leahy, J. 2002. Retirement Consumption: Insights from a Survey. NBER Working Paper 8735, 1-36, Cambridge: National Bureau of Economic Research.

Bałandynowicz-Panfil, K. 2012. The Role of Older People as Consumers - the Comparative Analysis of Old and New Members States of European Union. Comparative Economic Research. Central and Eastern Europe, 15(1), 83-101. DOI: https://doi.org/10.2478/v10103-012-0005-y.

Barigozzi, M., Alessi, L., Capass, M., Fagiolo, G. 2009. The Distribution Of Households Consumption-Expenditure Budget Shares. Working papier Series, 1061, 1-54, Germany: European Central Bank.

Battese, G.E., Bonyhady, B.P. 1979. Estimation of Household Expenditure Functions: an Application of a Class of Heteroscedastic Regression Models, 1-21. Retrieved from: https://www.une.edu.au/__data/assets/pdf_file/0004/15817/emetwp7.pdf.

Bąk, I. 2013. Statystyczna analiza aktywności turystycznej seniorów w Polsce. Szczecin: Wydawnictwo Uczelniane ZUT w Szczecinie.

Bąk, I., Szczecińska, B. 2020. Global Demographic Trends and Effects on Tourism. European Research Studies Journal, 23(4), 571-585. DOI: 10.35808/ersj/1701.

Bernheim, B.D., Skinner, J., Weinberg, S.A. 1997. What Accounts for the Variation in Retirement Among U.S. Households? NBER Working Paper 6227, 1-73, Cambridge: National Bureau of Economic Research. Retrieved from: What Accounts for the Variation in Retirement Wealth Among U.S. Households? by B. Douglas Bernheim, Jonathan S. Skinner, Steven Aric Weinberg :: SSRN. DOI: 10.3386/w6227.

Bowsher, K. 2020. Here's How Much Retiree Households Spend in a Year, Money Talks News. Retrieved from: https://www.moneytalksnews.com/heres-the-true-cost-of-living-in-retirement-and-it-aint-cheap/.

Burham, K. 2007. Expenditures of the Aged. Social Security Bulletin, 67(1), 45-51. Retrieved from: Social Security Bulletin, Vol. 67, No. 1, 2007 (ssa.gov).

Calvert, G. 1977. Pensions and Survival - The coming Crisis of Money and Retirement. London: Maclean-Hunter.

Cantrell C.A. 2008. Technical Note: Review of methods for linear least-squares fitting of data and application to atmospheric chemistry problems. Atmospheric Chemistry and Physics, 8, 5477–5487. Retrieved from: https://acp.copernicus.org/articles/8/5477/2008/acp-8-5477-2008.pdf.

Dang T., Antolin P., Oxley H. 2001. Fiscal Implications of Ageing: Projections of Age-Related Spending. OECD Economic Outlook, 69, 145-167. Retrieved from: http://www.oecd.org/economy/outlook/2085481.pdf. DOI:10.2139/ssrn.607122.

Deaton, A. 2008. Income, Health, and Well-Being around the World: Evidence from the Gallup World Poll. Journal of Economic Perspectives, 22(2), 53-72.

Easterlin, R.A. 2006. Life Cycle Happiness and Its Sources: Intersections of Psychology, Economics, and Demography. Journal of Economic Psychology, 27(4), 463-482.

European Union. 2016. The Impact of Demographic Change on European Regions. Retrieved from: https://cor.europa.eu/en/engage/studies/Documents/The%20impact%20of%20demographic%20change%20on%20European%20regions/Impact_demographic_change_european_regions.pdf.

Foster, A.C. 2016. A Closer Look at Spending Patterns of Older Americans. Beyond the Numbers: Prices & Spending, 5(4). Retrieved from: A closer look at spending patterns of older Americans : Beyond the Numbers: U.S. Bureau of Labor Statistics (bls.gov).

Frąckiewicz, L. 2001. Społeczno-demograficzne problemy starzenia się polskiego społeczeństwa. In: Pędich, W. (Ed.). Seniorzy w społeczeństwach Europy XXI wieku - współtworzenie i współodpowiedzialność: materiały X Euroforum Ludzi Starych. Białystok: Stowarzyszenie Wolontariatu Międzypokoleniowego.

Frątczak, E., Sobieszak, A. 1999. Sytuacja demograficzno-społeczna osób starszych. In: Seniorzy w społeczeństwie polskim, Warszawa: GUS.

Hamermesh, D.S. 1984. Consumption during retirement: The missing link in the life-cycle. Review of Economics and Statistics, 66(1), 1-7.

Hess, T.M., Rosenberg, D.C., Waters, S.J. 2001. Motivation and Representational Processes in Adulthood: The Effects of Social Accountability and Information Relevance. Psychology and Aging, 16(4), 629-642. Retrieved from: https://doi.org/10.1037/0882-7974.16.4.629.

Hurd, M., Rohwedder, S. 2005. The Retirement-Consumption Puzzle: Anticipated and Actual Declines in Spending at Retirement. Labour and Population Program Working Paper Series 03-12, 1-33, Santa Monica: RAND Corporation.

Kong, M., Li, D., Zhang, D. 2019. Research on the Application of Improved Least Square Method in Linear Fitting, IOP Conference Series: Earth and Environmental Science, 252(5), 052158. DOI:10.1088/1755-1315/252/5/052158.

Kurzawa, I., Wysocki, F. 2007. Ekonometryczna analiza preferencji artykułów żywnościowych według wykształcenia głowy gospodarstwa domowego. Prace Naukowe Akademii Ekonomicznej we Wrocławiu. Taksonomia. Klasyfikacja i analiza danych - teoria i zastosowania, 14(1169), 569-577.

Kurzawa, I., Wysocki, F. 2010. Zastosowanie modeli potęgowo-wykładniczych w badaniach zróżnicowania preferencji konsumpcyjnych w relacji miasto-wieś. Prace Naukowe Akademii Ekonomicznej we Wrocławiu. Taksonomia. Klasyfikacja i analiza danych – teoria i zastosowania, 17(107), 561-569.

Lambert-Pandraud, R., Laurent, G., Lapersonne, E. 2005. Repeat Purchasing of New Automobiles by Older Consumers: Empirical Evidence and Interpretations. Journal of Marketing, 69(2), 97-113.

Leicester, A., O'Dea, C., Oldfield, Z. 2009. The Expenditure Experience of Older Households. London: The Institute for Fiscal Studies.

Lena, A., Ashok, K., Padma, M., Kamath, V., Kamath, A. 2009. Health and Social Problems of the Elderly: A Cross-Sectional Study in Udupi Taluk, Karnataka. Indian Journal of Community Medicine, 34(2), 131-134.

Lin, Q., Lee, J. 2004. Consumer Information Search When Making Investment Decisions. Financial Services Review, 13(4), 319-332.

MacLeod, S., Musich, S., Hawkins, K., Armstrong, D.G. 2017. The Growing Need for Resources to Help Older Adults Manage their Financial and Healthcare Choices. BMC Geriatrics, 17(84), 1-9. Retrieved from: https://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-017-0477-5. DOI 10.1186/s12877-017-0477-5.

Nazareth, L. 2007. The Leisure Economy: How Changing Demographics, Economics, and Generational Attitudes will Reshape our Lives and our Industries. New Jersey: John Wiley and Sons.

Olejniczak, T. 2016. Senior Consumer Behaviour - Worldwide Research Areas Versus Polish Ones. Acta Scientarium Polonorum, Oeconomia, 15(4), 127-135.

Piekut, M. 2020. Living Standards in One-Person Households of the Elderly Population. Sustainability, 12(992), 1-26. DOI:10.3390/su12030992.

Piotrowska, A. 2018. Przedsiębiorczość wśród seniorów w świetle założeń koncepcji Silver Economy. Przedsiębiorczość i Zarządzanie, 19(7), 469-481.

Podogrodzka, M. 2016. Wybrane miary starości demograficznej i ich implikacja dla oceny przestrzennego zróżnicowania tego zjawiska w Polsce. Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach, 289, 98-108.

Podolec, B, Ulman, P., Wałęga, A. 2008. Aktywność ekonomiczna a sytuacja materialna gospodarstw domowych. Kraków: Wydawnictwo UE Kraków.

Scholefield, A.J. 2000. The Death of Europe: How Demographic Decline Will Destroy the European Union. Wembley: Futurus.

Styś, M. 2006. Konsument bez metryki, Marketing w Praktyce, 6, 10-12.

Sudbury-Riley, L., Kohlbacher, F., Hofmeister, A. 2014. A Cross-Cultural Analysis of Proenvironmental Consumer Behaviour Among Seniors. In: McEachern, M.G., Carrigan, M. (Eds.). Contemporary Issues in Green and Ethical Marketing. Routledge, 100-121.

Szczecińska, B. 2020. The Financial Situation of Households Headed by Individuals Aged 50+, Zeszyty Naukowe Uniwersytetu Przyrodniczo-Humanistycznego w Siedlcach. Administracja i Zarządzanie, 125(52), 47-56. DOI: https://doi.org/10.34739/zn.2020.52.05.

Usakli, A., Kucukergin, K.G. 2018. Using Partial Least Squares Structural Equation Modeling in Hospitality and Tourism: Do Researchers Follow Practical Guidelines? International Journal of Contemporary Hospitality Management, 30(11), 3462-3512. DOI: 10.1108/IJCHM-11-2017-0753.

Wolberg, J. 2006. Data Analysis Using the Method of Least Squares: Extracting the Most Information from Experiments. Berlin: Springer. DOI: 10.1007/3-540-31720-1.

World Population Prospects. The 2004 Revision. 2005. New York: UN Department of Economic and Social Affairs Population Division. Retrieved from: www.http://epp.eurostat.ec.europa.eu/.

Yeh, W.C. 2003. Living Arrangements and Lifestyle Satisfaction among the Elderly in Chinese Immigrant Families: A Preliminary Study. Chang Gung Medical Journal, 26(10), 729-736.

Yoon, C., Cole, C.A. 2008. Aging and Consumer Behaviour. In: Haugtvedt, C.P., Herr, P.M., Kardes, F.R. (Eds.). The Handbook of Consumer Psychology. New York: Lawrence Erlbaum Associates, 247-272.

Zalega, T. 2016. Segment osób w wieku 65+ w Polsce. Jakość życia - Konsumpcja-Zachowania konsumenckie. Warszawa: Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego.