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Market Power of Non-Life Insurers in Poland*

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Abstract:

Purpose: *The subject of the research in the article is market power of non-life insurers. The purpose of this study was to examine market power of non-life insurers in Poland and the factors affecting it.*
Design/Methodology/Approach: *The empirical investigations are carried out in three stages. Using annual firm level data on 18 non-life insurance companies from 2011 to 2019, the author first estimated the parameters of the translogarithmic cost function using the between-group method to determine marginal costs. In the second stage, the Lerner index has been designated. The final stage involves the econometric modeling to identify determinants of market power of the insurers under study and theoretical justifications of model variables. The results of the study suggest the presence of high market power of insurers in the non-life insurance market.*
Findings: *The results of the study suggest the presence of high market power of insurers in the non-life insurance market. The panel regression analysis identified two explanatory variables that significantly affect market power in this insurance sector, i.e., company size and technical cost efficiency*
Practical Implications: *Regulatory authorities should be directed towards enhancing to identify the sources of market power and devise policies to address their effects in the non-life market.*
Originality/Value: *This study presents the first application of non-structural measure of market power of non-life insurers in Poland.*

Keywords: *Market power, Lerner index, competition, non-life insurance industry in Poland.*

JEL codes: *D4, D21, G22, L11.*

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1. Introduction

Mergers and acquisitions occurring for several decades in many countries, including the EU countries, have resulted in greater consolidation of companies and the level of integration. An increase in concentration, the occurrence of monopolistic competition, a reduction in the degree of competition and an increase in market power of companies are the side effects of these processes. The issue of market power and the factors affecting it is related to the nature of competition in each market. In less competitive markets, firms with market power are likely to seek to price their products above their marginal costs, which may result in resource allocation losses, managerial inefficiencies, or market instability.

The subject of the study is the issue of market power of non-life insurers. The aim of the study was to examine market power of non-life insurers in Poland and the factors affecting it. The study used the Lerner index as a measure of market power, estimated the translogarithmic cost function to determine marginal costs, and applied the econometric modeling to identify determinants of market power of the insurers under study.

2. Characteristics of Selected Empirical Studies Worldwide

The vast majority of empirical insurance literature refers to the study of competition issues in insurance markets, with a limited focus on the analysis of insurers' market power. Two research approaches (i.e., structural and non-structural) are adopted in assessing the nature of competition in financial markets, including insurance markets. The former is related to the SCP paradigm (Mason, 1939; Bain 1951) and the concept of efficient market structure (Demsetz, 1973; Peltzman, 1977). In this approach, competition is determined by the structure of the market, and an increase in concentration results from the growing efficiency of companies which altogether leads to less competition in the market. This approach is reflected in the works of Fenn *et al.* (2008), Kasman and Turgutlu (2008).

The unstructured approach, which derives from the New Empirical Industrial Organization research stream, assesses competition through direct observation of how firms operate. According to this theory, firms are not seen as passive actors, differing only in size, but are active decision makers with a range of different strategies. The market structure is formed in an evolutionary manner and is influenced by a number of market characteristics and the behaviour of firms themselves. The concept assumes that the level of competition does not always depend solely on the level of concentration, but also on such market characteristics as dynamic barriers to entry and exit dictated by regulations.

This approach mainly relies upon the Panzar-Rosse model (1987), the Lerner index (1934) and the Boone index (2008) to study competition. In the insurance literature of this stream, the most noteworthy studies using the Panzar-Rosse model include the

publications of Murat *et al.* (2002), Kasman and Turgutlu (2008), Jeng (2015), Alhassan and Biepke (2016). The studies of market power of the financial sector firms mainly focus on the banking industry. Fernandez de Guevara *et al.* (2005), studied the evolution of market power in major EU markets between 1992 and 1999. The study estimated empirically the Lerner index (a measure of market power) and its determinants, including the size of a bank, cost efficiency, bank market share. The study found, among other things, that the size of a bank and operating efficiency were important explanatory variables for the value of the Lerner index.

Turk-Ariss (2010) studied the extent to which market power of banks affects banks' efficiency and financial stability using data of 821 banks from 60 developing countries during 1999-2005. The results of the study confirmed the existence of a strong negative correlation between cost efficiency and market power and a significant positive correlation between market power and profit efficiency.

One of the key studies of market power of insurers is a publication by Alhassan and Biepke (2019). Using data from 79 non-life insurers in South Africa from 2007-2012, the authors estimated the Lerner index as a measure of market power and identified its determinants. Variables such as the size of an insurer, their cost efficiency, product diversification, market concentration, insurance leverage, and the degree of reinsurance had a significant impact on the Lerner index.

3. Data and Model

The study uses the non-structural measures of competitiveness originating from the research stream of the New Empirical Industrial Organization.

3.1 The Lerner Index and Marginal Cost

The study estimates market power of insurers and attempts to empirically identify the sources of insurers' market power. In order to determine market power of insurers, the empirical research results of Turk-Ariss (2010), Alhassan and Biepke (2019) were relied upon, who used the Lerner Index (Lerner 1934). The Lerner index measures a firm's ability to price above marginal cost in a competitive market. It takes values between 0 and 1, where the zero value means that the price equals marginal cost (perfectly competitive market), the value of 1 means that the price exceeds marginal cost (monopoly market), and the values between 0 and 1 indicate monopolistic competition.

The classic Lerner index of market power of firms is defined as follows (Turk-Ariss, 2010, p. 767):

$$IL_{it} = \frac{p_{it} - mc_{it}}{p_{it}} \tag{1}$$

where:
p_{it}-price (average of insurance products) is set by the i-th insurer in the year t;
mc_{it}-marginal cost of the i-th insurer in the year t;
i-number of the insurer (i= 1, 2,...,18);
t-number of the year (t= 1, 2,...,9).

Similar to the banking markets, it is assumed that the aggregate product (insurer's output) is represented by assets (total assets), and the price of the aggregate product is determined as the ratio of insurer's income (the sum of net premium earned and investment income) to assets. On the other hand, the marginal cost was determined in a two-step process - first, the parameters of the translogarithmic cost function were estimated and then its appropriate values were determined. The following form of translogarithmic cost function was adopted after Eling and Luhnen (2010), Alhassan and Biepke (2019):

$$\ln\left(\frac{tc}{w_2}\right)_{it} = \alpha_0 + \alpha_1 ln(y)_{it} + 0{,}5\alpha_2 (lny)_{it}^2 + +\beta_1 ln\left(\frac{w_1}{w_2}\right)_{it} + \beta_2 ln\left(\frac{w_3}{w_2}\right)_{it} + 0{,}5\beta_3 (\ln\frac{w_1}{w_2})_{it}^2 + 0{,}5\beta_4 (ln\frac{w_3}{w_2})_{it}^2 + \beta_5 ln\left(\frac{w_1}{w_2}\right)_{it} \ln\left(\frac{w_3}{w_1}\right)_{it} + \gamma_1 ln(y)_{it} ln\left(\frac{w_1}{w_2}\right)_{it} + \gamma_2 ln(y)_{it} ln\left(\frac{w_3}{w_2}\right)_{it} + \epsilon_{it} \quad (2)$$

where:
tc- net cost of the insurance business;
y- assets (aggregate product);
w_1- price of labour and business services;
w_2- price of debt capital;
w_3- price of capital;
α, β, γ- model parameters based on equation (2);
ϵ_{it}- random variable expressing the impact of independent random components.

To ensure linear homogeneity of the translogarithmic cost function with respect to the prices of production factors, the cost (tc) and prices(w_1, w_3) were normalised by the chosen price, in this case by price 2 (Turk-Ariss, 2010). All monetary values were recalculated using a deflator, i.e.. CPI with a 2011 base. The marginal cost was determined from the first derivative of the estimated translogarithmic cost function relative to the aggregate product (Turk-Ariss, 2010), i.e.:

$$mc_{it} = \frac{\partial tc_{it}}{\partial y_{it}} = \frac{tc_{it}}{y_{it}} \{\alpha_1 + \alpha_2 lny_{it} + \gamma_1 \ln\left(\frac{w_1}{w_2}\right)_{it} + \gamma_2 \ln\left(\frac{w_3}{w_2}\right)_{it}\}. \quad (3)$$

The study used information of 18 insurance companies (joint stock companies) of the non-life insurance in Poland for the years 2011-2019, which provided their statistical

data to the "Annual Reports" of the Polish Insurance Association (PIA) in Warsaw for all 9 years[2].

Table 1. *Non-transformed variables in the translogarithmic cost function model*

Variables	Description
tc	Net cost of business
y	Asssets
w_1 - labour price	Net cost of business ratio
w_2-price of debt capital	Invested income to gross total reserves (unearned premiums and outstanding claims) ratio
w_3-equity capital price	Net profit to equity capital ratio

Source: *Own work*

The gross written premium of the studied insurance companies accounted for more than 85% of the gross written premium of this insurance division in 2019. The dataset used was a balanced panel of annual data. In addition, The Polish Financial Supervision Authority (PFSA) and Central Statistical Office (CSO) data were used. Gretl and Microsoft Excel software were used for calculations.

Table 2. *Descriptive statistics of non-transformed variables*

Variables	Mean value	Standard deviation	Minimum Value	Maximum Value	Number of observations
Net costs of business (000 PLN)	365 356	590 794	1 144	2 879 436	162
Product					
y - Asssets (thousands PLN)	3 746 819	7900161	20 936	40 820 281	162
Prices of production factors					
w_1- labour price	0.14371993	0.09198323	0.01787487	0.59443636	162
w_2- price of debt capital	0.04792218	0.04745583	-0.0147425	0.37364127	162
w_3- equity capital price	0.04840016	0.17446890	-0.9738684	0.41651260	162
Notes: All monetary values are expressed in constant 2011 prices (deflator-CPI)					

Source: *Own work based on PIA and CSO data*.

3.2 Linear Regression Model - Determinants of Market Power

In an attempt to determine the sources of market power of insurers, the research results from the following publications were used:

[2]*The following insurance companies were the subject of the study: Allianz Polska SA, Aviva General SA, Compensa SA, DAS SA, Ergo Hestia SA, Euler Hermes SA, Europa SA, Generali SA, Inter Polska SA, Interrisk SA, KUKE SA, Link 4 SA, Partner SA, PTR SA, PZU SA, Signal Iduna Polska SA, Uniqa SA, Warta SA.*

(Fernandez de Guevara *et al.*, 2005; Turk -Ariss, 2010; Cummins *et al.*, 2017; Alhassan and Biepke, 2019).

In the model determining factors that affect market power (the Lerner index), explanatory variables such as company size, technical efficiency, market concentration, insurance leverage, share of reinsurance premium in gross written premium, and share of foreign capital in the share capital of domestic insurers were analysed at the preliminary stage.

How company size affects its market power can be considered in two aspects. On the one hand, large firms gain from the benefits of the scale of production, while on the other hand, monitoring the large scale of business operations increases their production costs. The variable representing the company size is expressed as the natural logarithm of assets.

Changes in the value of the variable expressing technical cost efficiency will affect the company's profit (production costs), its production price, as well as its turnover volume and consequently its market power. The variable measuring the level of market concentration was included in two variants, i.e., as the CR5 index (market share of the five largest firms) and using the Herfindahl-Hirschman index. According to the SCP hypothesis (Mason, 1939; Bain, 1951) higher market concentration may increase the likelihood of collusion between large firms e.g., in terms of prices or margins (higher prices) and thus affect their market power. Changes in insurance leverage (the ratio of technical reserves to assets) may affect a firm's cost of funding as well as the price of insurance products and thus affect its market power.

The variable representing the amount of reinsurance utilisation through the functions of reinsurance (increasing underwriting capacity, stabilising the ceding company's claims, reducing the impact of catastrophe claims on its financial performance) affects the insurer's claims costs and benefits, and thus its market power.

The variable characterising the share of foreign capital in the share capital of domestic firms is a zero-one variable (1 for foreign capital share more than 50% and 0 otherwise). The characteristics of firms with dominant foreign capital tend to be competitive pricing and seeking to increase market share (Alhassan and Biepke, 2019). The linear regression model of determinants of market power of non-life insurers took the following analytical form:

$$IL_{it} = \alpha+\beta_1 Size_{it}+ \beta_2 ET_{it}+\beta_3 Concent_t+\beta_4 Lev_{it}+\beta_5 Reins_{it}+\beta_6 Owner_{it}+\epsilon_{it} \quad (4)$$

where:
IL_{it}- the Lerner index;
$Size_{it}$- -size of an insurer;
ET_{it}- technical efficiency;
$Concent_t$- market concentration;

Lev_{it}- insurance leverage;
$Reins_{it}$- reinsurance ratio;
$Owner_{it}$- zero-one variable: 1- share of foreign capital in the share capital more than 50% or 0- in other cases;
α, β, - structural parameters of the model;
ϵ_{it}- random variable expressing the influence of independent random components.

Table 3. *Variables in the linear regression model*

Variables	Description
IL	The Lerner index representing market power, determined by equation (1)
Size	A variable defined as the natural logarithm of assets
ET	Technical efficiency of costs determined from the translogarithmic function of costs3
Concent	A variable measuring the degree of concentration in the non-life insurance market (CR5 or Herfindahl-Hirschman index)
Lev	Insurance leverage (ratio of gross technical provisions to assets)
Reins	Reinsurance ratio (ratio of ceded reinsurance premium to gross written premium)
Owner	Zero-one variable: taking the value of 1 if the share of foreign capital in the share capital was more than 50% or 0- in other cases

Source: *Own work.*

4. Empirical Findings

4.1 The Lerner Index and Marginal Cost

Table 4 presents the estimation results for the translogarithmic cost function model (equation 2). Parameter estimation of the translogarithmic cost function was performed using the between-group method. With this estimation method, the model variables are replaced by the average values in period t for individual insurance companies. The obtained values of the estimators $(\alpha_1, \alpha_2, \gamma_1, \gamma_2)$ of the above translogarithmic cost function allowed determination of the value of marginal cost based on equation (3) and then the Lerner index using equation (1).

Table 5 presents changes in marginal cost, prices, and the Lerner index from 2010 to 2019. Between 2011 and 2019, the mean value of marginal cost increased by more than 25%, while the mean value of price showed a downward trend. This was reflected in the downward trend of the Lerner index. The mean Lerner index value of 0.9368 for 2011-2019 is interpreted in a way that insurers priced insurance products more than 93% above their marginal cost of production. This indicates their strong market power and less competitive pressure in the market.

[2]*The values of the technical cost efficiency of non-life insurers were taken from the study by K. Ortyński, J. Wołoszyn (2021) titled: " Efektywność techniczna ubezpieczycieli non-life "(Technical efficiency of non-life insurance companies) ", submitted for publication.*

Table 4. *Results of the estimation of the translogarithmic cost function model using the between group method for the non-life insurance market in Poland in 2010-2019*

	Dependent variable: ln(tc/w2), between group method estimation (between) (N=18)				
Variables	Estimators	Standard error	t-Student	p-value	Significance level
Const	70. 3321	9.18729	7.655	1.73e-005	***
lny	-2.99919	0.444871	-6.742	5.09e-05	***
$(lny)^2$	0.0418599	0.0083394	5.020	0.0005	***
ln(w1/w2)	-7.14023	1.89388	-3.77	0.0037	***
$(ln(w1/w1))^2$	-0.862749	0.0729464	-11.83	3.35e-07	***
lny*ln(w1/w2)	0.527976	0.0882913	5.980	0.0001	***
lny*ln(w3/w2)	0.165718	0.0826154	2.006	0.0727	*
ln(w3/w2)	-3.510069	1.70577	-2.058	0.0666	*
Arithmetic mean. of the dependent variable: 24.57736			Standard deviation of dependent variable: 0.650848		
Test for normality of the residuals distribution- Null hypothesis: the random component has a normal distribution Test statistics: Chi-square (2)= 4.410048 with p-value= 0. 110224 *** significance level α< 0,01 * significance level α< 0,1					

Source: *Own calculations using Gretl software.*

Table 5. *Marginal cost, prices and market power of insurers from 2010 to 2019*

	Marginal cost(mc)		Price (p)		the Lerner index[(p-mc) /p] (market power)	
Years	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
2011	0.01816	0.1345	0.43001	0.20420	0.5118	0.04639
2012	0.01752	0.01145	0.40771	0.15682	0.95669	0.02972
2013	0.01842	0.01071	0.38537	0.14913	0.94883	0.04286
2014	0.01492	0.00939	0.34666	0.15140	0.95270	0.04767
2015	0.01686	0.01189	0.32513	0.15370	0.95072	0.03268
2016	0.024131	0.02306	0.30393	0.17263	0.91130	0.09502
2017	0.019378	0.01178	0.32633	0.15584	0.92904	0.06581
2018	0.02235	0.01311	0.34912	0.15307	0.92827	0.05550
2019	0.02287	0.01359	0.34059	0.17824	0.90163	0.14215
Mean	0.01940	0.01365	0.35721	0.16540	0.93679	0.07140

Source: *Own calculations.*

The data of Table 6 indicate higher mean marginal cost and higher mean price of insurance products in firms with more than 50% foreign ownership than in firms with more than 50% domestic ownership. In contrast, the value of the u-test suggests the presence of non-significant differences between the mean values of the Lerner index of insurers with more than 50% domestic ownership and insurers with more than 50% foreign ownership, with significance level of less than 1%. This suggests that insurers

with dominant domestic ownership as well as those with dominant foreign ownership operate with similar cost structures.

Table 6. *Mean marginal cost, mean price and market power of insurers by capital ownership structure*

	Companies with more than 50% of domestic capital in the company's share capital (number of observations= 36)	Companies with more than 50% of foreign capital in the company's share capital (number of observations= 126)	Mean Difference	U Test U~ N(0,1)	Significance level
Mean of marginal cost (mc)	0.01097	0.02181	-0.01084	-5.871	
Variance of marginal cost	0.0000670629	0.000194796	x	x	x
Mean of price (p)	0.24753	0.38854	-0.14101	-4.445	
Variance of price	0.029813	0.022435	x		x
Mean of market power (the Lerner Index)	0.94070	0.93509	0.00561	0.4125	***
Variance of market power	0.00519294	0.0051302	x		x

Hypothesis HO: *Mean value (firms with more than 50% domestic capital share) = mean value (firms with more than 50% foreign capital share); while hypothesis H1: mean value (firms with more than 50% domestic capital share) ≠ mean value (firms with more than 50% foreign capital share).*

**** with significance level α< 0.01*

Source: *Own calculations.*

4.2 Linear Regression Model - Variables Affecting the Lerner Index

The values of basic descriptive statistics of the explained variable and explanatory variables of equation (4) are given in Table 7.

Table 7. *Descriptive statistics of the variables in the linear regression model*

Variables	Mean value	Standard deviation	Minimum value	Maximum value	Number of observations
the Lerner Index	0.94834	0.08372	0.35605	0.99803	162
Size	20.60934	1.87219	16.85699	24.43245	162
ET	0.69578	0.17875	0.07485	0.92020	162
Concent CR5	0.69100	0,01131	0.67045	0.70934	162
IHH	0.15118	0.00485	0.14611	0.15856	162

Lev	0.71131	0.27353	0.13282	1.99132	162
Reins	0.25517	0.22295	0.000000	0.80700	162
Owner	0.79012	0.40848	0	1	162

Source: *Own compilation based on PIA and CSO data.*

The estimation of the model parameters (equation 4) was done using the between-group method. The results of the model estimation (equation 4) are presented in the table below. The validity of the estimated model parameters was confirmed by the results of diagnostic tests, i.e. the explanatory variables are significant, the random component has a normal distribution - so the model meets the assumptions of the linear regression panel. It was shown that two variables representing the size of an insurer and technical efficiency of the costs are statistically significant, and the remaining variables were found to be statistically insignificant.

Table 8. *Linear regression model estimation results with the between-group method for the non-life insurance market in Poland in 2010-2019*

	Dependent variable: the Lerner Index; between-group estimation (between) (N=18)				
Independent Variables	Estimators	Standard error	t-Student	p-value	Significance level
Const	0.720501	0.118137	6.099	2.04e-05	***
Size (lny)	0.0230220	0.0051955	4.431	0.0005	***
ET(technical cost efficiency)	-0.354473	0.0614199	-5.771	3.69e-05	***
Arithmetic mean of the dependent variable: 0.936789895			Standard deviation of dependent variable: 0.07139681		
Test for normality of the residuals distribution- Null hypothesis: the random component has a normal distribution Test statistic: Chi-square (2)= 3.25515 with p-value= 0.196405; critical value chi-square (2) = 5.99146 at α= 0.05					
*** with significance level of α< 0.01					

Source: *Own elaboration based on PIA and CSO data using GRETL software.*

5. Conclusion

The paper estimates market power of non-life insurers, determines its evolution and identifies two of its determinants in Poland. These objectives were achieved by estimating marginal cost and the Lerner index as a measure of market power, using annual data from 18 insurance companies from 2011-2019.

Panel regression models were estimated using the between-group method. The results of the study suggest the presence of high market power of insurers in the non-life insurance market. The panel regression analysis identified two explanatory variables that significantly affect market power in this insurance sector, i.e. company size and technical cost efficiency.

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