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Application of reduced social welfare functions for estimating household insurance expenditures in Poland

Due to the role of insurance in economy, the factors determining the demand for insurance (e.g. income) have been the subject of many studies. On the other hand, income inequalities significantly affect many purchasing decisions and the perception of income among individuals. The aim of this study is to verify the relationship between social welfare and insurance expenditure. This verification was carried out on the basis of data on various socio-economic groups in Poland by using reduced social welfare functions such as: the Sen Index, Kakwani Index, Dagum indexes and the 'naïve' welfare function (income). As part of the research, a linear regression was applied between the dependent variable (average monthly expenses on insurance per 1 person in households by socio-economic groups) and the explanatory variable (reduced welfare functions) for a given social group. Reduced social welfare functions was determined on the basis of the average monthly disposable income per capita in households and the Gini coefficient for this group. Social welfare in the form of reduced welfare functions turned out to be a statistically better predictor of insurance expenditure than the income itself for social groups with relatively small income disparities (low Gini coefficient). For the group of farmers in Poland, where the income disproportions were statistically the largest, income turned out to be a better predictor.

Keywords: insurance, demand, welfare functions, household expenditures

Introduction

The insurance sector plays a very important role in economy. Apart from taking risks over, insurance companies are also important players in investing funds accumulated as technical provisions. What is more, insurance companies participate in innovation development on global markets. It is not surprising, therefore, that the factors which determine the demand for insurance have been the subject of numerous scientific studies for years. Those studies cover different groups

of factors such as demographic, economic or behavioral factors. Income factors are among the most common economic factors verified in research.

On the other hand, income inequalities occur both within selected socio-economic groups and at the level of national economies. Income inequalities have a significant impact on many purchasing decisions and the perception of income by individuals. In other words, they affect the perception of welfare by individuals in a selected group. The topic of income inequality is widely described in literature, though rather separately from its impact on the insurance sector.

The aim of this paper is to verify the relationship between social welfare and insurance expenditures. The verification will be carried out for different socio-economic groups in Poland by using reduced social welfare functions. According to the author's research hypothesis, social welfare is statistically a better predictor of insurance expenditures than income alone. This is directly due to the perception of risk by individuals, which depends on the feeling of being able to lose what is standard in the environment. That results indirectly from the perspective theory. Kahneman and Tversky suggest that the apparatus of human perception is focused on assessing changes or differences, not absolute quantities. Perception depends on the point of reference.[1] The analysis can be considered a unique contribution to the financial science development by verifying the impact of welfare in socio-economic groups in Poland on the insurance demand. To the best of the author's knowledge, there is no research or studies in this respect.

1. Social welfare

Welfare is a state of a complete satisfaction of material and spiritual needs of an individual and a society.[2] No matter how controversial this definition may be it underlines two important dimensions of welfare analysis. Welfare can be considered from an individual's perspective and also from the point of view of the entire society. In the latter case, we deal with social welfare. The second important dimension resulting directly from the concept of welfare is the fact that needs are fulfilled (partially or completely). In this definition, the needs are separated into material and spiritual ones. The greater an individual's welfare, the more needs are met or the greater the degree of their satisfaction.[3] Identification of the different types of needs allows to distinguish between economic welfare, sometimes also called prosperity, and general welfare, which includes education, medical care, or security needs. These factors very often appear in the formulation of the preference theory. Economic welfare determines general welfare.[4] In other words, a well-working economy and fair wealth distribution make it possible to achieve social welfare.

When analysing the concept of welfare, the utility derived from consumption of goods and services should be noted. The utility could be interpreted as a numerical representation of a consumer's

1. J. Ostaszewski, M. Iwanicz-Drozdowska (eds), *Finanse u progu trzeciej dekady XXI wieku*, Difin, Warszawa, 2021.
2. https://encyklopedia.pwn.pl/szukaj/dobrobyt%20spo%C5%82eczny.html, [access 16.09.2021].
3. M. Brzezinski, *Wpływ nierówności dochodowej na dobrobyt społeczny w Polsce w latach 1987–1997*, „Gospodarka Narodowa", 9/2002, p. 41–60, From: http://coin.wne.uw.edu.pl/mbrzezinski/research/MBwelfare2GN.pdf, [access 16.09.2021].
4. S. Marciniak, *Makro- i mikroekonomia*, Wydawnictwo Naukowe PWN, 2013.

choice, in accordance with the revealed preference theory.[5] In practice, changes in the utility are usually measured by estimating monetary utility measurements. Measurements such as nominal income, real income, expenditures, or consumption are used most often. They determine the amount of goods and services that can be purchased by an individual. These variables only indirectly reflect the idea of welfare in the broad sense, but are easier to estimate due to data availability.[6] At the macro level, the most popular measures of social welfare are the national income, GDP, GNP, and consumption. Their popularity stems from data availability and the ease of interpretation, however, their application requires many conditions to be met.[7,8] Therefore, indices that take into consideration other factors have started to be used to assess social welfare, such as: NNW (net national welfare index), MEW (the Nordhaus and Tobin economic prosperity index), ISEW (the Daly and Cobb indicator of ecological natural resources) or EAW (the indicator of the economic aspects of welfare). Currently, the Human Development Index (HDI) calculated by the UN is probably the most popular one. The HDI, also called a development indicator, takes into account not only the income criterion (national income per capita in USD) but it also includes such factors as knowledge (the average number of education years received by residents aged 25 years and older, expected number of education years for children starting the education process), as well as health and life expectancy.[9]

The measures referred to above have one significant drawback – they are not based on the measures of individual well-being but only on aggregate indicators at the macro level.[10] For this reason, the concept of a social welfare function (FD) has also been introduced in the welfare economics, which reflects social welfare through the welfare of individuals. The metrics of individuals' well-being in a society are the arguments in this function.[11] The most commonly used functions of social welfare include: the utilitarian function, the Bernoulli-Nash function, the Rawls function or, the most popular, Bergson-Samuelson function.

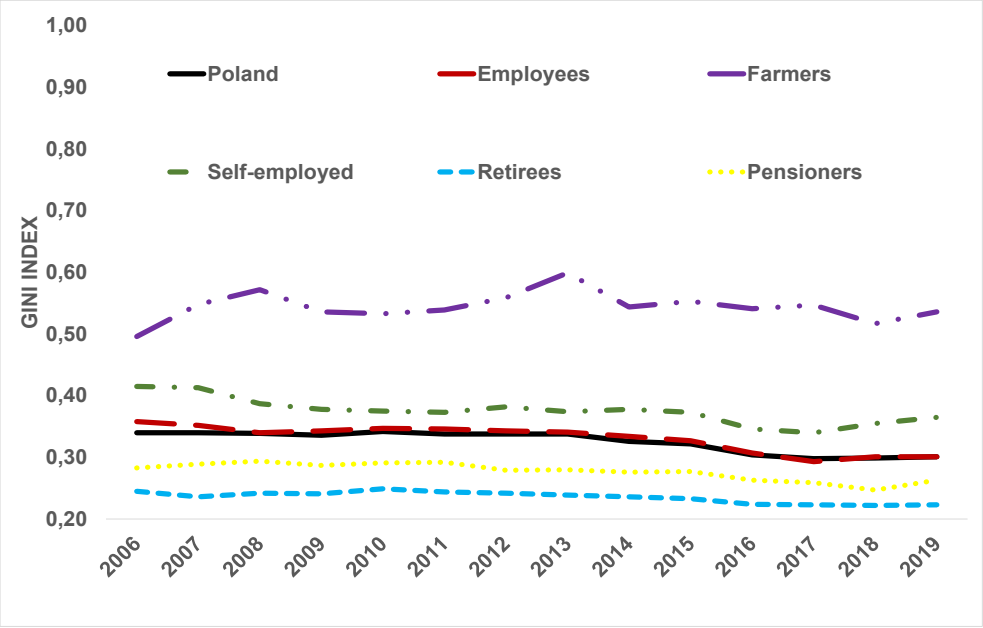
This study used reduced welfare functions (ZFDs), sometimes also called in literature shortened welfare functions (described in Chapter 1.1). Later in this paper, the term "reduced" is used only. The ZFDs reflect the distribution and dependence of welfare on income size and its disparities. According to the ZFD design, when the average income is constant, increase in inequality causes a decrease in social welfare, whereas when the level of inequality is constant, increase in the average income raises social welfare. The average disposable income of socio-economic groups was adopted as a measurement of income and the Gini index, commonly used in economics to describe social inequalities, mainly income inequality, was taken as a measurement of inequality. It very

5. P. Mongin, *Is there progress in normative economics?,* [in:] Boehm, S., Gehrke, Ch., Kurz, H.D., Strun, R., *Is there progress in normative economics?*, Edward Elgar Publishing, Inc., 2002, From: https://people.hec.edu/mongin/wp-content/uploads/sites/36/2018/08/Is-there-progress-in-Economics.pdf, [available as at 16.09.2021].
6. M. Brzezinski, Wpływ…, *op. cit.*
7. A. Sen, *The standard of living*, Cambridge University Press, 1987.
8. C. Grün, S. Klasen, *Growth, Income Distribution, and Well-Being: Comparisons across Space and Time*, "CESifo Working Paper", 837/2002, From https://www.cesifo.org/DocDL/cesifo_wp837.pdf, [access 16.09.2021].
9. https://hdr.undp.org/en/content/human-development-index-hdi, [available as at 16.09.2021].
10. M. Brzezinski, Wpływ…, *op. cit*.
11. Ibidem.

vividly reflects the differences in the income of a given society, which, combined with interpretation simplicity, determines its usefulness in research.[12,13]

The chart below (Figure 1) shows the Gini coefficient values for Poland, split into selected socio-economic groups in Poland in the years 2006–2019. The graph clearly shows that a decrease in the Gini coefficient (by 11.47%) was observed in Poland between 2006 and 2019, which points out to a decrease in income disparities in our country. This decrease pertained to almost all social groups and amounted to, respectively: Employees: – 15.92%; Self-employed: – 12.05%; Retirees: – 8.98%; Pensioners – 7.07%. The only exception are Farmers, where the disparity situation has deteriorated (increase in the Gini index by 8.06%).

Figure 1. The Gini index for Poland by selected socio-economic groups in 2006–2019.



Source: own study based on GUS data: "Budżety gospodarstw domowych" ["Household budgets"], 2006–2019

1.1 Reduced welfare functions

This paper used reduced welfare function in research, because of computation easiness and applying a different methodology than the one commonly used in research (described in Chapter 2) in order to fill the research gap.

12. J. Włodarczyk, *Nierówności dochodowe w Polsce według rozkładów Pareto i Boltzmanna-Gibsa,* „Problemy gospodarki rynkowej: Polska i świat", 130/2013, 76–87. From: https://www.ue.katowice.pl/fileadmin/_migrated/content_uploads/7_J.Wlodarczyk_Nierownosci_Dochodowe....pdf, [access 16.09.2021].
13. M. Brzezinski, Wpływ…, *op. cit*.

Reduced welfare functions (ZFDs) are defined as the functions of two arguments:[14] average income ($\overline{D}$) and income inequality index (WND) in a sample, which can be described by the formula:

$$ZFD_i = F(\overline{D}; WND) \quad (1)$$

where: ZFD_i – the ith reduced welfare function, $\overline{D}$ – the average income, WND – income inequality indicator.

Many different indicators can be used as an income inequality indicator, though the Gini index, used in this research, as well, is the most popular one. Then the reduced welfare functions take the form of:

$$ZFD_i = F(\overline{D}; GINI) \quad (2)$$

Thus, the social welfare is measured with the ZFD as the average income in a given socio-economic group or society, adjusted by the size of the inequality. Table 1 below and Figure 2 show selected ZFDs that will be used later in the analysis, along with a mathematical description. These will be: the Sen index, Kakwani index, Dagum index and modified Dagum index. The analysis also used a function that was called the 'naïve' welfare function, being the income itself. In each case, income used for this analysis is the average monthly disposable income per person in households by socio-economic groups (Appendix B – Table 6), whereas the inequality indicator – the Gini index for these groups.

Table 1. A summary of selected ZFDs used in the research, with their mathematical formula.

ZFD Name ZFD	Symbol	Mathematical formula	Equation number
Sen Index	ZFD_1	$\overline{D}(1 - GINI)$	(3)
Kakwani Index	ZFD_2	$\frac{\overline{D}}{(1 - GINI)}$	(4)
Dagum Index	ZFD_3	$\overline{D}\ \frac{(1 - GINI)}{(1 + GINI)}$	(5)
Dagum Modified Index	ZFD_4	$\overline{D}\ \frac{(1 - GINI)^2}{(1 + GINI)^2}$	(6)
'Naïve' ZFD	ZFD_5	$\overline{D}$	(7)

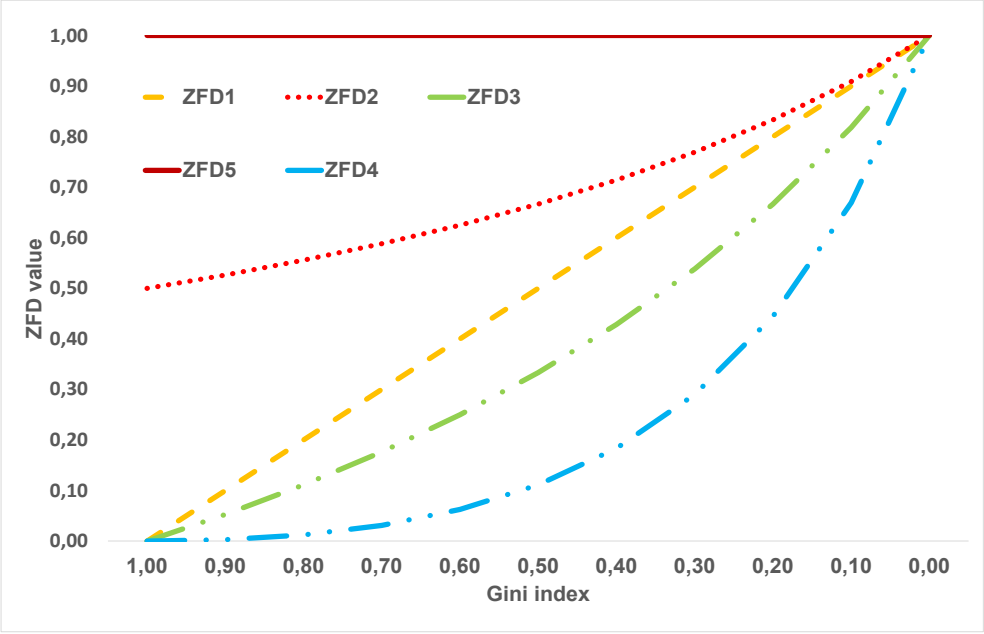
Source: own study based on: Włodarczyk, J., *Nierówności dochodowe w Polsce według rozkładów Pareto i Boltzmanna-Gibsa*, „Problemy gospodarki rynkowej: Polska i świat", 2013, 130, 76–87. From: https://www.ue.katowice.pl/fileadmin/_migrated/content_uploads/7_J.Wlodarczyk_Nierownosci_Dochodowe....pdf, [available as at 16.09.2021]; Brzezinski, M., *Wpływ nierówności dochodowej na dobrobyt społeczny w Polsce w latach 1987–1997*, „Gospodarka Narodowa" , 2002, 9, 41–60. From: http://coin.wne.uw.edu.pl/mbrzezinski/research/MBwelfare2GN.pdf, [available as at 16.09.2021]

The Sen Index (ZFD1) is the simplest of the reduced welfare functions. It expresses a linear relationship between income and inequality index and unlike the Kakwani Index (ZFD2), it is more sensitive to changes in the average income than to changes in the Gini coefficient for

14. M. Brzezinski, Wpływ…, *op. cit.*

Gini <0.5,[15] while the Kakwani index is always more sensitive to changes in the average income than to changes in the Gini coefficient.[16] (ZFD3) and (ZFD4) formulated by Dagum are far more sensitive to inequalities than the functions mentioned earlier. In other words, from the welfare assessment point of view, income disparities are more important than the income itself. (ZDF5) equal to the disposable income is not dependent, by its design, on the inequality indicator at all.

Figure 2. ZFDi values depending on the Gini coefficient, with stable income $\overline{D} = 1$,



Source: own study

Table 1 and Figure 2 show that ZFDs are a measure of social welfare relatively simple to be established. The undoubted advantage of using them is also the availability of data needed for calculating ZFDs and thus estimating income inequalities both in the selected socio-economic groups and at the level of national economies. Establishing ZFDs for the identified socio-economic groups in Poland will allow to verify the legitimacy of their use for estimating household insurance expenditures, which is one of the motivations of this work, due to the significant role of insurance in economy.

2. Factors determining the demand for insurance

The role of insurance in economy has been frequently analysed by many researchers. Although it is difficult to identify clear links due to different research methods and techniques, it cannot be denied that insurance has played an important role in economic development. As already mentioned, research into the economic impact of insurance varies significantly. Empirical research

15. M. Brzezinski, Wpływ…, *op. cit.*
16. Ibidem.

prevails here (examples: Arena (2008)[17]; Han et al. (2010)[18]; Phutkaradze (2014)[19]; Śliwiński et al. (2013)[20]), although theoretical research has also been done (examples: Arena (2008)[21]; Browne et al. (2000)[22]; Catalan et al. (2000)[23]; Holsboer (1999)[24]; Bednarczyk (2013)[25]). Empirical studies vary to a large extent, not only in terms of geographical coverage and types of economies. Some of them pertain to developed economies and OECD countries (examples: Catalan et al. (2000)[26]; Ward and Zurbruegg (2000)[27]), and some to developing countries (examples: Han et al. (2010)[28]; Phutkaradze (2014)[29]). Nevertheless, a vast majority of them are generally concerned with the financial market and its impact on the economy. According to the Polish Insurance Chamber,[30] insurance is the foundation of the social and economic security in Poland. Insurance not only protects and stabilises, but also enables economic development. The activity of the sector has an impact on the safety of Poles and it also makes an important contribution to economic growth and living standards. Insurers support the growth of businesses and stabilise the country's public finance by providing necessary capital.

As a rule, the impact of insurance on the economy is similar to that of savings accumulated in banks or investment funds. The main difference arises directly from the immanent characteristics of insurance products, namely a transfer of risks. It is risk hedging that translates into the activity of business entities. Of course, under certain circumstances it can have a negative impact

17. M. Arena, *Does Insurance Market Activity Promote Economic Growth? A Cross-Country Study for Industrialized and Developing Countries,* "Journal of Risk and Insurance", 75/2008, p. 921–946. https://doi.org/10.1111/j.1539–6975.2008.00291.x.
18. L. Han, L. Donghui, F. Moshirianb, Y. Tiana, *Insurance Development and Economic Growth*, "The Geneva Papers on Risk and Insurance – Issues and Practice",35/ 2010, p. 183–199. https://doi.org/10.1057/gpp.2010.4.
19. J. Phutkaradze, *Impact of Insurance Market on Economic Growth in Post-Transition Countries*, "International Journal of Management and Economics", 44/2014, p. 92–105. From https://ssl-kolegia.sgh.waw.pl/pl/KGS/publikacje/Documents/IJME44_ZN%2044%20(1).pdf, [access 16.09.2021].
20. A. Śliwiński, T. Michalski, M. Rószkiewicz, *Demand for Life Insurance – An Empirical Analysis in the Case of Poland*, "The Geneva Papers on Risk and Insurance – Issues and Practice", 38/2013, p. 62–87. https://doi.org/10.1057/gpp.2012.21.
21. M. Arena, *Does…*, *op. cit*.
22. M.J. Browne, J.W. Chung, E.W. Frees, *International Property-Liability Insurance Consumption,* "Journal of Risk and Insurance" 67/ 2000, p. 73–90. https://doi.org/10.2307/253677.
23. M. Catalan, G. Impavido, A.R. Musalem*, Contractual savings or stock market development – Which leads?*, "World Bank Policy Research Working Paper", 2421/ 2000, https://doi.org/10.1596/1813-9450-2421.
24. J.H. Holsboer, *Repositioning of the Insurance Industry in the Financial Sector and its Economic Role*, "The Geneva Papers on Risk and Insurance – Issues and Practice", 24/1999, p. 243–290. From https://www.jstor.org/stable/41952478, [access 16.09.2021].
25. T.H. Bednarczyk, Insurance development as a factor in long-term economic growth, "Insurance Review" 4/2013, 4, 29–47.
26. M. Catalan, G. Impavido, A.R. Musalem, *Contractual …, op.cit.*
27. D. Ward, R. Zurbruegg, *Does Insurance Promote Economic Growth? Evidence from OECD Countries,* "Journal of Risk and Insurance", 67/2000, p. 489–506. DOI:10.2307/253847.
28. L. Han, L. Donghui, F. Moshirianb, Y. Tiana, *Insurance…, op. cit.*
29. J. Phutkaradze, *Impact…, op. cit.*
30. PIU [Polish Insurance Chamber], Raport o wpływie branży ubezpieczeniowej [Report on the impact of the insurance industry], 2017, From https://piu.org.pl/wp-content/uploads/2017/11/171127_raport_wplywu_krotki.pdf, [access 16.09.2021].

through the so-called moral hazard. Insurance companies do not have the ability to create money, as banks do. This role is reserved exclusively for banks. Key channels of the impact of insurance and investments on the economy are presented as a summary in the table below.

Table 2. Key channels of the impact of insurance and investments on the economy.

Key channels of economic impact		
	Insurance	**Savings**
Risk transfer	X	
Investments	X	X
Labour market	X	X
Innovation	X	X
Money creation		X (Banks)

Source: own study based on Śliwiński, A., *Rola ubezpieczeń w gospodarce*, Oficyna Wydawnicza SGH, 2019.

Due to the role of insurance in the economy, factors influencing the demand for insurance have been the subject of many studies.[31] These factors were analysed across different perspectives such as geographical, social or economic. These factors were also considered because of their impact on the different types of insurance, including life and non-life insurance.[32] The multitude of studies and publications has also resulted in the availability of several studies that summarise the results of other studies. The most important ones include publications prepared by: Jaspersen (2016)[33], Zietz (2003)[34] and Śliwiński (2016)[35]. It is worth pointing out here that although the work of both Zietz[36] and Śliwiński[37] concerned life insurance and did not take into account non-life insurance, the factors determining the demand for insurance are, in principle, very similar, as it was indicated in studies published by Dragos[38]. The table below presents the key determinants of the demand for insurance stated in the above-mentioned publications.

31. N. Duczkowski, *Zastosowanie rozkładu α-stabilnego do modelowania zmian cen ubezpieczeń.,* „Wiadomosci Ubezpieczeniowe" 2/ 2021, p. 109–128. DOI: https://doi.org/10.33995/wu2021.2.7.
32. Ibidem.
33. J.G. Jaspersen, *Hypothetical Surveys and Experimental Studies of Insurance Demand: A Review*, "Journal of Risk and Insurance" 83/2016, p. 217–255. DOI: https://doi.org/10.1111/jori.12100.
34. E.N. Zietz, *An examination of demand for life insurance,* "Risk Management and Insurance Review", 6/2003, p. 159–191. https://doi.org/10.1046/J.1098–1616.2003.030.x
35. A. Śliwiński, *Popyt na ubezpieczenia na życie – przegląd badań światowych*, [in:] S. Nowak, A.Z.Nowak, A. Sopoćko A. (eds), Polski Rynek Ubezpieczeń na tle kryzysów społeczno-gospodarczych, 2016, Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego. From: http://www.wz.uw.edu.pl/portaleFiles/6133-wydawnictwo-/Polski_rynek_ubezpieczen_e-book.pdf, [access 16.09.2021]
36. E.N. Zietz, *An examination..., op. cit.*
37. A. Śliwiński, *Popyt..., op. cit.*
38. S.L. Dragos, *Life and non-life insurance demand: the different effects of influence factors in emerging countries from Europe and Asia*, "Economic Research-Ekonomska Istraživanja", 27 (1)/2014, p. 169–180, DOI: http://dx.doi.org/10.1080/1331677X.2014.952112.

Table 3. Key determinants of insurance demand.

Groups of determinants of insurance demand		
Demographic	**Economic**	**Behavioral**
• Age • Education level • Employment level • Family size • Sex • Life expectancy • Population • Race • Religion • Region	• Home budget • Number of credit cards • Property owned • Personal income • Expected personal income • Earnings • Net assets • Inflation • Profession • Insurance price • Interest rate • Social security level • Stock market index level • Insurance agent's commission • Discounts	• Inheritance theme • Cohort effect • Risk perception • Risk sharing • 'Moral hazard' • Way of communicating risks • Government support perception • Expected utility • Information disclosures

Source: own study based on: J.G. Jaspersen, *Hypothetical Surveys and Experimental Studies of Insurance Demand: A Review*, "Journal of Risk and Insurance", 83/2016, 217–255. DOI: https://doi.org/10.1111/jori.12100, E.N. Zietz, *An examination of demand for life insurance*, "Risk Management and Insurance Review", 3/2003, p. 159–191. https://doi.org/10.1046/J.1098–1616.2003.030.x, A. Śliwiński, *Rola ubezpieczeń w gospodarce*, Oficyna Wydawnicza SGH, 2019, A. Śliwiński, *Popyt na ubezpieczenia na życie – przegląd badań światowych*, [in:] S. Nowak, A.Z. Nowak, A. Sopoćko, *Polski Rynek Ubezpieczeń na tle kryzysów społeczno-gospodarczych*, 2016, Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego. From: http://www.wz.uw.edu.pl/portaleFiles/6133-wydawnictwo-/Polski_rynek_ubezpieczen_e-book.pdf, access 16.09.2021]. Table also published in: N. Duczkowski, *Wykorzystanie finansów behawioralnych do opisu wybranych zjawisk na polskim rynku ubezpieczeniowym*. „Zeszyty Naukowe Polskiego Towarzystwa Ekonomicznego w Zielonej Górze" 15/2021, p. 84–102. DOI: 10.26366/PTE.ZG.2021.205

A closer look should be taken at the studies that analyse economic variables, in particular income, mentioned in Zietz's paper.[39] This work identified 13 studies which showed a positive link of income with the demand for life insurance. As a general rule it could be found that in all articles disposable income is an important determinant of the demand for life and non-life insurance.[40] Importantly, two of the studies mentioned by Zietz[41] also obtained slightly different results depending on the level of current income or the dataset used. Anderson & Nevin[42] in their work published in 1975 refer to a positive link between current income and the demand for life insurance in the case of low – and high-income families but also to a negative relationship in the case of middle-income families. Ambiguous results were also obtained in Berekson's study[43] conducted

39. E.N. Zietz, *An examination..., op.cit.*
40. S.L. Dragos, Life…, op. cit.
41. E.N. Zietz, *An examination..., op.cit.*
42. D.R. Anderson, J.R. Nevin, *Determinants of Young Marrieds' Life Insurance Purchasing Behavior: An Empirical Investigation*, "Journal of Risk and Insurance" 42/ 1975, p. 375–387. https://doi.org/10.2307/251694.
43. L.L. Berekson, *Birth Order, Anxiety, Affiliation and the Purchase of Life Insurance*, "Journal of Risk and Insurance", 39/1972, p. 93–108. https://doi.org/10.2307/251654.

on groups of students, which was also mentioned by Zietz.[44] They point out to differences between insurance demand and income depending on the examined group. In his studies concerning the research on insurance demand Zietz[45] also cites the work of Chesney and Louberge[46], who analysed the effect of wealth along with risk aversion. They concluded that these two factors are not independent and both the risk aversion and the wealth effect should be taken into account when analysing insurance demand. Not without significance for this study is also the research published by Outreville[47] in 1996. Outreville's research concerned 48 developing countries from Africa, South America and Asia. As part of those analyses, differences in the behaviour of customers using insurance were explained, among others, by significant income inequality manifested in personal income distribution skewness. It should also be mentioned that one of the main factors in the demand for life insurance is also a subjective perception of the degree of insurance risk materialisation by consumers.[48]

Income is inextricably linked with income inequality within a given socio-economic group. Income inequality is one of the economic factors analysed by scientists as a determinant of the demand for insurance. Examples of such papers are: Eck and Nizovtsev (2006)[49]; Beenstock et al. (1986)[50]; Feyen et al.(2011)[51]; Beck and Webb (2003)[52]; Nakata and Sawada (2007)[53]; Noonan and Sadiq (2017)[54]; Kaestner and Lubotsky (2016)[55]. Although the researchers achieved different results, each of them highlights the importance and impact of possible income inequalities on customer purchasing decisions, including insurance. It is also worth pointing out an important common feature of research related to income inequality and its demand for insurance. This feature

44. E.N. Zietz, *An examination ..., op.cit.*
45. Ibidem.
46. M. Chesney, H. Louberge, *Risk Aversion and the Composition of Wealth in the Demand for Full Insurance Coverage*, "Schweizerische Zeitschrift fur Volkswirtschaft und Statistik", 3/1986, p.359–369. From: https://ideas.repec.org/a/ses/arsjes/1986-iii-7.html, [access 16.09.2021].
47. J.F. Outreville, *Life Insurance Markets in Developing Countries*, "Journal of Risk and Insurance", 63 (2)/1996, p. 262–278. doi:10.2307/253745.
48. A. Śliwiński, *Popyt ..., op. cit.*
49. J. Eck, D. Nizovtsev, *The impact of culture on the purchase of life insurance in Latin America and the Carabbean*, "International Business & Economics Research Journal", 5/2006, p.31–45, DOI: https://doi.org/10.19030/iber.v5i1.3447.
50. M. Beenstock, G. Dickinson, S. Khajuria, *The Determination of Life Premiums: An International Cross-Section Analysis 1970–1981*, "Insurance: Mathematics and Economics", 5/1986, p. 261–270, DOI: https://doi.org/10.1016/0167–6687(86)90020-X.
51. E. Feyen, R. Lester, R. Rocha, *What Drives the Development of the Insurance Sector, World Bank Policy Research Working Paper*, 2011, 5572, link: https://ssrn.com/abstract=1774419 [available as at 16.09.2021].
52. T. Beck, I. Webb, *Economic, Demographic, and Institutional Determinants of Life Insurance Consumption Across Countries*, "World Bank Economic Review" 17(1)/ 2003, p. 51–88, DOI: https://doi.org/10.1093/wber/lhg011.
53. H. Nakata, Y. Sawada, *Demand for Non-life Insurance: A Cross-Country Analysis*, CIRJE Working Paper, 2007, F-461, link: http://www.computer-services.e.u-tokyo.ac.jp/p/cemano/research/DP/documents/coe-f-159.pdf, [available as at 16.09.2021].
54. D.S. Noonan, A.A. Sadiq, *Flood Risk Management: Exploring the Impacts of the Community Rating System Program on Poverty and Income Inequality*, "Risk Analysis", 38(3)/2017,p. 489–503, DOI: 10.1111/risa.12853.
55. R. Kaestner, D. Lubotsky, Health Insurance and Income Inequality, "Journal of Economic Perspectives" 30(2)/2016, p. 53–78, DOI: http://dx.doi.org/10.1257/jep.30.2.53.

is the research method. In general, all the studies indicated above use a certain separate variable describing income inequality and analyse its statistical properties within the framework of econometric models (income and income inequality being separate variables in the model). This paper links income inequality directly with income by applying reduced welfare functions, which, apart from the computation easiness, is the reason for using the reduced welfare functions for this study.

These studies are the direct motivation of this work since they point out to the role of income differentiation and the subjective perception of insured risk. There is a huge difference in the way an individual perceives a random event resulting in a loss of something that is standard in the environment (smaller income disparity, greater welfare) and an event associated with even more severe loss that is not standard (greater income disparity, lower welfare). These are subjective feelings about achieved wealth that result in a completely different real value of income for households and thus imply a different propensity to hedge against risk and, consequently, incur insurance expenditures. The level of satisfaction with households' income reflects their general financial standing and has a significant impact on securing for the future as well as determines the willingness to mitigate the risk of a loss due to a random event.

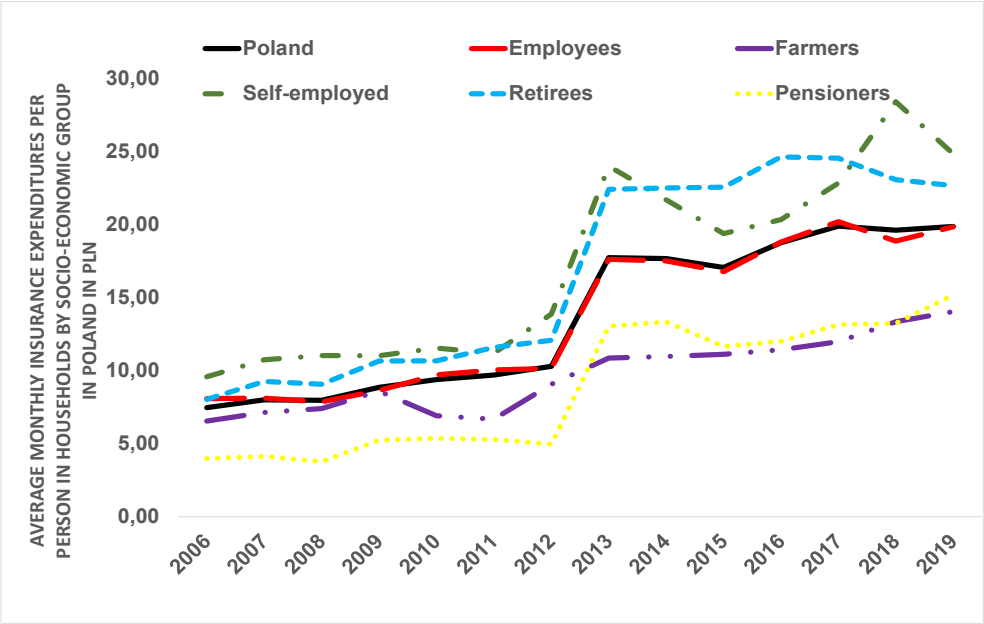
The studies cited above show the complexity of the issues related to an analysis of insurance demand determinants.[56] Nevertheless, they confirm that social welfare or individual income perception and its disparity within socio-economic groups, can be a significant determinant of the demand for insurance. Social welfare, estimated using the reduced welfare functions, is the factor that was examined in this study. And although it is based on income, it takes into account income inequalities which, due to their specifics, significantly imply the size of insurance demand.

3. Database and research method

The test method used in this research was a linear regression between the dependent variable (Figure 3) being the average monthly insurance expenditures in PLN per person in households by socio-economic groups in Poland and the explanatory variable which was the value of reduced welfare functions (ZFD1-ZFD5) calculated on the basis of the formulas presented in Table 1 for each socio-economic group, on the basis of the average monthly disposable income per person in households (Appendix B – Table 6) and the Gini coefficient for that group (Figure 1).

56. A. Śliwiński, *Popyt E, op. cit.*

Figure 3. The average monthly insurance expenditures in PLN per person in households by socio-economic groups in Poland.



Source: own study based on GUS data: "Budżety gospodarstw domowych" ["Household budgets"], 2006–2019

The data used for the research was taken from annual publications "Household budgets" published by the Polish Central Statistical Office (GUS) in the years 2006–2019.[57] By the date of calculating the results presented in this article, the publication for 2019 was the last available one. The data source is one of the most reliable in Poland.

This research does not include the statutory division of insurance into life insurance (Section I) and non-life insurance (Section II) described in the Appendix to the Insurance Act. The analysis concerned the impact of social welfare on total insurance expenditures by verifying the way of estimating income inequalities with the use of ZFDs, without taking into account the specifics of insurance sections and groups that are characterised by different demand determinants. The analysis did not include the varying demand elasticity among selected insurance groups. A good example is a compulsory civil liability insurance for farmers or a civil liability insurance dedicated to selected self-employed professionals such as lawyers or doctors. However, unlike in the case of motor third-party liability insurance, in the economic practice of many sectors (e.g. farmers) no effective control mechanism has been developed so far for holding compulsory third-party liability insurance, which results in a lower amount of insurance premiums than it would appear from data (underinsurance). It is also worth mentioning that although GUS publishes data on the specification of various types of insurance (life, housing-related, private health-related, transport-related) as a part of "Household budgets", these data do not take into account the breakdown for compulsory and voluntary insurance. What is more, the detailing of various types insurance has changed over time (adding life insurance

57. GUS [Polish Central Statistical Office], "Budżety gospodarstw domowych" ["Household budgets"], 2006–2019

from 2013). As a limitation of this study the time range of data included in the calculation should also be indicated. Nevertheless, on the day of preparing the research, the data used was the most recent possible (GUS data from "Household budgets", 2006–2019[58]). However, as of the date of publication of this paper, data from "Household budgets" may be available for 2020.

As a part of the econometric models preparation, the following equation was subject to the regression procedure:

$$W = A_i * \text{ZFDi}\ (\overline{D}\,;\, GINI) \tag{8}$$

where: W – the average monthly insurance expenses per person in households by socio-economic groups, ZDFi – reduced welfare function for a given socio-economic group.

As a part of the estimation of the regression equations, a simplified model of a linear equation without the intercept was adopted due to the specificity of the variables and the fact that the regression coefficient in these models corresponds to the share of insurance expenditure in disposable income.

4. Results

On the basis of the procedure described in Chapter 3. The Database and Research Method 30 regression models were estimated along with statistics to determine the static significance of the parameters and residuals. The mean relative error of estimation was also calculated as the quotient of the difference between the average share of a given ZFD in the insurance expenditures of a given socio-economic group and their model realisation determined by Ai factor. For each model the model parameters were statistically significant. The results are presented in Table 4 below. The models with the best fit for a given socio-economic group were marked in grey.

Table 4. A summary of the results of estimation of insurance expenditure models for different socio-economic groups, with basic parameters and the assessment of matching errors.

Simulation variant			Regression statistics			Variance Analysis (F <0.05 significance for each variant)	Model (p-value <0.05 for each variant)			Evaluation of a fitting error
No.	Socio-economic group	ZFD	R^2	Adjusted R^2	Standard error	F	Ai	Standard error	t Stat	Relative error
1.1	Total	ZFD1	0.9683	0.8914	2.7037	397.2043	0.0159	0.000798	19.9300	4.66%
1.2	Total	ZFD2	0.9660	0.8891	2.7985	369.8782	0.0143	0.000742	19.2322	4.90%
1.3	Total	ZFD3	0.9703	0.8934	2.6163	425.0663	0.0210	0.001018	20.6171	4.32%
1.4	Total	ZFD4	0.9741	0.8972	2.4421	489.7999	0.0406	0.001835	22.1314	2.91%
1.5	Total	ZFD5	0.9633	0.8864	2.9087	341.4315	0.0108	0.000584	18.4779	5.09%
2.1	Employees	ZFD1	0.9705	0.8935	2.6017	427.1679	0.0159	0.000767	20.6680	3.76%

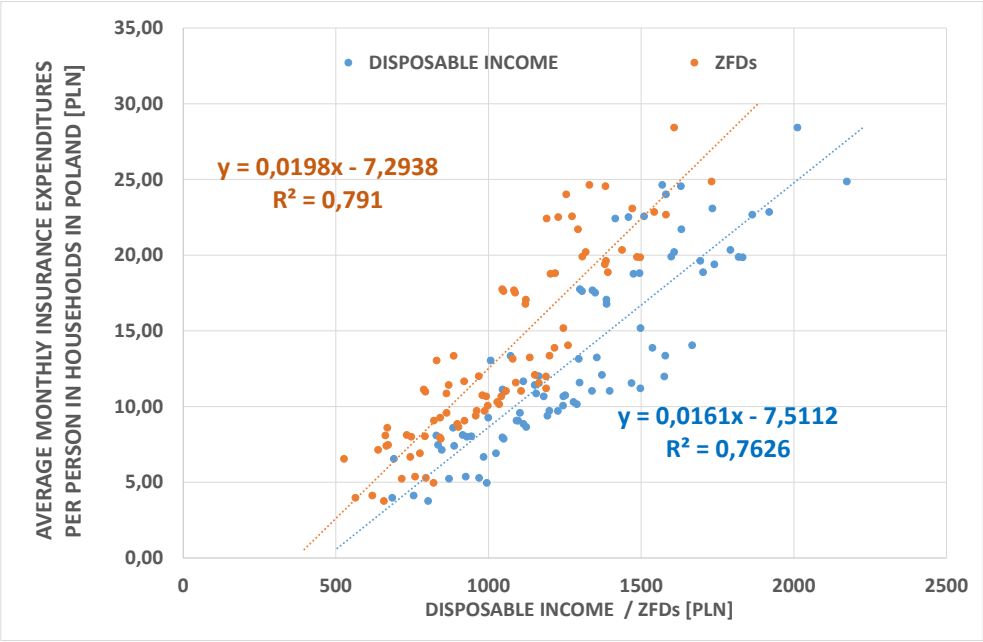
58. GUS [Polish Central Statistical Office], "Budżety gospodarstw domowych" ["Household budgets"], 2006–2019

2.2	Employees	ZFD2	0.9681	0.8912	2.7027	394.9086	0.0142	0.000714	19.8723	4.16%
2.3	Employees	ZFD3	0.9724	0.8954	2.5164	457.5199	0.0210	0.000981	21.3897	3.24%
2.4	Employees	ZFD4	0.9750	0.8981	2.3940	506.8777	0.0408	0.001812	22.5139	1.12%
2.5	Employees	ZFD5	0.9652	0.8883	2.8235	360.7334	0.0107	0.000564	18.9930	4.46%
3.1	Farmers	ZFD1	0.9801	0.9032	1.4682	641.4023	0.0189	0.000746	25.3259	-2.20%
3.2	Farmers	ZFD2	0.9834	0.9065	1.3407	771.7260	0.0133	0.000480	27.7800	-1.57%
3.3	Farmers	ZFD3	0.9783	0.9014	1.5347	585.9084	0.0291	0.001201	24.2055	-2.57%
3.4	Farmers	ZFD4	0.9666	0.8897	1.9030	376.5092	0.0969	0.004993	19.4038	-5.05%
3.5	Farmers	ZFD5	0.9842	0.9072	1.3108	807.9274	0.0086	0.000304	28.4241	-1.46%
4.1	Self-employed	ZFD1	0.9605	0.8836	3.7745	316.1425	0.0175	0.000982	17.7804	4.66%
4.2	Self-employed	ZFD2	0.9581	0.8811	3.8900	296.9008	0.0151	0.000874	17.2308	4.97%
4.3	Self-employed	ZFD3	0.9621	0.8852	3.6952	330.4377	0.0239	0.001315	18.1779	4.33%
4.4	Self-employed	ZFD4	0.9651	0.8881	3.5497	359.1673	0.0517	0.002730	18.9517	2.74%
4.5	Self-employed	ZFD5	0.9556	0.8787	4.0014	279.8783	0.0110	0.000657	16.7296	5.13%
5.1	Retirees	ZFD1	0.9515	0.8746	4.1039	255.2726	0.0163	0.001018	15.9773	6.40%
5.2	Retirees	ZFD2	0.9504	0.8734	4.1532	248.9417	0.0154	0.000975	15,7779	6,41%
5.3	Retirees	ZFD3	0.9534	0.8764	4.0266	265.6796	0.0201	0.001231	16.2997	6.37%
5.4	Retirees	ZFD4	0.9576	0.8806	3.8410	293.2644	0.0323	0.001886	17.1250	6.17%
5.5	Retirees	ZFD5	0.9484	0.8715	4.2357	238.8394	0.0125	0.000806	15.4544	6.40%
6.1	Pensioners	ZFD1	0.9267	0.8498	2.7733	164.3290	0.0123	0.000960	12.8191	9.16%
6.2	Pensioners	ZFD2	0.9243	0.8474	2.8176	158.8004	0.0114	0.000903	12.6016	9.20%
6.3	Pensioners	ZFD3	0.9295	0.8526	2.7189	171.5001	0.0157	0.001196	13.0958	9.06%
6.4	Pensioners	ZFD4	0.9361	0.8591	2.5901	190.2940	0.0274	0.001986	13.7947	8.49%
6.5	Pensioners	ZFD5	0.9210	0.8441	2.8784	151.6140	0.0089	0.000725	12.3132	9.21%

Source: own study

For 5 out of the 6 analysed groups, the best estimation of a monthly insurance expenditure per person per household was achieved by using the reduced welfare function defined as the modified Dagum Index (ZFD4). The results of these models were characterised by the smallest relative errors and the best fitting parameters. It should also be noted that in each of these 5 cases mentioned above, each reduced welfare function was a better estimator of insurance expenditures than ZFD5 also known as the naïve welfare function being the income itself. The exception in this respect is the group of farmers, where the income only turned out to be the best estimator. Such significant differences result directly from the disproportion between the Gini coefficient for this group and the Gini coefficients for other socio-economic groups analysed. In general, social welfare in the form of reduced welfare functions turned out to be a statistically better predictor of insurance expenditure than the disposable income itself. Figure 4, where linear regression between both: all ZFDs values or all disposable income values used in research (previously divided into socio-economic groups) and average monthly insurance expenditures per person in households in Poland were presented, is one of the proofs of this (higher determination coefficient for ZFDs).

Figure 4. A summary of the results of estimation of insurance expenditure models for all observations used in research with basic parameters and determination coefficient.



Source: own study

Conclusions

This work verified the impact of the relationship between both social welfare and income inequalities, and insurance expenditures. The verification was carried out on the basis of data for various socio-economic groups in Poland by using reduced social welfare functions (ZFDs) such as the Sen index, Kakwani index, Dagum indices and the 'naïve' welfare function (income). The study applied a linear regression between the dependent variable (the average monthly insurance expenditure per person in households by socio-economic groups) and the explanatory variable (reduced welfare functions) for a given socio-economic group.

The study partially confirmed the research hypothesis. Social welfare in the form of reduced welfare functions has proven to be a statistically better predictor of insurance expenditures than income alone for social groups with relatively small income disparities (low Gini coefficient) – 5 out of 6 groups analysed. For the group of farmers in Poland, where, statistically, income disparities were the largest, income turned out to be the best predictor. In general, social welfare in the form of reduced welfare functions has also proven to be a statistically better predictor of insurance expenditures (Figure 4).

These results confirm the observation that has been made in other studies referred to in Chapter 2. One of the main factors that determines the demand for insurance is the subjective perception of the degree of risk materialisation by consumers.[59] In the case of smaller income differences

59. A. Śliwiński, *Popyt E, op. cit.*

within the groups and, consequently, greater welfare, a potential loss associated with risk materialisation is more severe for individuals, also because of their environment (point of reference). It is the setting of the reference point (socio-economic group) that influences the fact that each decision-making process, including decisions regarding insurance spending, may be framed differently.[60]

Further research in this area may concern the application of the reduced social welfare functions to the estimation of household insurance expenditures on an international scale. These studies may lead to important conclusions, such as the dependence of using an appropriate reduced social welfare function depending on the level of income disparity (the Gini coefficient). Additionally, very interesting results could be obtained also from the analysis of detailed insurance types, such as: life insurance, motor insurance or private health insurance.

The results of this research can have a practical application. Insurance companies can apply different pricing policies and marketing communications depending on the welfare diversity in a given socio-economic group (the target market). Practical example of such an action may be insurance premium collection in advance for the entire insurance period and more active communication of discounts due to the upfront premium payment for groups where income disparities are greater. In addition, the up-to-date character of the research subject should be taken into account, especially in the light of the COVID-19 pandemic. It can significantly increase income inequalities between various socio-economic groups, e.g. by the temporary closure of the selected parts of economy (lockdown), and therefore change the risk perception of individuals in a given group and thus change the demand for insurance.

The analysis can be considered a unique contribution to the development of financial science (insurance) by combining the dependence of social welfare on income inequalities and verifying the impact of welfare in the selected socio-economic groups in Poland on the insurance demand. To the best of the author's knowledge, there is no research or studies in this respect. What is also worth highlighting is the easiness of welfare estimation by using the reduced welfare functions and the availability of data. Combining that with the justification of using reduced welfare functions, resulting from this research, provides a basis for analysing the impact of welfare on other goods and services.

60. J. Ostaszewski, M. Iwanicz-Drozdowska, (eds), *Finanse ...., op. cit.*

Appendix

Appendix A: Table 5. The average monthly insurance expenditures per person in households by socio-economic groups.

Year	Total	Households							
		of which							
		Employees			Farmers	Self-employed	Retirees and Pensioners		
		Total	in positions				Total	Retirees	Pensioners
			manual workers	non – manual worker					
	in zlotys								
2006	7.47	8.09	4.73	12.89	6.55	9.59	6.93	8.04	3.98
2007	8.01	8.12	4.63	13.29	7.14	10.75	7.98	9.27	4.13
2008	7.97	7.87	5.1	11.91	7.41	11.04	7.9	9.07	3.77
2009	8.86	8.65	5.65	12.88	8.6	11.03	9.54	10.67	5.24
2010	9.4	9.72	5.54	15.13	6.92	11.55	9.61	10.68	5.37
2011	9.71	10.06	5.97	15.14	6.68	11.20	10.35	11.59	5.29
2012	10.30	10.16	6.01	15.40	9.08	13.88	10.70	12.09	4.96
2013	17.75	17.63	10.54	26.47	10.87	24.02	20.43	22.42	13.05
2014	17.68	17.52	10.67	26.00	10.98	21.71	20.72	22.52	13.35
2015	17.07	16.78	10.67	24.25	11.13	19.39	20.60	22.57	11.67
2016	18.77	18.81	12.39	26.28	11.43	20.35	22.45	24.64	12.01
2017	19.90	20.21	13.52	27.64	11.99	22.85	22.81	24.56	13.15
2018	19.63	18.88	13.67	24.44	13.36	28.43	21.80	23.09	13.25
2019	19.88	19.86	13.76	26.24	14.05	24.86	21.77	22.68	15.18

Source: own study based on GUS data: "Budżety gospodarstw domowych" ["Household budgets"], 2006–2019

Appendix B: Table 6. The average monthly disposable income per person in households by socio-economic groups.

Year	Total	Households								
		of which								
		Employees			Farmers	Self-employed	Retirees and Pensioners			
		Total	in positions				Total	Retirees	Pensioners	
			manual workers	non – manual worker						
	in zlotys									
2006	834.68	829.18	622.73	1125.1	689.75	1102.6	872.86	943.89	684.95	
2007	928.87	915.17	700.95	1232.2	846.76	1251.1	937.63	999.05	754.52	
2008	1045.5	1049.8	815.18	1392.3	887.35	1338.5	1031.9	1096.9	802.38	
2009	1114.5	1123.3	863.02	1489.6	884.01	1396.5	1116.3	1180.7	870.55	
2010	1192.8	1199.2	896.27	1591.7	1024.5	1468.4	1180.8	1244.8	925.63	
2011	1226.95	1243.84	936.07	1625.61	983.88	1497.43	1233.08	1297.96	968.98	
2012	1278.43	1289.16	967.06	1695.64	1091.55	1536.68	1297.90	1371.62	994.13	
2013	1299.07	1305.88	990.02	1699.89	1156.13	1581.05	1328.65	1415.23	1006.80	
2014	1340.44	1349.12	1038.28	1733.83	1050.85	1631.64	1382.32	1458.12	1072.44	
2015	1386.16	1386.87	1081.00	1761.36	1046.17	1739.48	1438.04	1509.50	1114.07	
2016	1474.56	1494.79	1205.44	1831.15	1151.28	1792.33	1498.78	1568.96	1164.48	
2017	1598.13	1607.77	1319.58	1928.13	1575.57	1918.94	1579.03	1630.12	1295.64	
2018	1693.46	1702.64	1405.04	2020.45	1579.00	2011.71	1683.35	1732.95	1354.60	
2019	1819.14	1832.14	1549.93	2127.60	1666.55	2173.63	1819.27	1863.61	1498.01	

Source: own study based on GUS data: "Budżety gospodarstw domowych" ["Household budgets"], 2006–2019

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Zastosowanie zredukowanych funkcji dobrobytu społecznego do estymacji wydatków gospodarstw domowych na ubezpieczenia w Polsce

Ze względu na rolę ubezpieczeń w gospodarce czynniki determinujące popyt na ubezpieczenia (np. dochód) były przedmiotem wielu prac badawczych. Z drugiej zaś strony nierówności dochodowe w znacznym stopniu wpływają na wiele decyzji zakupowych i percepcję osiąganego przez jednostki dochodu. Celem niniejszej pracy jest połączenie tych dwóch zagadnień poprzez weryfikację zależności miedzy dobrobytem społecznym a wydatkami na ubezpieczenia. Weryfikacja ta została przeprowadzona na podstawie danych dla różnych grup społeczno-ekonomicznych w Polsce przy zastosowaniu zredukowanych funkcji dobrobytu (ZFD) społecznego takich jak: Indeks Sena, indeks Kakwaniego, indeksy Daguma oraz „naiwna" funkcja dobrobytu (dochód). W ramach pracy badawczej zastosowano regresję liniową pomiędzy zmienną objaśnianą (przeciętne miesięczne wydatki na ubezpieczenia na 1 osobę w gospodarstwach domowych według grup społeczno-ekonomicznych), a zmienną objaśniającą (zredukowane funkcje dobrobytu), dla danej grupy społecznej. ZFD wyznaczono na podstawie średniego miesięcznego dochodu rozporządzalnego na 1 osobę w gospodarstwach domowych oraz współczynnika Giniego dla tej grupy. Dobrobyt społeczny w postaci zredukowanych funkcji dobrobytu okazał się statystycznie lepszym predyktorem wydatków na ubezpieczenia niż sam dochód dla grup społecznych o stosunkowo niedużych dysproporcjach dochodowych (mały współczynnik Giniego).

Dla grupy rolników w Polsce, gdzie statystycznie dysproporcje dochodowe były największe, lepszym predyktorem okazał się dochód.

Słowa kluczowe: ubezpieczenia, popyt, funkcje dobrobytu, wydatki gospodarstw domowych.

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