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Kazimierz Ortyński*
Jacek Wołoszyn**

Structure of technical efficiency of insurers in the life insurance industry in Poland

Abstract
The primary objective of the article was to examine the level and efficiency structure of insurance companies on life insurance market in Poland.
The study presents critical analysis of the insurance literature relating to technical efficiency of insurers, i.e. methods of estimating efficiency, the form of the efficiency frontier model, the choice of production factors and insurance production. The study used the methods of mathematical and econometric modelling in SFA method.
The results the technical efficiency study for 22 life insurance companies for a period between 2011-2020 using the SFA method, showed high average cost efficiency of insurers (0.9140) and lower profit efficiency (0. 8565). It was confirmed that a group of large companies achieved higher cost efficiency than the remaining companies, suggesting that large companies benefited from the scale of production. In contrast, higher average profit efficiency was recorded for the remaining companies.

Keywords: life insurance market, cost efficiency, profit efficiency, stochastic frontier analysis

JEL Classification: C52, D24, G22, L11

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* Professor (Prof Tit) at the Department of Finance and Insurance, Faculty of Economics and Finance of the Kazimierz Pułaski University of Technology and Humanities in Radom, Poland

** Assistant Professor at the Department of Computer Science and Teleinformatics, Faculty of Transport, Electrical Engineering and Computer Science of the Kazimierz Pułaski University of Technology and Humanities in Radom, Poland

Introduction

The Efficient Market Structure Hypothesis, represented primarily by Hicks (Hicks, 1935, pp.1-20) Demsetz (Demsetz, 1973, pp.1-9; Demsetz, 1974, pp.164-184) and Peltzman (Peltzman, 1977, pp.23-34), has a special place in the study of firm efficiency. This hypothesis suggests that the market structure in which firms operate is largely determined by their efficiency. It assumes a positive effect of concentration on the performance of firms-more efficient firms have lower costs (lower marginal costs) and thus earn higher profits. Increasing efficiency of firms leads to an increase in market concentration. In turn, an increase in a firm's market share roughly shows its higher operating efficiency, as well as its higher profitability. In other words, higher profits of firms with high market share result from their higher efficiency, which also affects their market power. The issue of measuring the efficiency of firms, including insurance companies, is among the rapidly developing research areas that use efficiency methods (Biener et al., 2015, pp. 703-714).

The use of the frontier analysis approach in the study of firm efficiency was pioneered by M. Farell (Farrell, 1957, pp.255-260), defining, among other things, technical efficiency as the ability of a firm to produce the maximum output from a given set of production factors, or to produce a given amount of output with minimum factor inputs. Currently, there are two mainstream approaches to measuring technical efficiency i.e. using parametric stochastic frontier models (SFA) (Aigner et al.,1977, pp.21-37; Meeusen and van den Broeck, pp.435-444) and the non-parametric deterministic data envelopment analysis - DEA (Chames et al., 1978, pp.429-444). SFA analysis determines the so-called efficiency frontier (the highest efficiency achieved) on the basis of the efficiency scores of all the companies studied, together with a comparison of this frontier with the performance of companies using the same set of inputs (production factor inputs). Thus, this analysis enables determination of the efficiency of those companies that are outside this frontier and enables to them appropriate decision making to improve their position (Chen and Lin, 2020, p.65-86).

The purpose of the article is to study the level and structure of the efficiency of life insurance companies in Poland.

The following research questions have been formulated in the study i.e. was the cost efficiency of the group of large companies significantly higher than the group of other insurance companies?

Based on the microeconomic theory of production, the article examines the technical efficiency of costs and profit efficiency of insurers operating in the life insurance sector. Statistical methods and econometric modeling in the SFA method were used to estimate the inefficiency of the companies.

The efficiency of the insurance companies studied was determined based on the Jondrov formula (Jondrov et al., 1982, pp. 233-238), which uses previously determined inefficiency values. The study was based on the annual data of selected 22 insurance companies in the life insurance sector in Poland from 2011-2020.

1. Technical efficiency of insurance companies-Review of selected empirical studies

The research conducted on the insurance literature on the technical efficiency of insurance companies confirms their diversity. These include, in particular, such issues as (Cummins and Weiss, 2000, pp. 803-810; Eling and Luhnen, 2009, pp. 1497-1509; Zata, 2019, pp. 40-51 and 55-79):

- efficiency estimation methods
- the form of the efficiency frontier model
- selection of production inputs and outputs.

Most studies in the developed markets have looked at cost efficiency and, to a limited extent, profit efficiency. One of two groups of methods was usually used, i.e. parametric (econometric method) or non-parametric (mathematical programming method).

The SFA method is based on the assumption that all companies in a given sector should be able to obtain efficiency at the level set by so-called "benchmark" companies, i.e. those using best practice methods. A characteristic feature of the SFA method is the separation of the variable that determines inefficiency from the variable that measures random disturbances, but this requires making separate assumptions about their distributions. The parametric method uses the functional form of the frontier values to estimate a given function (production function or translogarithmic cost function). This method allows to estimate the effective cost or production taking into account the stochastic nature of the input data (Aigner et al., 1997, pp. 21-37). The following models are distinguished within the parametric method: SFA (Stochastic Frontier Analysis), DFA (Distribution-Free Approach), TFA (Thick Frontier Approach) or FFA (Flexible Fourier Approach) – the approaches differ in their assumptions about the form of the distributions of the random variables modeling inefficiency and the variables reflecting the influence of random factors and measurement errors.

The non-parametric approach (mathematical programming methods) uses the DEA (data envelopment analysis) method, adapting linear programming techniques.

The SFA approach distinguishes applied forms of functional relationships such as: the linear production function, the Cobb-Douglass production function, the Leontief production function, tobit model functions and logistic regressions, and the more and more commonly used translogarithmic production function.

Among production factors, the cost of labour, the cost of capital or debt capital, have often been taken into account. In determining the type of products, the value-added approach for policyholders (those entitled under insurance contracts) is most often used.

Among the representative empirical studies in the insurance literature, the following should be noted.

Hardwick and Li (Hardwick and Li, 1997, pp. 37-44) studied the cost efficiency of life insurance companies in the UK from 1989 to 1993 using the SFA method. The authors showed that large companies were more efficient than smaller ones.

Klumpes (Klumpes, 2004, pp. 257-273) focused on studying cost and profit efficiency in the life insurance sector in the UK in 1994-1999. The author showed that insurers with direct sales, compared to those that distributed insurance using insurance intermediary institutions, achieved higher cost and profit efficiency.

Greene and Segal (Greene and Segal, 2004, pp. 229-247) analysed the relationship between cost efficiency and profitability in the U.S. life insurance market in 1995-1998, using data from 136 companies in a final panel model. The authors determined the average cost inefficiency of insurers at 20%, and showed that cost efficiency is crucial to their profitability. They confirmed that inefficiency was negatively correlated with ROE and ROA ratios, and that efficient companies had, on average, a higher cumulative return on capital and assets.

Bikker and Van Leuvensteijn (Bikker and Van Leuvensteijn, 2008, pp. 2063-2084) studied the relationship between efficiency and competition in the Dutch life insurance market between 1995 and 2003. The authors proved presence of great advantages resulting from production scale and from the relationship of inefficiency in the market with limited competition.

Eling and Luhnen (Eling and Luhnen, 2010, pp. 217-265) studied two approaches used in measuring efficiency, i.e. using econometric models, including the SFA method, and using mathematical programming, including the DEA method. Selection criteria for production inputs and products for measuring efficiency of insurers was also analysed.

Biener et al. (Biener et al. , 2016, pp. 703-714) studied the efficiency and productivity of Swiss insurers in the life insurance, non-life insurance and reinsurance markets from 1997 to 2013 using frontier models. The results showed that, among other things, the internationalization of the insurance business had a positive impact on the efficiency of insurers. It was also confirmed that firm size did not affect the efficiency of insurers.

Cummins et al. (Cummins et al., 2017, pp. 66-78) analysed the relationship between the financial stability of insurers and competition in 10 life insurance markets, in EU countries between 1999 and 2011. The results of the study indicated that competition increases the stability of life insurance markets by reallocating profits from inefficient insurers to efficient ones.

Porębski (Porębski, 2017, pp. 123-136) used the non-parametric DEA method to assess the technical efficiency of 15 non-life insurance companies in Poland in 2012-2015. The highest technical efficiency in the years studied was achieved by two insurance companies, namely PZU SA (100% according to the CCR model and BCC in 2015) and TUnŻ WARTA S.A. (60.13% according to the CCR model and 100% according to the BCC model in 2015).

Eling and Jia (Eling and Jia, 2018, pp. 58-76) studied the relationship between technical efficiency and business volatility in insurance companies from 16 European countries between 2006 and 2013. They found a negative correlation between technical efficiency and the probability of insurer insolvency. The effect of an insurer's turnover growth on its insolvency was also examined, suggesting the existence of a non-linear U-shaped relationship, in the non-life insurance sector (both negative and marginally high growth favour company insolvency).

Ortyński and Wołoszyn (Ortyński and Wołoszyn, 2021, pp. 61-77) determined the cost efficiency and profit efficiency using the SFA method of 18 insurance companies of the non-life insurance sector in Poland in 2011-2019. The study showed that the average cost efficiency was 0.6958, and the average profit efficiency was 0.8382. During the period studied, there was relatively higher variability in cost efficiency than in profit efficiency, and low correlation between the values of these efficiencies.

Bukowski and Lament (Bukowski and Lament, 2021, pp. 502-514) examined the relationship between insurers' financial efficiency, measured by ROE, and the share of insurers' gross written premium in the total premium of the life insurance company market, the premium retention ratio and the so-called combined ratio. The subject of the study was the data of 20 life insurers in Poland, from 2004 to 2019. The authors positively verified the hypothesis that the structure of the life insurance market has a positive effect on the financial efficiency of insurers.

2. Research method and statistics

Cost efficiency is derived from a cost function in which the cost depends on the prices of production inputs, outputs, a variable modeling inefficiency, and a variable determining the impact of the random component.

The cost function of an insurance company in the frontier model was defined as follows, following Ward (Ward, 2002, pp. 1959-1968) :

$C_{it} = f\{Y_{it}, w_{it}, e_{it}\}$ (1)

C_{it}- costs of the insurance company
Y_{it} – vector of the insurance company products
w_{it}- vector of factor prices (inputs)
e_{it}- random variable expressing the impact of independent random components
i-number of the insurance company (i=1, 2, ..., N)
t- number of the year (t=1, 2, ..., T)

It is assumed that the random variable e_{it} includes the following two components:

$e_{it} = u_{it} + v_{it}$, (2)

where:
u_{it} – an independent random variable, asymmetric and positive, modeling inefficiency;
v_{it} – an independent random variable, symmetric with respect to zero and reflecting the influence of random factors and measurement errors.

The frontier model assumes that the component expressing inefficiency $[u_{it}]$ is an independent random variable with an exponential distribution; while the random variable v_{it} is an independent variable with a normal symmetric distribution (with an average equal to zero and a constant variance).

By performing a logarithmic transformation of equation (1), the following expression was obtained:

$\ln C_{it} = f[lny_{it}, \ln w_{it}] + lnu_{it} + lnv_{it}$. (3)

In determining profit efficiency, the approach of efficiency of an alternative profit was adopted (alternative profit efficiency) (Delis et al., 2009, pp.6-8; Wicaksono and Mulyaningsih, 2019, pp. 371-373), which assumes the existence of a market with imperfect competition (Ortyński and Pypeć, 2021, pp.161-163), in contrast to the approach of frontier efficiency of the standard profit used in markets with perfect competition. The alternative approach takes into account differences in the quality of services provided by insurers and in information about the prices of insurance products.

The general model of the profit function is determined by replacing the variable with the variable, which is the net profit, in equations (1) and (3) i.e.:

$\pi_{it} = f[y_{it}, w_{it}, e_{it}]$ (4)

and

$\ln[\pi_{it}] = f[lny_{it}, lnw_{it}] - lnu_{it} + lnv_{it}$ (5)

While there are no major differences in the literature with regards to the selection of production factors (inputs), the views on determining insurance production (outputs) are not unanimous. In the article, the selection of insurance outputs was guided by the reasoning presented in the study by Bikker (Bikker, 2012, pp. 9-10), i.e. for new output, the amount of y_1 was used, which is the difference between the net written premium and the cost of net insurance business, and gross profit (this output represents insurance services to new customers); while for existing customers, y_2- the amount of investments (the state of deposits) was used as output .

A translogarithmic cost function (Eling and Luhnen, 2010, pp. 1508-1509; Alhassan and Biepke, 2016, pp. 889-890) was used to study cost (and profit) efficiency. The profit efficiency model exchanges tc for net income[1] π ; the cost function took the following functional form:

$$(\ln\frac{tc}{w_3})_{it} = \alpha_0 + \alpha_1(lny_1)_{it} + \alpha_2(\ln(y_2))_{it} + \alpha_3 0{,}5(lny_2)^2_{it} + \alpha_4 0{,}5\,((lny_1)^2)_{it} + \alpha_5(lny_1)_{it}\,(\ln y_2)_{it} + \beta_1(ln\frac{w_1}{w_3})_{it} + \beta_2(ln\frac{w_2}{w_3})_{it} + \beta_3 0{,}5\,((\ln\frac{w_1}{w_3})^2_{\ it} + \beta_4 0{,}5\,((ln\frac{w_2}{w_3})^2_{\ it} + \beta_5\left(ln\frac{w_1}{w_3}\right)_{it}\left(ln\frac{w_2}{w_3}\right)_{it} + \gamma_1(lny_1)_{it}\,(ln\frac{w_1}{w_3})_{it} + \gamma_2(lny_1)_{it}\,(\,ln\frac{w_2}{w_3})_{it} + \gamma_3\,(lny_2)_{it}\,(ln\frac{w_2}{w_3})_{it} + \gamma_4(lny_2)_{it}\,(ln\frac{w_1}{w_3})_{it} + v_{it} + u_{it} \tag{6}$$

where:

tc- net costs of insurance activity

y_1- net written premiums minus net costs of insurance activity minus gross financial result

y_2 - the amount of investments

w_1 - price of labour and business services

w_2 - price of capital

w_3- price of debt capital

v- independent random variable, symmetrical with respect to zero and reflecting the influence of random factors and measurement errors

u- independent random variable, asymmetric and positive, modeling inefficiency

α, β, γ- parameters of model (6).

In order to ensure the linear homogeneity of the translogarithmic cost function with respect to production factor prices, a normalisation of costs (tc) (as well as profit (π) and prices (w_1, w_2) by the chosen price, in this case by w_3, was carried out.

[1] For the profit function, the inefficiency term changes in equation (6) to "-u".

The presence of inefficiency in the model is tested by the γ variance ratio, i.e. $\gamma = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2}$.

This ratio determines the share of the variance (variability) of the random variable u in the variance (variability) of the random variable e. This ratio takes values between 0 and 1, and values closer to 1 indicate that most deviations from the frontier (optimal) efficiency can be associated with management inefficiency. Efficiency quantities were determined using the formula (Battese and Coelli, 1995, pp. 326-327)

$$TE_{it} = exp(-\hat{u}_{it}) \quad (7)$$

where:

TE_{it}- technical efficiency

i-means the number of the insurance company (i=1, 2, ..., N)

t-number of the year (t=1, 2, ..., T)

Efficiency values are between 0 and 1, closer to 1 mean higher efficiency.

Table 1. Non-transformed primary variables in cost and profit function models

Variables	Description
tc	Net costs of insurance activity
π	Net financial result
y_1	Net written premium minus net costs of insurance activity minus gross financial result
y_2	The amount of investments
w_1- price of labour	Ratio of net cost of insurance activity to assets
w_2- price of capital	Net financial result to equity ratio
w_3- price of debt capital	Ratio of gross claims paid to gross technical provisions

Source: own work

The study used data from 22 life insurance companies in Poland between 2011-2020, included in the "Annual Reports" of the Polish Insurance Chamber (PIU) in Warsaw[2]. The companies provided their statistical data for all 10 years to the "Annual Reports" of the Polish Insurance Association (PIU) in Warsaw. The gross premiums written of the studied insurance companies accounted for more than 99%

[2] The subject of the study was the data of the following insurance companies: AEGON TU na ŻYCIE S.A., TU ALLIANZ ŻYCIE POLSKA S.A., AVIVA tunż S.A., AXA Życie TU SA, tunż CARDIF POLSKA S.A., COMPENSA TU na ŻYCIE S.A. Vienna Insurance Group, stunż ERGO HESTIA SA, TU na ŻYCIE EUROPA S.A., GENERALI ŻYCIE T.U. S.A., TU INTER-ŻYCIE POLSKA S.A., METLIFE tunżir S.A., NATIONALE-NEDERLANDEN tunż S.A., OPEN LIFE TU ŻYCIE S.A., PKO ŻYCIE TU S.A., PZU ŻYCIE SA, TUW REJENT-LIFE, SANTANDER AVIVA TU na ŻYCIE S.A., SIGNAL IDUNA ŻYCIE POLSKA TU S.A., UNIQA TU na ŻYCIE S.A., UNUM ŻYCIE tuir S.A., VIENNA LIFE TU na ŻYCIE S.A. Vienna Insurance Group, tunż WARTA S.A.

of this insurance sector's gross premiums written in 2020. The dataset used was a balanced panel of annual data.

In the study, the estimation of the parameters of the translogarithmic cost function and the profit function (Equation 6) of the SFA model, as well as the estimation of the random component (v_{it}) and the part determining the time-varying inefficiency $\hat{u}_{it}$, were performed by the maximum likelihood method using R software (Battese and Coelli, 1992, , pp. 153-169; Battese and Coelli, 1995, pp.325-332), and the efficiency values were determined from Equation 7.

In addition, Microsoft Excel was used for calculations.

Table 2. Descriptive statistics of non-transformed variables

Variables	Average value	Standard deviation	Minimum Value	Maximum Value	Number of observations
Net costs of insurance activity (thousand PLN)	238 662	244 996	1 117	1137 568	220
Net financial result (thousand PLN)	113832	324 291	-140 507	1845 811	220
Products					
y_1 -(thousand PLN)	732 709	1 144 021	519	6 875 907	220
y_2 (thousand PLN)	4 017 590	5 910 051	25 988	28818225	220
Prices of production factors					
w_1	0.131862866	0.184864921	0.003712672	1.134840602	220
w_2	0.02760051	0.627919362	-7.535	0.568083401	220
w_3	0.340372342	0.323619285	0.0009398	2.454373338	220

y_1 - Net written premium minus net costs of insurance activity minus gross financial result
y_2 - The amount of investments
w_1 - Ratio of net cost of insurance activity to assets
w_2 - Net financial result to equity ratio
w_3 - Ratio of gross claims paid to gross technical provisions
All monetary values are expressed in constant 2011 prices (deflator-CPI).

Source: own work based on KNF, PIU and CSO data.

3. Results of empirical study

In estimating the SFA model for the cost function and profit function using the maximum likelihood method, it was assumed that the random variable u_{it} is a variable with an exponential distribution.

Table 3 . Results of SFA model estimates for cost function and profit function

Variables	Parameters	Cost effectiveness			Profit effectiveness		
		Estimators	Standard deviation	t-value	Estimators	Standard deviation	t-value
Constant	α_0	-0.0954	0.0143	-6.66	-0.1903	0.0123	-15.47
$(\ln y_1)_{it}$	α_1	0.0156	2.7204	0.01	-9.5042	5.0943	-1.87
$\ln(y_2))_{it}$	α_2	-0.4464	3.5009	-0.13	-45.5685	7.3832	-6.17
$0{,}5(lny_2)^2_{it}$	α_3	-1.2271	1.1171	-1.10	0.3686	0.8478	0.43
$0{,}5\ ((lny_1)^2)_{it}$	α_4	0.6284	0.9369	0.67	-0.3865	0.4425	-0.87
$(lny_1)_{it}\ (\ln y_2)_{it}$	α_5	-0.7527	1.8721	-0.40	0.6663	0.9830	0.67
$(ln\frac{w_1}{w_3})_{it}$	β_1	1.9374	0.7382	2.62	-52.9405	4.3403	-12.20
$(ln\frac{w_2}{w_3})_{it}$	β_2	-2.8554	2.7429	-1.04	25.2081	3.4048	7.40
$0{,}5\ ((\ln\frac{w_1}{w_3})^2{}_{it}$	β_3	-0.1466	0.0265	-5.52	-0.1005	0.6156	-0.16
$0{,}5\ ((ln\frac{w_2}{w_3})^2{}_{it}$	β_4	0.1493	0.1223	1.22	-0.0258	0.0128	-2.01
$\left(ln\frac{w_1}{w_3}\right)_{it}\left(ln\frac{w_2}{w_3}\right)_{it}$	β_5	0.6700	0.7868	0.85	-25.2806	3.4015	-7.43
$(lny_1)_{it}\ (ln\frac{w_1}{w_3})_{it}$	γ_1	0.0744	0.3756	0.20	13.3852	7.3474	1.82
$(lny_1)_{it}\ (\ ln\frac{w_2}{w_3})_{it}$	γ_2	-0.4083	3.8383	-0.11	0.4845	0.2117	2.20
$(lny_2)_{it}\ \ (ln\frac{w_2}{w_3})_{it}$	γ_3	4.1165	5.4074	0.76	67.6102	11.5027	5.88
$(lny_2)_{it}\ (ln\frac{w_1}{w_3})_{it}$	γ_4	-2.2473	0.3910	-5.75	-0.2143	0.3404	-0.63
(sigma u)^2		0.0091	0.0027	3.32	0.0362	0.0064	5.70
(sigma v)^2		0.0073	0.0016	4.62	0.0080	0.0014	5.84
LR test: sigmau2=0 (inefficiency does not affect the model); H0: sigma u2=0; LR test value: 53.14 at 16 degrees of freedom with p-value: 0.99999; critical value chi2= 26.2962 at α=0.05;					LR test: sigma u2=0 (inefficiency does not affect the model); H0: sigmau2=0; LR test value: 215.916 at 16 degrees of freedom with p-value: 1; critical value of chi2= 26.2962 at α=0.05;		
log-likelihood: 138.5732					log-likelihood: 57.2552		
value of the variance parameter γ: 0.5549					value of the variance parameter γ: 0.8190		

Source: own calculations

The test statistic of the LR log-likelihood quotient reached a value greater than the critical value of the chi2 test, which means that the null hypothesis should be rejected and it can be assumed that inefficiency affected the estimators of the variables in the model.

The variance coefficients (0.5549 for the cost function and 0.8190 for the profit function) indicate that the residual component structure is dominated by the component depicting inefficiency, which means that the study legitimately used the SFA method instead of deterministic methods.

Table 4. Average cost efficiency and profit efficiency from 2011 to 2020

Years	Cost effectiveness		Efficiency of profits	
	Average value	Standard deviation	Average value	Standard deviation
2011	0.9059	0.0684	0.8583	0.1150
2012	0.9170	0.0541	0.8589	0.1285
2013	0.9030	0.1093	0.8547	0.1116
2014	0.9006	0.0682	0.8396	0.1294
2015	0.9156	0.0582	0.8667	0.1004
2016	0.9278	0.0265	0.8678	0.1160
2017	0.8951	0.1481	0.8773	0.1036
2018	0.9182	0.0566	0.8698	0.1113
2019	0.9294	0.0445	0.8699	0.1148
2020	0.9279	0.0328	0.8025	0.2401
Average value	0.9140	0.0745	0.8565	0.1317

Source: own calculations

The average cost efficiency of 0.9194 indicates that, on average, insurers in the life insurance sector incurred more than 8% higher costs versus a benchmark insurer, i.e. using the principles of so-called best practice. On the other hand, the average profit efficiency was at the level of 0.8565, i.e. on average insurers made more than 14% lower profits than the so-called benchmark insurers, i.e. when applying optimal proportions of inputs of production factors and their prices. However, there was no clear trend of changes in the analysed efficiencies during the considered period.

Pearson's linear correlation coefficient between cost efficiency and profit efficiency was 0.0282, which means a very low correlation. This suggests that cost efficiency does not significantly affect profit efficiency. The literature indicates that revenue may have a greater impact on profit efficiency than company costs (Rogers,1998, pp. 477-482).

Due to the large differences in the revenues of the studied companies, an analysis of the efficiency differential between large and smaller insurance companies was conducted.

Table 5. Average cost efficiency and profit efficiency of large and other insurers

	Smaller companies (n=170)	Large companies (n=50)	Difference in Effectiveness	Test-u U~N(0,1)
Average cost effectiveness	0.9073	0.9371	-0.0298	u=-3.9822
Cost efficiency variance	0.0068	0.0008		x
Average profit efficiency	0.8775	0.7853	0.0922	u=2.5589
Profit efficiency variance	0.0117	0.0305		x

Hypothesis HO: average value (smaller companies) = average value (large companies); while hypothesis H1: average value (smaller companies) ≠ average value (large companies). The criterion for grouping of the insurers was gross premiums written in 2020; large companies included the following insurance companies: Aviva Życie SA, Compensa Życie SA, Nationale-Nederlanden SA, PZU Życie SA, Warta TUnŻ SA; significance level α=0.05.
Source: own calculations

The data in Table 5 above indicate higher average cost efficiency for large companies and higher average profit efficiency for smaller companies. The-u test showed statistically significant differences between average values in cost efficiency and profit efficiency between large and smaller companies, with a significance level of 5%. Relatively high cost efficiency for large companies means better utilisation of their scale of operations, which lowers their costs. This most likely indicates that mergers and consolidations, by increasing their scale of operations, contribute to increasing their cost efficiency.

Conclusions

The results of the study of the technical efficiency of 22 life insurance companies using the SFA method confirmed the hypothesis of their high cost efficiency (with an average value of 0.9140 and a variance of 0.0745, with differential variation in efficiency from year to year) and lower profit efficiency (with an average value of 0, 8565 and a higher average variance: 0.1317 , with fluctuations in efficiency without a clearly defined direction of change).

It was confirmed that the group of large insurers achieved higher cost efficiency than the group of smaller companies, suggesting that large companies achieved benefits from the scale of production. In contrast, higher average profit efficiency was recorded by the so-called "smaller" companies.

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