EFFICIENCY OF NON-LIFE INSURANCE COMPANIES AND ITS DETERMINANTS

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ABSTRACT

The research evaluates efficiency of non-life insurance companies in Poland from 2002 till 2016 and determines factors affecting it. The stochastic frontier analysis (SFA) method was applied for estimating cost efficiency of 29 insurance companies and the panel data Tobit model for identification of the efficiency determinants. The results of the research showed significant volatility of companies' efficiency scores changing from 62.5% in 2002 to 65.8% in 2007 and 59.4% in 2016. Efficiency of most companies was low and the average for the sector was driven by a small group of the most efficient entities. The efficiency was positively impacted by the value of company's gross written premium and acquisition costs, an increase in the profitability and the average wage in the non-life insurance sector and a decrease in the sector's concentration. Companies operated more efficiently in the environment of declining rates of the economic growth and inflation. These relationships were relevant for the entire sector, as well as for groups of companies characterized with higher and lower efficiency.

Key words: Poland, non-life insurance, cost efficiency, stochastic frontier analysis

INTRODUCTION

The sector of insurance companies of the section II[1] provides such important financial services as insurance of cars, air and sea vessels, commercial and residential property, civil liability, financial risk, guarantees and other types of insurance of business operations. At the end of 2016, the value of the sector's assets amounted to PLN 82 billion and constituted about 4% of the financial system assets [NBP 2017]. The dominant group of services offered by the sector is the motor insurance, i.e. car comprehensive insurance and insurance of civil liability resulting from a car possession. The gross written premium (GWP) for this type of insurance accounts for about 60% of the sector's GWP[2].

In recent years non-life insurance has become an intrinsic part of the process of lending for residential and commercial real estate, as well as lending to enterprises as banks require insuring assets which serve as collateral for the loan claims. In addition, the need for protection against catastrophic risk, financial risk or civil liability causes that non-life insurance plays an important

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[1] According to the Act of 22 May 2003 on insurance activity in Poland the insurance sector is divided into two sections. The section I provides life insurance and the section II other personal and property insurance. Hereafter the non-life insurance sector stands for the sector which offers insurance classified in the section II.

[2] The share of premium for car comprehensive insurance and insurance of civil liability resulting from a car possession remained in the range from 64% in 2002 to 56% in 2016 [PIU 2012, 2017].

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role in management of enterprises. For these reasons, the efficient operation of non-life insurance companies is vital for the stability and profitability of the corporate sector and the state of household budgets.

In the last two decades, non-life insurance companies in Poland experienced some development opportunities as well as limitations in running their business operations. Poland's accession into the EU significantly expanded the possibilities to acquire new foreign capital investors, new technologies and customers, among others, enterprises set up by foreign corporations. The improvement of economic situation at that time was conducive to increasing the insurance premium. In turn, the indirect negative impact on the Polish economy coming from the global financial crisis of 2007–2009 and the crisis of public finances in the euro area significantly weakened the demand of corporations for property and liability insurance.

Competition in the sector, to some extent represented by the market concentration, also significantly impacted the performance of insurance companies and their efficiency. Excessive competition, especially recorded in the motor insurance segment in 2012–2015, was considered as the main reason for the deterioration of companies' earnings and an important source of risk for their stable operation [NBP 2015]. The decline in sector's profitability was so serious that in September 2015 the Polish Financial Supervision Authority (PFSA) called on insurance companies to adjust the prices of motor insurance policies to cover their costs. The PFSA action contributed to a significant increase in prices and value of collected motor insurance premium in the next year [UOKiK 2018].

The importance of the non-life insurance for the corporate sector and household budgets justifies the validity of the problem of assessing efficiency of non-life insurance companies and determination factors which affect its level. The analysis covers 29 insurance companies operating in Poland between 2002 and 2016 and is conducted on the basis of financial data of individual insurance companies published by the Polish Insurance

Association (PIU), the PFSA and the economic information platform – EMIS (www.emis.com). The macroeconomic data are provided by the Central Statistical Office (CSO). The Stochastic frontier analysis (SFA) was applied for the cost efficiency estimation and the panel data Tobit model with random effects for identification of factors impacting companies' efficiency.

The remaining part of this article has the following structure. The next section presents the situation of the non-life insurance sector in Poland, followed by the results of the literature review, and finally the data, methods and results of the research. The entire study is summarized in the conclusions.

NON-LIFE INSURANCE SECTOR IN POLAND

During the years 2002–2016 the number of operating non-life insurance companies decreased from 36 to 33. The substantial changes in the number took place before Poland's accession into the EU and had a significant impact on the sector's concentration calculated by the value of GWP (Fig. 1). The non-life insurance market was strongly concentrated in Poland. The share of the largest company (PZU) in the sector's GWP ranged from 56% in 2002 to 33% in 2016.

In the years 2002–2016 the non-life insurance sector comprised of about 20 and 10 entities controlled, respectively, by foreign and domestic investors. Initially the highest share in the sector's GWP was held by domestically-controlled companies (about 62% in 2002). However since 2009 the sector has become dominated by the foreign-controlled companies and their share in the sector's GWP rose to 59% in 2016. The majority of non-life insurance entities operated as joint-stock companies and their share in the sector's GWP ranged from 99% in 2002 to 94.5% in 2016. The remaining part of the non-life market was covered by mutual insurance companies[3].

The value of the non-life insurance GWP was systematically growing, except for the years 2011–2015, when companies intensively competed on the motor

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[3] The number of companies controlled by foreign investors changed from 22 in 2002 to 20 in 2007 and to 21 in 2016. The number of companies with the status of a joint-stock company decreased from 30 in 2002 to 25 in 2016. The remaining companies operate in the form of a mutual insurance company – TUW; the data based on statistics of the PSFA (https://www.knf.gov.pl/?articleId=57191&p_id=18).
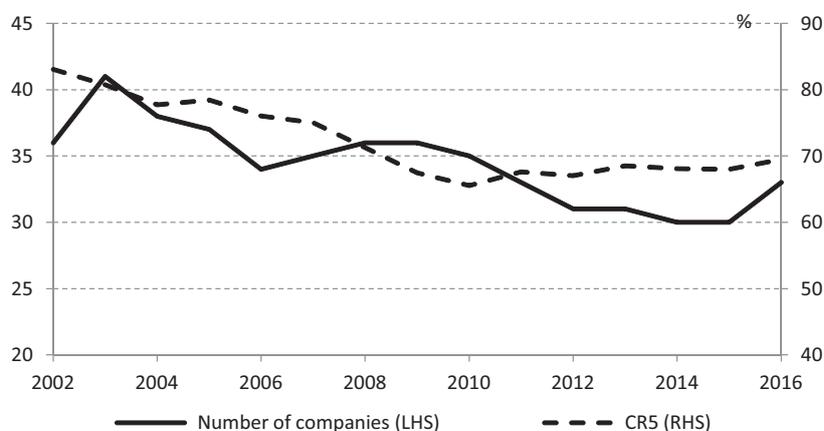
Fig. 1. Number of operating non-life insurance companies and the CR5 concentration ratio in Poland in 2002–2016
Source: Annual reports of the PIU.

insurance market, often underestimating the price of insurance policies. The PFSA warning of 2015 on the risk coming from the underestimation of insurance policy prices contributed to a significant increase in the premium in 2016. The value of the sector's assets was significantly affected by the companies' current activity, as well as the yield on Treasury bonds, which serve as their basic investment tool. Significant increase in the yield on five- and ten-year Treasury bonds in 2004 and 2009 to levels of around 7.5% and 6.4%, respectively, contributed to a reduction in the value of the bond portfolio and the value of non-life sector's assets. The profitability of the non-life insurance sector was considerably variable. The ROA rose from 3.9% in 2003 to 9.8% in 2006 and gradually decreased to 2.4% in 2016.

LITERATURE REVIEW

The efficiency of insurance companies has recently become the subject of many studies and is gaining considerable interest among economists. Most of the research was done on insurance companies operating in the highly developed countries, mainly in the USA and EU countries. Among others, Weiss [1991] using the SFA method and analyzing about 100 insurance companies in the USA in the years 1980–1984, stated that their technical efficiency level ranged from 67 to 88%. Bikker and van Leuvensteijn [2008] assessing efficiency of approximately 100 life insurance compa-

nies in the Netherlands with the SFA method in the period 1995–2003 found that the average cost efficiency in the sector was around 75%. The study of Cummins and Rubio-Misas [2006] showed that cost efficiency of the Spanish insurers in 1998 was relatively low and equaled to 30%.

However some differences in the efficiency scores can be noticed in studies about the same insurance industry. Fenn et al. [2008], using the SFA method, assessed the cost efficiency of the non-life insurance companies in the Netherlands at the average level of 94%, while Rai [1996], using the same method, found that efficiency of the overall Dutch insurance industry in the period 1988–1992 amounted to 63%. Some discrepancies appear when different methods are applied. Cummins and Zi [1998] and Eling and Luhnen [2010] based on the analysis of the insurance companies operating, respectively, in the USA in 1988–1992 and in 36 countries in 2002–2006 noticed that the efficiency assessments obtained by the SFA method were usually higher than those of the DEA method.

Another group of studies refer not only to the estimation of the insurance companies' efficiency, but also identify factors impacting it. Eling and Luhnen [2010] showed that the value of efficiency was negatively impacted by the size of the insurance company and positively by the level of its solvency. Cummins and Weis [1993] found that efficiency of the US property insurance companies in 1980–1988 depends on the value of companies' assets. The cost efficiency scores of larger

entities equaled to 90%, while the small and medium-sized entities 80%. Similarly Donni and Fecher [1997] found the technical efficiency in 15 OECD insurance industries in 1983-1991was positively impacted by the company's market share. The positive impact of the company's asset on the efficiency showed Davu-tyan and Klumpes [2008] testing insurance sector in the major European markets. Based on the research on the Polish non-life insurance companies in 2003–2007 Kozak [2010] noticed the positive impact of the GDP growth and the reduction of operating costs on compa-nies' efficiency. In addition, no relationship between the level of efficiency and the value of the company's GWP was found.

METHOD AND RESULTS OF THE RESEARCH

The idea of economic efficiency has its source in the microeconomic theory of the enterprise. It employs the concept of a production frontier. Two methods are used to determine the frontier and the level of efficiency: nonparametric and parametric. The most frequent option of the first one is the data envelop-ment analysis (DEA) developed by Charnes, Cooper and Rhodes [1978]. The most common version of the parametric methods is the stochastic frontier analysis (SFA), which was formulated by independent research groups, including Aigner et al. [1977] and Meeusen and van den Broeck [1977].

In the current study the SFA method was applied. The cost frontier is described by the trans-logarithmic function (eq. 1). The function requires a linear homo-geneity of input prices and the symmetry of second-or-der factors. To meet these conditions, the cost function for one output and two inputs is transformed into the form [Parmeter and Kumbhakar 2014]:

$$\ln\left(\frac{TC_i}{p_{2i}}\right) = \alpha_0 + \beta_1 \ln y_i + \frac{1}{2}\beta_2 \left(\ln y_i\right)^2 +$$

$$+ \beta_3 \ln\left(\frac{p_{1i}}{p_{2i}}\right) + \frac{1}{2}\beta_4 \left(\ln\left(\frac{p_{1i}}{p_{2i}}\right)\right)^2 + \quad (1)$$

$$+ \beta_5 \ln y_i \ln\left(\frac{p_{1i}}{p_{2i}}\right) + \beta_6 M_i + \mu_i + \eta_i$$

where for the company i:

TC_i – total operating cost;

y_i – assets;

p_{1i}, p_{2i} – prices of labor and capital;

M_i – dummy variable referring to specialization in motor insurance,

μ_i – non-negative cost inefficiency,

η_i – random error,

$\alpha_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ – parameters to be estimated.

The variable M_i is introduced to control for the essential characteristic of some non-life companies – specialization in motor insurance. The variable M_i equals 1 when the company i obtains more than 50% of the GWP out of the motor insurance (i.e. car com-prehensive insurance and insurance of civil liability resulting from car possession) and 0 otherwise. Fol-lowing Bikker and Leuvensteijn [2008] the prices of inputs, i.e. labor and capital, are specified, respective-ly, as the ratio of administrative costs to total assets and the ratio of acquisition costs to the GWP.

The current analysis covers 29 insurance compa-nies operating in Poland in the years 2002–2016. Sta-tistics describing individual, sectoral and macroeco-nomic variables used for the research are presented in Table 1. The data indicate that companies differ in terms of the value of their assets, and administrative costs and acquisition costs incurred for their opera-tions. Additionally, it can be noticed that they operate in the significantly volatile macroeconomic and secto-ral conditions with considerable amplitude of changes in rates of the GDP growth and inflation.

In the first stage of the research the cost efficiency scores were assessed. The results of estimation of the trans-logarithmic cost frontier (eq. 1) with the time-variable efficiency option are presented in Table 2.

Based on the cost frontier estimation, the scores of insurance companies' efficiency were determined (Ta-ble 3). They indicate that throughout the entire period the efficiency of individual companies was strongly diversified. The average difference between the maxi-mum and minimum efficiency scores amounted to 76 percentage points (p.p.) and the average interquartile range 22.8 p.p. The biggest difference between the highest and the lowest efficiency scores occurred be-fore the outbreak of the global financial crisis (77 p.p.)

Table 1. Descriptive statistics of variables used in the study

Variable	Number of observations	Average	Standard error	Minimum	Maximum
Assets (PLN thou.)	389	2 090 000	5 910 000	13 607	37 300 000
GWP (PLN thou.)	389	886 000	1 850 000	572	10 800 000
Acquisition cost (PLN thou.)	389	173 000	308 000	66	1 870 000
Administrative cost (PLN thou.)	389	81 589	200 000	257	1 300 000
Acquisition cost to GWP	389	0.26	0.22	0.01	2.13
Administrative cost to assets	389	0.07	0.07	0.001	0.43
M	389	0.53	0.50	0	1
CPI (%)	15	101.94	1.71	99.05	104.27
GDP growth (%)	15	103.68	1.51	101.40	107.00
Wage (PLN)	15	4 114	1 005	2 328	5 197
ROE (%)	15	16.35	5.23	8.90	29.10
CR5 (%)	15	0.72	0.05	0.66	0.83

GWP – gross written premium, M – specialization in motor insurance, Wage, ROE and CR5 respectively, average monthly wage, rate of return on equity and the share of five largest companies in the non-life insurance sector.

Source: Own calculations based on the CSO, the PIU and the PSFA data.

Table 2. Results of the trans-logarithmic cost frontier estimation

Variable	Coefficient	Standard error	z-stat.	$P > z$
$\ln y$	1.721[a]	0.288	5.97	0.00
$(\ln y)^2$	−0.046[a]	0.017	−2.76	0.01
$\ln(p_1/p_2)$	0.085	0.263	0.32	0.75
$[\ln(p_1/p_2)]^2$	0.077[a]	0.022	3.55	0.00
$\ln y \cdot \ln(p_1/p_2)$	0.036[b]	0.016	2.17	0.03
M	0.922[a]	0.229	4.02	0.00
Constant	−3.970[a]	2.476	−1.60	0.11
N (groups)	360 (29)	×	×	×
Wald $\chi^2(6)$	803.93	×	×	×
Prob. $> \chi^2$	0.000	×	×	×

a, b – statistical significance at the level of 1%, 5%, respectively.

Source: own calculations based on the CSO, the PIU and the PSFA data.

and the smallest in 2011–2016 (75 p.p.). In case of the first period the distribution of the efficiency scores could be explained by the extensive foreign investments and the entrance of foreign companies using advanced technologies and management strategies. The second period was characterized by the intensive competition on the motor insurance market, when the market was driven by the price strategy of the largest insurance company controlling approximately 35% of the market.

Table 3. Distribution of the non-life insurance companies' efficiency scores (%)

Year	Minimum	Quartile 1	Median	Quartile 3	Maximum
2002	5.6	9.9	23.8	31.6	82.7
2003	6.0	10.2	23.1	31.6	83.0
2004	6.4	10.7	23.9	32.5	83.4
2005	6.8	11.3	25.0	34.6	83.8
2006	7.3	11.9	25.8	35.5	84.1
2007	7.7	12.8	26.4	35.9	84.4
2008	8.2	13.1	26.9	36.4	84.8
2009	8.7	13.8	24.1	36.2	85.1
2010	9.2	14.4	25.0	37.1	85.4
2011	9.8	15.1	29.5	37.8	85.7
2012	10.3	15.8	30.3	38.7	86.0
2013	10.9	16.5	31.2	39.5	86.3
2014	11.5	17.2	32.0	40.4	86.6
2015	12.1	17.9	32.9	41.3	86.9
2016	12.7	18.7	33.8	42.1	87.2

Source: Own calculations based on the CSO, the PIU and the PSFA data.

In 2002–2016, the overall level of the insurance companies' efficiency increased. The minimum efficiency in the sector increased by 7.1 p.p. while the maximum only by 4.5 p.p. Additionally, the median for the sector increased by 10 p.p., which indicates that the group of the medium non-life insurance companies significantly improved their efficiency. The lowest improvements were achieved by the dominant insurance company, what put downward pressure on the efficiency of the group of large companies.

The distribution of efficiency scores shows that most of Polish non-life insurance companies operated with relatively low efficiency. High sector's average scores were driven by a few highly efficient large entities. Throughout the entire period the efficiency scores of three quarters of companies did not achieve even a half of the efficiency scores of the largest company in the sector.

The goal of the second stage of the research was to determine factors impacting the efficiency level. The relationship between individual, sectoral and macroeconomic variables and efficiency scores was tested with the panel data Tobit regression with random effects and the formula:

$$Z_i = \alpha_0 + \beta_j h_{i,j} + \gamma_t m_k + e_i \qquad (2)$$

where:
Z_i – efficiency score of the insurance company i;
$h_{i,j}$ – variable j specific for the company i;
m_k – the sectoral and macroeconomic factor k,
e_i – random error;
$\alpha_0, \beta_j, \gamma_t$ – coefficients to be estimated.

The results of the estimation indicate that efficiency is positively impacted by the increase in the scale of the company's operation measured by the GWP and the increase in the ratio of acquisition costs to the GWP (Table 4). Such relationships indicate that larger companies have better opportunities to improve efficiency by taking advantage of the economy of scale and reduction of operation costs. The positive impact of increasing acquisition costs suggests that expansionary

Table 4. Determinants of the efficiency of the non-life insurance companies

Variable	Full sample			Below efficiency median			Above efficiency median		
	coeff.	SE	z-stat.	coeff.	SE	z-stat.	coeff.	SE	z-stat.
Ln_GWP	0.006[a]	0.001	3.83	0.007[a]	0.001	4.77	0.007[a]	0.003	2.68
Acquisition/ GWP	0.010[a]	0.004	2.37	0.002[a]	0.004	0.61	0.013	0.009	1.54
Ln_CPI	−0.979[a]	0.053	−18.59	−0.838[a]	0.060	−13.95	−1.071[a]	0.078	−13.71
Ln_GDP	−0.293[a]	0.057	−5.15	−0.265[a]	0.062	−4.28	−0.315[a]	0.085	-3.70
Ln_Wage	0.129[a]	0.012	10.38	0.115[a]	0.013	8.58	0.140[a]	0.019	7.38
ROE	0.001[a]	0.000	2.85	0.001[c]	0.000	1.73	0.001[b]	0.000	2.16
CR5	−0.201	0.033	−6.13	−0.144[a]	0.036	−4.00	−0.234[a]	0.049	−4.75
Constant	4.508[a]	0.246	18.31	3.828[a]	0.280	13.66	4.826[a]	0.359[a]	13.45
N	360			360			360		
Groups	29			29			29		
Wald χ^2(7)	2520.5			1423.4			1369.3		
Prob > χ^2	0.00			0.00			0.00		

Ln_GWP – logarithm of GWP, Acquisition/GWP – acquisition costs over GWP, Ln_CPI – logarithm of CPI, Ln_PKB – logarithm of GDP growth, Ln_Wage – logarithm of the average wage in the insurance sector, ROE and CR5 – ROE and CR5 for the non-life insurance sector; a, b, c – statistical significance at the level of 1%, 5%, 10%, respectively.

Source: own calculations based on the CSO, the PIU and the PSFA data.

strategy backed by rising costs of promotion and remuneration for insurance agents could bring positive effects on the value of collected GWP and enhance the overall efficiency.

Stable economic conditions are more suitable for the growth in efficiency of the non-life insurance sector. Companies operate more efficiently in the environment of greater price stability and declining rate of the GDP growth, what is consistent with results of Kozak [2010]. Such relationships could result, among others, from changes in valuation of the Treasury bond portfolio, the main investment vehicle for non-life insurance companies. With the decline in the inflation rate, the value of the Treasury bond portfolio usually increases, what improves the company's financial performance.

However, a fall in the rates of inflation and the GDP growth could be also the symptoms of deteriorating economic situation in the country and an increase in risk in the enterprise and household sectors. Such situation justifies insurance companies to increase the value of premium to compensate for the risk and to improve their overall performance.

The intra-sector factors have also a significant impact on the efficiency of insurance companies. They operate more efficiently when profitability of the entire sector is improving and wages in the sector are rising. In turn, a positive reaction of efficiency to the decreasing concentration of the sector indicates that higher competition improves efficiency of the sector. This means that the non-life insurance sector follows the Efficiency Structure paradigm which states that more efficient and more competitive entities eliminate less effective competitors from the market and thus increase their market share and at the same time increase the overall efficiency of the sector. Such thesis could be supported by the fact that during analyzed period, the number of operating entities decreased and, at the same time, the efficiency of companies significantly increased (Table 3). It means that some of the least efficient companies were forced to exit the market or to merge with other more efficient entities.

CONCLUSIONS

The efficiency scores of the non-life insurance companies in Poland in the years 2002–2016 had an upward trend. The higher pace in the efficiency occurred in the group of medium-efficient companies and the lowest in group of the largest companies in the sector. Most insurance companies, however, were characterized by the low efficiency and their efficiency scores did not achieved even a half of the score of the largest company in the sector.

The research showed that the increase in the value of company's GWP and acquisition costs related to the GWP had a positive impact on the increase in efficiency. Higher efficiency was supported by sectoral factors, i.e. rising profitability and average wages in the sector, as well as an improvement in competition resulting from the lowering of the sector's concentration level. In addition, non-life insurance companies achieved higher efficiency in the context of declining rates of the GDP growth and inflation.

The above mentioned factors in a similar way contributed to the improvement in efficiency of the entire sector and two groups of companies – with higher and lower efficiency.

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EFEKTYWNOŚĆ ZAKŁADÓW UBEZPIECZEŃ MAJĄTKOWYCH I JEJ DETERMINANTY

STRESZCZENIE

Artykuł prezentuje ocenę efektywności 29 zakładów ubezpieczeń majątkowych w Polsce w latach 2002–2016 oraz wyznacza czynniki ją kształtujące. Do oszacowania efektywności wykorzystano metodę SFA, a model Tobita do identyfikacji jej determinant. Badania wskazały, że efektywność charakteryzuje się znaczną zmiennością, a jej wartości zmieniają się od 62,5% w 2002 r. do 65,8% w 2007 r. i 59,4% w 2016 r. Efektywność większości zakładów była mała, a średnia w sektorze była podwyższana wynikami niewielkiej grupy najbardziej wydajnych podmiotów. Na efektywność pozytywnie wpłynęła wartość pozyskiwanej przez zakład składki oraz ponoszonych przez nią kosztów akwizycji, wzrost rentowności i przeciętnego wynagrodzenia w sektorze ubezpieczeń majątkowych oraz spadek koncentracji sektora. Firmy działały efektywniej w środowisku obniżającej się dynamiki wzrostu PKB i stopy inflacji. Relacje te były istotne dla całego sektora, a także dla grup firm charakteryzujących się większą i mniejszą efektywnością.

Słowa kluczowe: Polska, ubezpieczenie majątkowe, efektywność kosztowa, metoda SFA