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DETERMINANTS OF THE CONSUMPTION OF LIFE INSURANCE IN POLAND

Summary: The main aim of the paper is to present the results of an application of factor analysis into a process of distinguishing features which significantly influence life insurance demand. After grouping particular variables into aggregate factors, the study also examines the influence of the factors on the level of life insurance consumption in the case of Poland. The study is made up of fifteen following features: GDP, interest rate, inflation, financial development, life expectancy, market monopolization, share of foreign capital, level of urbanization, level of education, expenditures on health and social care, dependency ratio. The application of factor analysis allows the merging of chosen variables into four main factors that determine life insurance demand separately. The paper concludes with a discussion of major findings.

Key words: life insurance, demand, factor analysis.

1. Introduction

Life insurance demand is the subject of a number of research projects. Nevertheless the majority of studies focus on types of determinants and the extent of determination on the level of insurance consumption. There is also a lack of studies on the life insurance demand's determinants in the case of Central and Eastern Europe (CEE). An alternate strong justification point for using Poland is that the life insurance industry in the country has developed to be one of the biggest among other CEE life insurance markets.

The main aim of the paper is to present the results of the study on creating a set of factors which should be used in the analysis of the determination of life insurance demand in the case of Poland. At the beginning of the paper a short characteristic of the Polish life insurance sector is presented. The characteristics is followed by a review of the previous studies of life insurance determinants. An empirical part is then provided. In that part firstly, the study applies factor analysis into a process of distinguishing the independent factors, which determine demand for life insurance. The reduction of the initial set of variables (preliminary features) by applying a procedu-

re of constructing aggregate factors is the main advantage of applied methodology. The condition of implementing the risk based pricing into life insurance is finding the factors which independently influence demand for the insurance policies.

2. Polish life insurance market – short characteristics

Polish insurance market is still regarded as an emerging market. When we compare it to mature western European markets, for example the British, we can assume that the Polish market is rather small. However, during the last fifteen years of development the Polish insurance market has experienced two huge events, which undoubtedly had a significant impact on its shape and performance.

The first one was the introduction of new insurance law in July 1990, the main idea of which was to allow private and foreign investors to invest in the Polish insurance market. Since 1990 they have been able to open insurance companies. July 1990 is regarded as the starting point in the process of the creation of a new, free Polish insurance market.

The European integration in May 2004 was the second huge event. The integration ultimately opened up the market. Despite that the market is still rather small but these two events and more than 18 years of transition allow us to do the research.

On the other hand, the Polish insurance market is one of the biggest among other emerging markets. It has top ranked position in terms of the gross written premium's share in total gross written premium amongst emerging markets.

Table 1. Top ten emerging markets in life and non-life insurance

Life insurance	2007 premium volume (in USD milllion)	Share of emerging markets (in %)	Non-life insurance	2007 premium volume (in USD milllion)	Share of emerging markets (in %)
China	58.673	26,4	China	33.810	17,0
India	51.322	23,0	Russia	28.973	14,6
South Africa	34.430	15,5	Brazil	20.501	10,3
Brazil	18.533	8,3	Mexico	9.763	4,9
Poland	**7.950**	**3,6**	South Africa	8.345	4,2
Mexico	7.653	3,4	**Poland**	**7.677**	**3,9**
Malaysia	5.573	2,5	India	7.402	3,7
Indonesia	4.728	2,1	Turkey	7.201	3,6
Thailand	4.521	2,0	Venezuela	6.977	3,5
Chile	3.792	1,7	Argentina	4.471	2,2
Top 10	197.177	88,6	Top 10	129.619	68,0

Source: [National insurance authorities... 2008, p. 12].

The fact that the Polish market is still one of the biggest among the other emerging and post-communist countries is also a good justification for studying it. On the other hand, during the transition period the Polish insurance market underwent significant changes. The ownership structure changed in particular. For example, domestic capital accounted for 75% in total subscribed capital in 1991. During the period of transition (to 2008) the share of domestic capital decreased to only 23%. The decrease in the level of domestic capital was gradual. Nevertheless, we can assume that the change is significant.

The market growth is very remarkable especially when considering changes in the life insurance sector where the number of companies has increased almost eight and half times in the analysed period. The gross written premium during the transition period increased approximately sixty times while non-life insurance in the same period of time increased 10 times[1]. Therefore, it is interesting to answer the question: To what extent and what factors have determined life insurance development in Poland? The research presented later in the text is our attempt to give the answer to this question.

3. Review of previous study on life insurance demand

Hammond, Houston and Malandra devised the first model of life insurance demand [Hammond, Houston, Malandra 1967]. The study presented by the authors concentrated on demographic and social factors such as : *order of birth, age, level of education, number of dependants*. They discussed the influence of the factors on the optimisation of life insurance consumption level. Later the study on life insurance demand determinants became more interesting for a great deal of researchers. Successive studies evaluated in the direction of using more economic factors such as the price of life insurance, inflation or the level of disposable income. The chronological order of the best known studies is presented in Table 2.

The authors used different techniques to assess the determination of life insurance demand. The majority of the studies were based on time series data. For instance, the study of Manits and Farmer applies simple correlation analysis to determine independent variables. The variables such as relative price index, personal income, population, marriages, births and employment were selected after their coefficient of correlation with dependent variable was 0.85. The methodology based on simple linear correlation could not eliminate the multicollinearity problem.

The proposed approach minimises the problem of multicollinearity. The literature study shows us that all chosen variables were significant determinants of demand for life insurance. Therefore it is not the intention to eliminate variables. That is the justification for application of the *principal components' method*.

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[1] Calculation based on data published by the Polish Insurance Supervision Committee. Gross written premiums for life insurance in 1991 was equal to 208 MLN. PLN and in 2004 the premium was equal to 12 735 MLN. PLN (in a nominal value).

Table 2. Studies on life insurance demand in chronological order

Year of publication	Author	Journal	Title
1967	Hammond Houston Malandra	JRI	Determinations of Household Life Insurance Premium Expenditures: An Empirical Investigation
1968	Mantis and Farmer	JRI	Demand For Life Insurance
1969	Neuman	JRI	Inflation And Savings Through The Life Insurance
1971	Lee and Whitaker	JRI	Competition Among Life Insurance Products Lines: Determinants Of Demand
1972	Berekson	JRI	Birth Order, Anxiety, Affiliation And The Purchase Of Life Insurance
1973	Fortune	JRI	The Theory Of Optimal Life Insurance: Development And Test
1980	Ferber and Lee	JRI	Acquisition And Accumulation Of Life Insurance In Early Married Life
1981	Babbel	JRI	Inflation, Indexation, And Life Insurance Sales In Brazil
1985	Babbel	JRI	The Price Elasticity Of Demand For Whole Life Insurance
1985	Miller	MLR	Age Related Reductions In Worker's Life Insurance
1986	Wiliams	JRI	Higher Interest Rates, Longer Lifetimes, And The Demand For Life Annuities
1987	Fitzgerald	JRI	The Effect Of Social Security On Life Insurance Demand By Married Couples
1989	Lewis	AER	Dependents And The Demand For Life Insurance
1989	Auerbach and Kotlikoff	JRI	The Demand For Life Insurance In Mexico And U.S.: A Comparative Study
1990	Truett and Truett	JRI	How Rational Is The Purchase Of Life Insurance?
1993	Brown and Kim	JRI	An International Analysis Of Life Insurance Demand
1994	Showers and Shotick	JRI	The Effects Of Household Characteristics On Demand For Insurance: A Tobit Analysis
1996	Outreville	JRI	Insurance Markets In Developing Countries
2000	Hau	JRI	Liquidity, Estate Liquidation, Charitable Motives, And Life Insurance Demand By Retired Singles
2001	Chen, Wong, Lee	JRI	Age, Period, And Cohort Effects On Life Insurance In The U.S.
2003	Tienyu Hwang, Simon Gao	JMF	The determinants of the demand for life insurance in an emerging economy – the case of China
2004	R.A. Somerville	AER	Insurance Consumption and Saving: A Dynamic Analysis in Continuous Time
2005	S. Hussles, D. Ward, R. Zurbruegg	RMIR	Stimulating the Demand for Insurance
2008	A.CW Chui, C.CY Kwok	JIBS	National culture and Life insurance consumption
2008	S. Sen	**	An Analysis of Life Insurance demand determinants for Selected Asian Economies and India

JMF – "Journal of Managerial Finance", AER – "The American Economic Review", RMIR – "Risk Management&Insurance Review", JRI – "Journal of Risk &Insurance", JIBS – "Journal of International Business Studies", ** Working papers 36/2008 of Madres School of Economics, "MLR" – Monthly Labour Review, AER – "American Economic Review".

Source: the authors.

4. Identification of the determinants of life insurance demand

Based on an analysis of previously published studies the set of variables was proposed. The set contains 15 variables.

Table 3. Features chosen for an investigation

Symbol	Chosen feature
X_1	Gross domestic product
X_2	Interest rate
X_3	Inflation
X_4	Financial development
X_5	Men life expectancy
X_6	Women life expectancy
X_7	Monopolistic market (number of competitors)
X_8	Share of foreign companies in a market (share of foreign capital)
X_9	Population
X_{10}	Education level
X_{11}	Health expenditures
X_{12}	Social benefit
X_{13}	Dependency ratio
X_{14}	Rate of birth
X_{15}	Unemployment rate
Y	**Gross written premiums (represents life insurance demand)**

Source: the authors.

The data used for the analyses came from the databases of the Statistical Office of Poland for the period 1991-2005. In the case of the variable named "Financial development" the monetary aggregates M1 and M2 published by the Polish National Bank were used. The level of education represents the number of graduates from the universities (postgraduate and undergraduate level). The variable "Interest rate" represents the average rate of 12 month's deposits in the Polish banking system. "Monopolistic market" represents the change in the number of life insurance companies in Poland during the transition period. The "Share of foreign companies in the market" is calculated as a change in terms of the share of foreign investments during the transition period. The study estimated the change of the values of all variables counted from year to year (index).

Prior to factor analysis the correlation coefficients between all chosen variables were calculated.

Table 4. Correlation matrix

	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
Y	1	0.511	0.518	0.362	–0.486	0.434	–0.088	0.290	–0.516	0.047	–0.425	0.504	–0.051	0.547	0.519	–0.231
X_1	0.511	1	0.773	0.753	–0.389	–0.049	–0.287	0.435	–0.806	0.487	–0.669	0.797	0.049	0.857	0.758	–0.373
X_2	0.518	0.773	1	0.973	–0.738	–0.065	–0.220	0.291	–0.812	0.600	–0.692	0.773	–0.037	0.937	0.982	–0.467
X_3	0.362	0.753	0.973	1	–0.752	–0.226	–0.228	0.197	–0.734	0.564	–0.681	0.740	–0.088	0.882	0.964	–0.413
X_4	–0.486	–0.389	–0.738	–0.752	1	0.190	0.120	0.072	0.347	–0.171	0.412	–0.380	0.015	–0.521	–0.704	0.265
X_5	0.434	–0.049	–0.065	–0.226	0.190	1	0.283	0.157	–0.093	0.072	0.094	–0.001	0.020	0.031	–0.065	–0.011
X_6	–0.088	–0.287	–0.220	–0.228	0.120	0.283	1	–0.019	0.244	0.006	0.158	–0.273	0.052	–0.239	–0.182	0.190
X_7	0.290	0.435	0.291	0.197	0.072	0.157	–0.019	1	–0.523	0.436	–0.321	0.440	0.182	0.443	0.299	–0.357
X_8	–0.516	–0.806	–0.812	–0.734	0.347	–0.093	0.244	–0.523	1	–0.796	0.649	–0.912	0.027	–0.949	–0.767	0.749
X_9	0.047	0.487	0.600	0.564	–0.171	0.072	0.006	0.436	–0.796	1	–0.305	0.610	0.176	0.732	0.524	–0.721
X_{10}	–0.425	–0.669	–0.692	–0.681	0.412	0.094	0.158	–0.321	0.649	–0.305	1	–0.770	0.535	–0.687	–0.713	0.487
X_{11}	0.504	0.797	0.773	0.740	–0.380	–0.001	–0.273	0.440	–0.912	0.610	–0.770	1	–0.225	0.890	0.774	–0.712
X_{12}	–0.051	0.049	–0.037	–0.088	0.015	0.020	0.052	0.182	0.027	0.176	0.535	–0.225	1	–0.021	–0.104	0.105
X_{13}	0.547	0.857	0.937	0.882	–0.521	0.031	–0.239	0.443	–0.949	0.732	–0.687	0.890	–0.021	1	0.915	–0.586
X_{14}	0.519	0.758	0.982	0.964	–0.704	–0.065	–0.182	0.299	–0.767	0.524	–0.713	0.774	–0.104	0.915	1	–0.373
X_{15}	–0.231	–0.373	–0.467	–0.413	0.265	–0.011	0.190	–0.357	0.749	–0.721	0.487	–0.712	0.105	–0.586	–0.373	1

Source: the authors.

Table 5. Communalities estimated

Features	Communalities
X_1 – GDP	0.734
X_2 – interest rate	0.982
X_3 – inflation	0.972
X_4 – financial development	0.798
X_5 – life expectancy (men)	0.640
X_6 – life expectancy (women)	0.734
X_7 – monopolistic market	0.578
X_8 – share of foreign capital	0.963
X_9 – urbanization ratio	0.749
X_{10} – education level	0.878
X_{11} – share of health expenditures in GDP	0.914
X_{12} – social benefits	0.942
X_{13} – dependency ratio	0.971
X_{14} – rate of birth	0.954
X_{15} – unemployment rate	0.644

Source: the authors.

Table 6. Estimated eigenvalues

Feature no	Eigonvalue	Share in total volatility of set of features	Cumulative share in total volatility of set of features
1	**8.109**	**54.057**	**54.057**
2	**1.841**	**12.275**	**66.333**
3	**1.354**	**9.028**	**75.360**
4	**1.149**	**7.662**	**83.022**
5	.844	5.627	88.650
6	.695	4.631	93.280
7	.441	2.940	96.221
8	.293	1.955	98.176
9	.121	.806	98.982
10	.093	.617	99.599
11	.044	.290	99.889
12	.013	.086	99.976
13	.003	.017	99.993
14	.001	.007	100.000
15	–8.44E–017	–5.63E–016	100.000

Source: the authors.

The adequacy of the sample was verified by Kaiser-Mayer-Olkin (K-M-O) statistics. The K-M-O is a measure of the adequacy of the sample to the assumption of factor analysis. The level of sample adequacy for factor analysis measured by K-M-O statistics exceeds 0.9. Such a level is regarded as very high. Table 6 contains communalities estimated for the realisation of a chosen set of features.

The high value of all communalities indicates that the random factors' influence on the factor analysis model is scamp.

The number of extracted factors is determined by a sum of their variation coefficients or the number of eigenvalue (from reduced matrix) higher than 1 according to Kaiser criterion.

The first four factors have an eigenvalue higher than 1. Those factors also render 83,022% of variation for the whole set. Therefore all preliminary features can be extracted in four main factors. The matrix of factor loadings is presented below.

Table 7. Factor loadings − first estimation

Features	Factor 1	Factor 2	Factor 3	Factor 4
X_1	0.849	0.024	0.081	–0.081
X_2	0.945	–0.176	0.183	0.153
X_3	0.911	–0.305	0.192	0.104
X_4	–0.586	0.521	–0.332	–0.267
X_5	–0.054	0.549	–0.189	0.548
X_6	–0.265	0.276	0.015	0.766
X_7	0.443	0.603	–0.038	–0.129
X_8	–0.934	–0.283	0.061	0.082
X_9	0.700	0.489	0.135	–0.036
X_{10}	–0.774	0.223	0.472	–0.079
X_{11}	0.917	0.090	–0.237	–0.091
X_{12}	–0.102	0.407	0.866	–0.128
X_{13}	0.979	0.081	0.070	0.037
X_{14}	0.921	–0.220	0.131	0.202
X_{15}	–0.656	–0.326	0.238	0.227

Source: the authors.

To check the alternative solutions the Varimax rotation is applied. Factor rotation is an important tool in interpreting factors. Varimax is one of the most popular orthogonal factor rotation methods. In particular, the reference axes of the factors are turned about the origin until some other position has been reached. First, unrotated factor solutions extract factors in the order of their importance. Each accounts for

a successively smaller portion of variance. The ultimate effect of rotating the factor matrix is to redistribute the variance from earlier factors to later ones to achieve a simpler, theoretically more meaningful factor pattern[2].

Table 8. Factor Loadings after Varimax rotation

Features	Factor 1	Factor 2	Factor 3	Factor 4
X_1	**0.611**	0.576	–0.055	–0.161
X_2	**0.893**	0.418	–0.071	–0.064
X_3	**0.913**	0.320	–0.096	–0.162
X_4	**–0.882**	0.109	0.002	0.092
X_5	–0.161	0.217	–0.034	**0.752**
X_6	–0.040	–0.202	0.073	0.828
X_7	–0.011	**0.744**	0.109	0.111
X_8	–0.505	**–0.833**	0.111	0.043
X_9	0.323	**0.777**	0.175	0.098
X_{10}	–0.534	–0.405	**0.651**	0.075
X_{11}	0.516	**0.722**	–0.335	–0.121
X_{12}	–0.005	0.105	**0.965**	0.005
X_{13}	**0.719**	0.668	–0.080	–0.045
X_{14}	**0.895**	0.367	–0.134	–0.033
X_{15}	–0.167	**–0.753**	0.195	0.107

Source: the authors.

The biggest values of the factors' loadings are marked in bold. The Varimax depicts which of the preliminary variables is strongly connected to the four extracted factors. The higher factor loadings were the criterion for assigning features to a particular factor. According to this principle we have assigned all the preliminary variables to the created factors. The Varimax analysis also confirms that four relatively independent factors could be created.

The diversion of the loading factors' matrix allows the calculation of coefficients for particular features in the factor.

Correlation coefficients are calculated to check the influence on the created factors on the level of demand of life insurance. A short look at the coefficients could lead to the conclusion that the first factor stimulates demand for life insurance. It is also clearly seen that the power of stimulation depends on the period of delay between the realization of the factor (included variables) and the dependent variable (life insurance demand). The longer the delay period, the bigger the power of stimulation.

[2] J.F. Hair Jr., R.E. Anderson, R.L. Tatham, W.C. Black, *Multivariate Data Analysis*, Prentice Hall, Inc. A Simon & Schuster Company, Upper Sadler River, New Jersey 07458, 1984, p. 87-135.

Therefore, economic development (factor I – F_1) has a delay effect on life insurance demand.

Similarly however, the opposite effect on life insurance demand is a second factor. The factor is becoming a significant destimulant for the demand after a third year of delay.

Table 9. Features assigned to particular factors

Factors	Features
I	Gross Domestic Product Interest rate Inflation Financial development Dependency ratio Rate of birth
II	Monopolistic market Share of foreign companies Urbanisation ratio Share of health expenditures in GDP Unemployment rate
III	Education level Social benefits
IV	Life expectancy (Men) Life expectancy (Women)

Source: the authors.

Table 10. Coefficients of correlation between dependent variable and independent variable calculated for different time delay

Dependent variable	Factors in period *t*			
	F_1	F_2	F_3	F_4
Current (*t*)	0.458	0.269	–0.156	0.238
t–1	0.828	0.118	–0.339	–0.364
t–2	0.783	0.253	–0.344	–0.366
t–3	0.771	0.033	–0.324	–0.157
t–4	0.920	–0.376	–0.033	–0.064
t–5	0.952	–0.724	0.011	–0.022
t–6	0.902	–0.811	0.241	–0.196

Source: the authors.

The third factor could be regarded as non-significant in determining life insurance demand. The determination is non-significant even if the delay is applied. The same situation applies in terms of factor four, which could be seen as a non-significant stimulant when current time is applied. However, if the delay is concerned the factor changes into a non-significant destimulant.

5. Conclusions

The methodology led us to create four main factors. The first factor stimulates the demand for life insurance, the second destimulates. The third has a rather non-significant influence on the demand for life insurance. The fourth has a positive but rather non-significant impact on the demand. The factor could be regarded as the price of insurance. However, the impact changes to negative after one year's delay. It is also quite interesting that the second factor, which could be regarded as a potential future social development, has a delayed negative impact on life insurance demand. The factor comprises the features such as the monopolistic market, the share of foreign companies, population, the share of health expenditures in GDP and unemployment rate.

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DETERMINANTY KONSUMPCJI UBEZPIECZEŃ NA ŻYCIE W POLSCE

Streszczenie: Głównym celem artykułu jest prezentacja wyników badań dotyczących determinacji popytu na ubezpieczenia na życie. W badaniach zastosowano metodę analizy czynnikowej do wyodrębnienia niezależnych czynników determinujących popyt na ubezpieczenia na życie. Następnie dokonano oceny wpływu wyodrębnionych czynników na popyt na ubezpieczenia na życie. Czynniki wydzielono poprzez połączenie cech wstępnie wybranych do badań, takich jak: PKB, stopa procentowa, poziom inflacji, rozwój finansowy, oczekiwana długość trwania życia (kobiety, mężczyźni), struktura rynku, udział kapitału zagranicznego, wskaźnik urbanizacji, poziom edukacji, poziom wydatków na służbę zdrowia, wskaźnik zastąpienia. Wybrane cechy połączono w cztery czynniki.