

ORIGINAL ARTICLE

Financial Performance Assessment of Non-Life Insurance Companies by Using Grey Relational Analysis: The Case of TRNC*

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Abstract

The financial performance of insurance companies is important for the company executives, policyholders, employees, supervisors, and all other stakeholders. For this reason, the measurement and assessment of the financial performance of insurance companies continues to be a subject that attracts the attention of researchers today. Grey relational analysis, which is one of the multi-criteria decision making techniques, has a very common use in financial performance assessment. In this study, it is aimed to assess the financial performances of non-life insurance companies operating in the TRNC via the grey relational analysis method. Accordingly, the financial performance of 10 insurance companies operating in the TRNC non-life insurance sector in the 2013 - 2019 period was analysed using 12 financial ratios related to capital adequacy, asset quality and liquidity, operating, and profitability indicators.

Keywords

Insurance, Financial Performance, Grey Relational Analysis, TRNC

JEL Classification

G22, L25.

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1. INTRODUCTION

The main factor in the emergence of the concept of insurance is the risk. Individuals or institutions apply to insurance in order to be protected from the risks that are a part of daily life. The insurance sector, which provides predictability and safety to individuals and institutions in economic and social life, also plays an important role in the development process of countries. The developing insurance sector in the Turkish Republic of Northern Cyprus (TRNC) is expected to make significant contributions to the country's economy. Therefore, it is important to measure and assess the financial performance of insurance companies. When the literature is examined, it has been determined that the studies on the TRNC insurance sector are limited. The purpose of this study is to analyse the financial performances of non-life insurance companies operating in the TRNC with the grey relational analysis (GRA) method within the framework of capital adequacy ratios, asset quality and liquidity ratios, operating ratios, and profitability ratios. In this framework, the rest of the study is organized as follows. In the second section, the characteristics of the TRNC insurance sector are presented. In the third section, previous studies that analysed the financial performance of insurance companies with the grey relational analysis method are examined. In the fourth section, the data set used in the analysis of the financial performance of non-life insurance companies operating in the TRNC is introduced and the implementation of the grey relational analysis method is described. In the fifth section, the findings of the empirical analysis are discussed. In the final section of the study, the conclusion is presented.

2. INSURANCE SECTOR IN TRNC

Although the history of insurance in the world goes back centuries, it is seen that insurance activities in Cyprus started in the 1950s. The insurance activities, which were carried out in the form of agency for many years, entered a new era with the Insurance Services (Regulation and Audit) Law No. 39/1993, which was prepared in 1993 and entered into force in 1996. While insurance activities were carried out at the agency level before 1996, with the enactment of the Law No. 39/1993, local insurance companies started to be established and these companies started to operate by forming their own agency networks (KKSRSB, 2021a). As Law No. 39/1993 became unable to meet the needs over time due to the developments in the global insurance sector, the Insurance Services (Regulation and Supervision) Law No. 60/2010 came into force at the end of 2010 (Hoca, 2017: 22). In line with the practices in the world, insurance contracts in the TRNC are divided into two groups as life insurance and non-life insurance, and insurance companies can operate in only one of these groups in accordance with the Insurance Services (Regulation and Supervision) Law No. 60/2010. Reinsurance companies, on the other hand, can operate in both life and non-life insurance. The population of the TRNC is approximately 360,000 as of 2020 (TRNC Statistical Institute, 2021a: 7). In the TRNC insurance sector, there are 33 insurance companies, of which 30 operate in non-life insurance and 3 in life insurance (TRNC Ministry of Finance, 2021a). There is also a reinsurance company operating in the TRNC insurance sector (KKSRSB, 2021a). In addition to insurance and reinsurance companies, one of the important elements of the TRNC insurance sector is insurance intermediaries. As of May 2021, approximately 350 insurance agencies (including natural person insurance agencies, legal person insurance agencies, bank insurance agencies, and cooperative insurance agencies) operate in the TRNC insurance sector (TRNC Ministry of Finance, 2021b). The financial sector (financial institutions) in the TRNC consists of the banking sector, insurance sector, international banking units, cooperatives, and foreign exchange offices (Central Bank of the TRNC, 2021a). However, it is possible to say that the TRNC financial sector has a structure that is built on the banking sector. Because as of the end of 2019, the asset size of the TRNC banking sector has reached 40.8 billion TL, and it constitutes approximately 90% of the asset size of the finance sector (See Table 1).

Table 1.
TRNC Financial Sector Asset Size (2013-2019)

	2013	2014	2015	2016	2017	2018	2019
Banking Sector(million TL)	13,326.7	14,829.6	17,366.7	21,137.7	26,115.3	32,980.2	40,748.5
International Banking Units (USD million)	597.8	632.1	410	427.9	543	554.4	345.9
Cooperatives	560.8	977.2	1.123.4	1.081.4	1.054.6	1.768.2	1.954.2
Insurance Sector (million TL)	347.7	396.8	451.6	495.3	568.3	711.7	855.8
Non-Life (million TL)	211.6	242.5	271.6	299.7	347.7	451.2	524.2
Life (million TL)	136.1	154.3	180.0	195.6	220.6	260.5	331.6
Exchange Offices (million TL)	11.4	14.9	24.3	28	37.4	35.4	41.3

Source: Data on the asset sizes of the non-banking finance sector: Central Bank of the TRNC (2021a); Data on the asset size of the banking sector: Central Bank of the TRNC (2021b); Data on the asset size of the insurance sector in terms of non-life and life: TRNC Ministry of Finance (2021c).

When Table 1 is analysed, it is seen that the share of the asset size of the insurance sector in the asset size of the finance sector is quite small when compared to the banking sector. However, it is noteworthy that in the 2013-2019 period, the asset size of the insurance sector increased continuously, both in life and non-life insurance.

Insurance premium volume is one of the main indicators of the development of the insurance sector. In line with the data obtained from the consolidated technical profit and loss statements of the TRNC insurance companies, the total premium volume in 2019 was 441.1 million TL (TRNC Ministry of Finance, 2021d). The insurance premium volume of the TRNC insurance sector for the period 2013-2019 is presented in Table 2.

Table 2.
TRNC Insurance Sector Premium Volume (2013-2019)

Insurance Premium Volume (thousand TL)	2013	2014	2015	2016	2017	2018	2019
Fire	22,105.7	25,047.1	27,884.6	31,469.8	39,708.4	53,588.9	64,257.0
Marine	3,820.0	3,443.1	4,378.3	4,453.1	6,044.6	6,842.6	7,273.3
Motor Vehicle	77,128.5	90,988.7	100,231.1	111,419.2	139,815.1	198,586.1	274,025.5
Accident	20,029.0	26,815.5	26,813.1	32,599.5	42,234.2	49,880.7	52,902.8
Machine Assembly	2,535.8	3,889.0	2,198.0	6,438.2	3,994.3	5,852.9	5,665.0
Sickness	3,712.5	3,561.1	4,335.6	6,884.1	6,604.8	8,848.2	11,277.2
Total Non-Life	129,891.3	154,630.8	166,829.9	194,693.8	240,157.5	325,698.3	415,400.9
Life	23,888.8	25,338.8	30,407.5	27,934.1	30,416.7	33,198.6	25,701.7
Total	153,780.1	179,969.7	197,237.5	222,627.8	270,574.2	358,896.9	441,102.6

Source: TRNC Ministry of Finance (2021d).

Table 2 reveals that the premium volume of the TRNC insurance sector has increased continuously over the years in the 2013-2019 period. It is possible to say that the insurance sector concentrates on non-life insurance and the system is built on motor vehicle insurance. As a matter of fact, as of 2019, approximately 94% of the insurance premium volume was written in non-life insurance, and approximately 66% of the non-life insurance premium volume was written in motor vehicle insurance. In the process of assessing the development of the insurance sector in a country, it is not sufficient to examine the premium volume alone, but the share of premiums in the gross domestic product (GDP) should also be assessed. The ratio of premiums to gross domestic product, also called "insurance penetration", is presented in Table 3 for the 2013-2019 period.

Table 3.
TRNC Insurance Sector Penetration (2013-2019)

(million TL)	2013	2014	2015	2016	2017	2018	2019
Insurance Premium Volume	153.8	179.9	197.2	222.6	270.6	358.9	441.1
Non-Life Premium Volume	129.9	154.6	166.8	194.6	240.2	325.7	415.4
Life Premium Volume	23.9	25.3	30.4	27.9	30.4	33.2	25.7
GDP	7,606.90	8,858.60	10,222.50	11,601.20	14,544.80	18,324.20	21,395.40
Total Premium Volume / GDP	0.0202	0.0203	0.0193	0.0192	0.0186	0.0196	0.0206
Non-Life Premium Volume / GDP	0.0171	0.0175	0.0163	0.0168	0.0165	0.0178	0.0194
Life Premium Volume / GDP	0.0031	0.0029	0.0030	0.0024	0.0021	0.0018	0.0012

Source: Insurance premium volume data: TRNC Ministry of Finance (2021d); GDP data: TRNC Statistical Institute (2021b).

According to the data in Table 3, it is seen that the premium volume of the TRNC insurance sector is approximately 2% of the gross domestic product as of 2019 and there has been no significant change in this ratio over the years. In the same year, the ratio of non-life insurance premium volume to gross domestic product was 1.94%, while the ratio of life insurance premium volume to gross domestic product was 0.12%. Another important indicator regarding the insurance sector is the premiums per capita, also called "insurance density". Premiums per capita calculated for the 2013-2019 period in the TRNC insurance sector are presented in Table 4.

Table 4.
TRNC Insurance Sector Density (2013-2019)

	2013	2014	2015	2016	2017	2018	2019
Non-institutional civilian population	277,031	289,252	299,514	307,255	314,169	347,340	357,216
Premiums per capita (TL)	555.1	622.2	658.5	724.6	861.2	1,033.3	1,234.8
Premiums per capita in nonlife (TL)	468.8	534.6	557.0	633.7	764.4	937.7	1,162.9
Premiums per capita in life (TL)	86.2	87.6	101.5	90.9	96.8	95.6	71.9

Source: Insurance premium volume data: TRNC Ministry of Finance (2021d); Population data: TRNC Statistical Institute (2021a).

The data presented in Table 4 shows that the premiums per capita in the TRNC have increased continuously between 2013 and 2019. Similarly, premiums per capita in non-life insurance have increased continuously over the years. It is noteworthy that premiums per capita in life insurance followed a fluctuating course and decreased significantly in 2019 compared to the previous year. The technical result is an important indicator in assessing the effectiveness of the core insurance activities of the insurance company

(Kozak, 2011). In Table 5, the technical profitability of the TRNC insurance sector for the period 2013-2019 is analysed by using the data obtained from the consolidated technical profit and loss statements of the TRNC insurance companies.

Table 5.

Technical Profitability in the TRNC Insurance Sector (2013-2019)

Technical Results (thousand TL)	2013	2014	2015	2016	2017	2018	2019
Fire	7,892.6	4,693.0	9,198.5	9,610.8	9,528.9	7,659.0	13,251.1
Marine	1,841.0	1,042.7	1,667.6	1,699.4	1,614.4	3,697.2	3,388.1
Motor Vehicle	16,158.6	19,283.8	21,734.5	22,230.0	26,421.7	24,103.5	48,727.3
Accident	8,137.3	9,403.0	9,310.6	12,305.9	14,690.0	14,969.3	21,331.9
Machine Assembly	594.3	-102.7	305.3	1,213.1	696.5	508.1	770.3
Sickness	745.9	912.2	305.9	672.5	846.6	1,528.1	1,941.5
Total Non -Life	35,633.3	35,232.1	42,522.7	47,732.4	53,798.2	52,465.1	89,410.2
Life	1,529.5	4,189.4	3,378.9	5,243.8	4,493.1	6,148.1	5,936.6

Source: TRNC Ministry of Finance (2021d).

In the analysed years, technical profitability in TRNC life insurance has shown a fluctuating course. In non-life insurance, on the other hand, it is observed that technical profitability has increased more steadily (See Table 5). The technical profitability ratio is calculated by dividing the technical profit to premiums received (Öner Kaya, 2015: 516), and the technical profitability ratios calculated for the TRNC insurance sector are given in Table 6.

Table 6.

Technical Profitability Ratios in the TRNC Insurance Sector (2013-2019)

Technical Profitability Ratios (%)	2013	2014	2015	2016	2017	2018	2019
Fire	0.38	0.19	0.33	0.30	0.231	0.143	0.206
Marine	0.481	0.302	0.380	0.38	0.27	0.540	0.466
Motor Vehicle	0.209	0.221	0.224	0.189	0.188	0.121	0.178
Accident	0.406	0.350	0.311	0.344	0.333	0.300	0.403
Machine Assembly	0.234	-0.026	0.144	0.263	0.174	0.087	0.136
Sickness	0.200	0.256	0.070	0.117	0.128	0.173	0.172
Total Non -Life	0.274	0.229	0.256	0.238	0.224	0.161	0.215
Life	0.064	0.165	0.111	0.187	0.164	0.185	0.231

Source: TRNC Ministry of Finance (2021d).

The data in Table 6 show that, in the last two years, technical profitability ratios in life insurance have been higher than those in non-life insurances. Moreover, despite its high share in the premium volume, the technical profitability ratio in motor insurance lagged behind the non-life insurance technical profitability ratio.

3. LITERATURE REVIEW

In recent years, it is seen that the grey relational analysis method is frequently used to measure the performance of companies operating in various sectors (Ersoy, 2020; Şengül and Ece, 2018; Karkacier and Yazgan, 2017; Ecer and Günay, 2014; Bektaş and Tuna, 2013; Ecer, 2013; Uçkun and Girginer, 2011; Wu et al., 2010; Ho and Wu, 2006). The grey relational analysis method is also widely used to assess the performance of insurance companies. Peker and Baki (2011) is one of the first studies in the Turkish insurance industry that measured the performance with the grey relational analysis method. In the study, which included three insurance companies, financial performance assessment was made with the GRA method using liquidity, leverage and profitability ratios. Within the scope of liquidity, leverage and profitability indicators, 10 financial ratios were used in the study and the weights of the ratios were taken equally. It has been determined that the most important ratio group affecting financial performance is liquidity. Öner Kaya (2016) investigated the financial performances of non-life insurance companies traded in Borsa Istanbul using the grey relational analysis method. In the study, financial performances of non-life insurance companies were examined in terms of capital adequacy ratios, liquidity ratios, operating ratios, and profitability ratios for the period 2010-2014. The grey relational analysis results, using 16 financial ratios, showed that profitability ratios have the most impact on the financial performance of non-life insurance companies traded on the BIST. In another study on the Turkish insurance sector, Kula et al. (2016) conducted a financial performance assessment using the 2013 data of seven insurance companies and one private pension company traded on the BIST, using the grey relational analysis method. In the study conducted using 10 financial ratios, the ratio weights were determined by taking the opinions of three academicians, a portfolio investor and a bank manager. As a result of the grey relational analysis, it has been determined that companies with low current ratio and profitability ratios have low financial performance. Suvvari et al. (2019) analysed the financial performance of 24 life insurance companies operating in India between 2013 and 2016 using the grey relational analysis method. A total of 14 indicators from capital adequacy ratios, liquidity ratios, operating ratios and profitability ratios were included in the analysis. As a result of the analysis in which each ratio weight is taken into account equally, it has been determined that profitability ratios are playing a crucial role in determining the financial performance. In the study, it is emphasized that companies should focus more on profitability ratios in order to continue their activities in a healthier financial structure. Jaaman et al. (2019) assessed the financial performance and capital adequacy ratio of nine general insurance companies operating in Malaysia in the period 2011-2015. The research results have shown that an insurer will be considered solvent and financially stable if it performs well for both capital adequacy ratio and grey relational analysis measurements. In the study conducted by Venkateswarlu and Bhishma Rao (2016), the performance of a total of 16 insurance companies, including 4 public and 12 private insurance companies operating in India, was analyzed. Between 2008 and 2013, financial performance was evaluated by using TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) and GRA methods, based on the profitability ratios of the companies. As a result of the research, it was stated that in order to increase the profitability, the companies have to reduce expenses, better claims management, enhance their underwriting discipline, and minimize operating costs. Yan and Kung (2011) analyzed the financial performance of 15 large-scale insurance companies operating in Taiwan between 2004 and 2008 using the grey relational analysis method. In the study, a total of 24 ratios were employed within the scope of five categories determined as capital structure, profitability, debt servicing capability, business efficiency, and capital employment. As a result of the analysis, the performance of 15 insurance companies were ranked based on the grey relational grade. Tsai et al. (2008) proposed a performance evaluation model for the property-liability insurance companies operating in Taiwan, using a combination of analytic hierarchy process (AHP) and GRA. Three main evaluation criteria (including business index, profitability index, and whole company operating index) and 11 sub-evaluation criteria were used in the analysis. The weights of the criteria were obtained by the AHP method, and the insurance companies included in the study were ranked by the GRA method. By applying grey relational analysis,

Kung et al. (2006) evaluated the financial performance of 16 insurance companies operating in Taiwan for the period 2000-2004. 24 financial ratios were used in the analysis and these ratios were separated into 5 operation indicators (capital structure, profitability, solvency, management efficiency, and capital operational capability). As a result of the grey relational analysis, it has been determined that the ratios that have the greatest impact on financial performance are return of assets ratio, funds utilization efficiency ratio, current debt-capital ratio, equity ratio, and operating net profit-retention premium ratio.

4. RESEARCH DESIGN

In this section of the study, the data used in the analysis, the sources from which the data were obtained and the methodology used in the research are examined.

4.1. Data

The main data source of the study is the financial statements of the non-life insurance companies operating in the TRNC for the period 2013-2019. The study covers a period of seven years between 2013 and 2019. The reason for choosing the years 2013-2019 as the analysis period is that the financial statements of the non-life insurance companies could be obtained in full for this period. Depending on the existence of data, 10 non-life insurance companies operating in the TRNC for the period 2013-2019 have been selected for the study. The insurance companies included in the analysis are presented in Table 7.

Table 7.

List of the non-life insurance companies included in the analysis

Insurance Companies	Code
As Can	C1
Can	C2
Commercial	C3
Creditwest	C4
Eurocity	C5
Gold	C6
Güven	C7
Kıbrıs	C8
Limassol	C9
Segure	C10

The financial performance of the non-life insurance companies, operating in the TRNC, have been analysed in terms of the capital adequacy ratios, asset quality and liquidity ratios, operating ratios, and profitability ratios. The financial ratios were calculated using the annual data of the non-life insurance companies. All financial ratios employed in the analysis were selected taking into account the availability of data and based on the related literature. The financial ratios used in the analysis are presented in Table 8.

Table 8.
Financial ratios included in the analysis

	Financial Ratios	Code	Target
Capital Adequacy Ratios	Premiums Received / Equity Capital	CAR1	nominal the best
	Equity Capital / Total Assets	CAR2	nominal the best
	Equity Capital / Net Technical Reserves	CAR3	nominal the best
Operating Ratios	Premium Retention Ratio	OR1	nominal the best
	Claims Payment Ratio	OR2	nominal the best
Profitability Ratios	Loss Ratio	PR1	smaller the better
	Technical Profit / Premiums Received	PR2	larger the better
	Net Income Before Taxes / Premiums Received	PR3	larger the better
	Net Income Before Taxes / Total Assets	PR4	larger the better
	Net Income Before Taxes / Equity Capital	PR5	larger the better
Asset Quality and Liquidity Ratios	Liquid Assets / Total Assets	AQL1	larger the better
	Premium and Reinsurance Receivables / Total Assets	AQL2	smaller the better

The TRNC insurance sector financial ratios calculated using the TRNC insurance sector consolidated financial statements are presented in Table 9 for the 2013-2019 period.

Table 9.
The TRNC insurance sector financial ratios

Financial Ratios	2013	2014	2015	2016	2017	2018	2019
Premiums Received / Equity Capital	1.17	1.29	1.26	1.34	1.47	1.71	1.92
Equity Capital / Total Assets	0.52	0.50	0.49	0.50	0.47	0.42	0.42
Equity Capital / Net Technical Reserves	1.93	1.72	1.72	1.72	1.54	1.25	1.13
Retention Ratio	0.52	0.52	0.52	0.52	0.53	0.54	0.56
Claims Payment Ratio	0.69	0.65	0.66	0.69	0.68	0.60	0.70
Loss Ratio	0.62	0.63	0.54	0.57	0.57	0.70	0.58
Technical Profit / Premiums Received	0.27	0.23	0.26	0.24	0.22	0.16	0.22
Net Income Before Taxes / Premiums Received	0.13	0.09	0.12	0.11	0.10	0.10	0.11
Net Income Before Taxes / Total Assets	0.08	0.06	0.08	0.07	0.07	0.07	0.09
Net Income Before Taxes / Equity Capital	0.15	0.11	0.16	0.14	0.14	0.17	0.22
Liquid Assets / Total Assets	0.47	0.48	0.49	0.52	0.53	0.51	0.52
Premium and Reinsurance Receivables / Total Assets	0.36	0.36	0.35	0.32	0.31	0.31	0.32

Source: The financial ratios of the TRNC insurance sector are calculated based on the data in the TRNC insurance sector consolidated financial statements published by the TRNC Ministry of Finance (2021c; 2021d).

The ratio of premiums received to equity capital is one of the most important measures assessing the capital adequacy of insurance companies. This ratio shows the insurance company's exposure to underwriting risk and higher values of this ratio increase the company's vulnerability to underwriting risk (Öner Kaya, 2016: 281). Therefore, it is not desired that this ratio be greater than 4 (Başpınar, 2005: 14). Although this ratio, which is expected to take a value below 4, has been increasing over the years in the TRNC non-life insurance sector during the 2013-2019 period, it is seen that it is well below the level expressed as the limit (See Table 9). The ratio of equity capital to total assets indicates how much of the company's assets are financed by equity capital. Another important ratio related to capital adequacy of insurance companies is the ratio of equity capital to net technical reserves, which measures the power of equity capital to meet the technical reserves (Öner Kaya, 2016: 281). The high level of both ratios is considered as an important indicator of the company's financial strength. Although both ratios in the TRNC insurance sector are in a downward trend in the 2013-2019 period, it is possible to state that both ratios are still at high levels (See Table 9). Two financial ratios are employed in the study to measure the effectiveness of the operations of non-life insurance companies. One of these ratios, the premium retention ratio, indicates the amount of risk an insurance company retains rather than transfers to reinsurers (Öner Kaya, 2016: 282). It is expected that a higher premium retention ratio will positively affect financial performance with a lower loss ratio (Öner Kaya, 2015: 518). The claims payment ratio, which is another operating ratio, is calculated by dividing the paid claims by the sum of paid claims and outstanding claims reserves (Başpınar, 2005: 15). This ratio is expected to be within the 60% and 80% range (Başpınar, 2005: 20). In the 2013-2019 period, it is observed that the claims payment ratios calculated for the TRNC non-life insurance sector are in the range of 60% - 80% (See Table 9). In order to measure the profitability of insurance companies, the loss ratio, the ratio of technical profit to premiums received, the ratio of net income before taxes to premiums received, the ratio of net income before taxes to total assets, and the ratio of net income before taxes to equity capital are used in this study. Loss ratio, which is one of the most important performance indicators for insurance companies, demonstrates the effectiveness of the underwriting activities of insurance companies (Öner Kaya, 2015: 517). It is accepted that there is a reverse relationship between loss ratio and financial performance. Therefore, the low loss ratio is preferred. The technical profitability ratio, which assesses the effectiveness of the core insurance activities of insurance companies (Kozak, 2011), is calculated by dividing the technical profit to premiums received (Öner Kaya, 2015: 516), as stated before. The ratio of net income before taxes to premiums received, can also be called as sales profitability ratio, associates net income before taxes obtained by the insurance company with premiums received (Öner Kaya, 2015: 516). Return on assets (ROA) shows the profitability of the insurance company's assets, while return on equity (ROE) shows the profitability of the insurance company's equity capital. In other words, ROA indicates how efficiently the assets of the insurance company are used, while ROE indicates how efficiently the equity capital of the insurance company is used. The high profitability ratios (except for the loss ratio) are naturally desired by insurers. The ratio of liquid assets to total assets shows the weight of liquid assets within the total assets of the insurance company (Öner Kaya, 2016: 282). It is desirable for insurance companies to have high liquidity. Another ratio used in the study to measure the adequacy of the liquidity of insurance companies is the ratio of premium and reinsurance receivables to total assets (Başpınar, 2005: 15). The high ratio of premium and reinsurance receivables to total assets can be considered as an indicator of liquidity insufficiency.

4.2. Methodology

In the study, the financial performance of non-life insurance companies operating in the TRNC was analyzed using the grey relational analysis (GRA) method. Grey relational analysis is part of grey system theory proposed by Deng (1982). In the grey system theory, "grey" means poor, incomplete, and uncertain (Deng, 1989: 1). The main advantages of grey relational analysis method are that the calculations are simple and the method is easy to implement, the results obtained are based on the original data, the method does not require a large amount of data, and the data do not need to be normally distributed (Wu, 2002: 211; Wen, 2004: 23; Kung et al., 2006: 156; Yan and Kung, 2011: 84).

The grey relational analysis process is applied by following certain steps. The application steps of the grey relational analysis method can be summarized as follows (Wu, 2002; Kuo et al., 2008; Zhai et al., 2009):

Step 1: Construction of the initial decision matrix

Assuming that there are n data sequences (non-life insurance companies operating in TRNC for this study) characterized by m criteria (12 financial ratios are determined for this study), the compared sequences can be shown in a matrix:

$$X_i = \left[x_1(1) \ x_2(1) \ ; \ x_n(1) \ x_1(2) \ x_2(2) \ ; \ x_n(2) \ \dots \ \ddots \ \dots \ x_1(m) \ x_2(m) \ ; \ x_n(m) \right] \quad (1)$$

where $x_i(j)$ is the value of the i^{th} insurance company corresponding to the j^{th} financial ratio ($i=1, \dots, n; j=1, \dots, m$).

Step 2: Calculation of the normalized values of the financial ratios in the decision matrix

The financial ratios in the decision matrix are normalized to obtain comparable scales (Feng and Wang, 2000: 138). The data can be normalized by one of the three alternatives; i.e., larger-is-better, smaller-is-better, and nominal-is-best.

For larger is the better normalization, the formula to transform $x_i(j)$ to $x_i^*(j)$ is defined as:

$$x_i^*(j) = \frac{x_i(j) - \min_j x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \quad (2)$$

For smaller is the better normalization, the formula to transform $x_i(j)$ to $x_i^*(j)$ is defined as:

$$x_i^*(j) = \frac{\max_j x_i(j) - x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \quad (3)$$

For nominal is the best normalization, the formula is defined as:

$$x_i^*(j) = 1 - \frac{|x_i(j) - x_{obj}(j)|}{\max\{\max_j x_i(j) - x_{obj}(j), x_{obj}(j) - \min_j x_i(j)\}} \quad (4)$$

where $x_{obj}(j)$ is the target value of the j^{th} financial ratio, and

$$x_i(j) \geq x_{obj}(j) \geq x_i(j)$$

Step 3: Construction of the normalized matrix and generation of the reference sequence based on equation (2)-(4).

After that the normalization process is complete, the decision matrix in equation (1) looks like equation (5). The normalized matrix is shown in equation (5), and the reference sequence is shown in equation (6).

$$x_i^* = \left[x_1^* \ x_2^* \ ; \ x_n^*(1) \ x_1^* \ x_2^* \ ; \ x_n^*(2) \ \dots \ \ddots \ \dots \ x_1^*(m) \ x_2^*(m) \ ; \ x_n^*(m) \right] \quad (5)$$

$$x_0^* = x_0^*(1), x_0^*(2), \dots, x_0^*(j), \dots, x_0^*(n) \quad (6)$$

After the completion of the normalization process using equations (2), (3) or (4), the normalized values of the financial ratios will be scaled into $[0, 1]$. An insurance company will have the highest financial performance if all of the normalized values of its financial ratios are closest to or equal to 1. However, this kind of alternative (non-life insurance companies operating in TRNC for this study) does not usually exist (Kuo et al., 2008: 82). Therefore this study defines the reference sequence as:

$$x_0^* = x_0^*(1), x_0^*(2), \dots, x_0^*(j), \dots, x_0^*(n) = (1, 1, \dots, 1, \dots, 1).$$

Step 4. Construction of the difference matrix

The absolute value of difference between the normalized value and the reference value of the j th financial ratio, $\Delta_{0i}(j)$, is calculated by equation (7).

$$\Delta_{0i}(j) = |x_0^*(j) - x_i^*(j)| \quad (7)$$

After the calculations using equation (7) are completed, equation (8) shows the difference matrix.

$$\Delta = \begin{bmatrix} \Delta_{01}(1) & \Delta_{02}(1) & \dots & \Delta_{0m}(1) & \Delta_{01}(2) & \Delta_{02}(2) & \dots & \Delta_{0m}(2) & \dots & \dots & \Delta_{01}(n) & \Delta_{02}(n) & \dots & \Delta_{0m}(n) \end{bmatrix} \quad (8)$$

Step 5. Calculation of the grey relational coefficients

Grey relational coefficients are calculated using equation (9).

$$\gamma_{0i}(j) = \frac{\Delta_{min} + \xi \Delta_{max}}{\Delta_{0i}(j) + \xi \Delta_{max}} \quad (9)$$

where $\gamma_{0i}(j)$ is the grey relational coefficient of the j th financial ratio, $\Delta_{max} = \Delta_{0i}(j)$, $\Delta_{min} = \Delta_{0i}(j)$ and “ ξ ” is the distinguishing coefficient. The distinguishing coefficient is a value between 0 and 1.

Step 6. Calculation of the grey relational grades

Grey relational grades are calculated using equation (10) by weighting the grey relational coefficients.

$$\Gamma_{0i} = \sum_{j=1}^n [W_i(j) \times r_{0i}(j)] \quad (10)$$

where Γ_{0i} is the grey relational grade, and $W_i(j)$ is the weight of the j th financial ratio. Therefore, the weight of each financial ratio should be determined first. As a result, the non-life insurance companies are ranked according to the calculated grey relational grades, and the higher grey relational grade indicates better financial performance.

5. EMPIRICAL RESULTS

Within the scope of the study, firstly the financial ratios for the years 2013-2019 were calculated for each of the 10 non-life insurance companies operating in the TRNC, and then the seven-year averages of each financial ratio for each company were taken. The decision matrix showing the seven-year average values of 12 financial ratios for 10 non-life insurance companies operating in the TRNC is shown in Table 10.

Table 10.
Decision matrix

Insurance Companies	Capital Adequacy Ratios			Operating Ratios		Profitability Ratios				Asset Quality and Liquidity Ratios		
	2013-2019	CAR1	CAR2	CAR3	OR1	OR2	PR1	PR2	PR3	PR4	PR5	AQL1
C1	0.920	0.669	3.388	0.477	0.894	0.724	0.307	0.087	0.051	0.079	0.725	0.252
C2	1.974	0.382	1.202	0.547	0.901	0.703	0.353	0.039	0.029	0.078	0.256	0.575
C3	2.159	0.307	0.980	0.243	0.577	1.164	0.153	0.058	0.037	0.123	0.464	0.390
C4	1.322	0.541	1.958	0.487	0.562	0.338	0.411	0.309	0.206	0.388	0.491	0.231
C5	1.886	0.325	1.978	0.252	0.812	0.864	0.321	0.020	0.011	0.033	0.243	0.482
C6	0.756	0.686	6.076	0.328	0.663	0.553	0.361	0.031	0.017	0.028	0.343	0.387
C7	1.623	0.468	1.734	0.461	0.704	0.584	0.241	0.149	0.099	0.215	0.461	0.401
C8	1.513	0.538	1.421	0.753	0.880	0.505	0.296	0.170	0.134	0.246	0.653	0.246
C9	2.521	0.416	1.249	0.438	0.911	0.634	0.221	0.092	0.094	0.232	0.448	0.370
C10	1.683	0.330	1.393	0.714	0.907	0.869	0.253	-0.001	-0.003	-0.023	0.182	0.503

The normalized values of the financial ratios in the decision matrix are presented in Table 11. In the normalization process, Equation (4) was used for the capital adequacy ratios (CAR1, CAR2, and CAR3) and operating ratios (OR1 and OR2), which have the expectancy of “nominal-is-best”. In the normalization process of the capital adequacy ratios and operating ratios, considering the capital adequacy and operating ratios calculated for the TRNC non-life insurance sector in the 2013-2019 period (see Table 9), the TRNC insurance sector capital adequacy and operating ratios were determined as the target value ($x_{obj}(j)$). Equation (2) was used for the financial ratios, which have the expectancy of “larger-is-better” (PR2, PR3, PR4, PR5, and AQL1). Finally, Equation (3) was used for the financial ratios, which have the expectancy of “smaller-is-better” (PR1 and AQL2). Table 11 also shows the reference sequence.

Table 11.
Normalized matrix and reference sequence

Insurance Companies	Capital Adequacy Ratios			Operating Ratios		Profitability Ratios					Asset Quality and Liquidity Ratios	
	CAR1	CAR2	CAR3	OR1	OR2	PR1	PR2	PR3	PR4	PR5	AQL1	AQL2
2013-2019	CAR1	CAR2	CAR3	OR1	OR2	PR1	PR2	PR3	PR4	PR5	AQL1	AQL2
Reference	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
C1	0.141	0.065	0.543	0.743	0.084	0.533	0.598	0.284	0.260	0.248	1.000	0.939
C2	0.952	0.875	0.985	0.964	0.048	0.559	0.777	0.128	0.153	0.246	0.137	0.000
C3	0.793	0.601	0.970	0.000	0.401	0.000	0.000	0.191	0.193	0.354	0.520	0.539
C4	0.487	0.536	0.833	0.775	0.331	1.000	1.000	1.000	1.000	1.000	0.570	1.000
C5	0.971	0.664	0.828	0.028	0.471	0.363	0.652	0.068	0.065	0.136	0.113	0.271
C6	0.000	0.000	0.000	0.269	0.814	0.740	0.805	0.103	0.096	0.123	0.298	0.547
C7	0.746	0.805	0.878	0.692	0.991	0.702	0.342	0.483	0.488	0.577	0.515	0.505
C8	0.651	0.547	0.941	0.381	0.147	0.799	0.554	0.552	0.653	0.655	0.867	0.958
C9	0.482	0.999	0.976	0.620	0.000	0.641	0.262	0.299	0.466	0.620	0.490	0.597
C10	0.797	0.684	0.947	0.504	0.018	0.358	0.387	0.000	0.000	0.000	0.000	0.209

For the difference matrix, the distances between the normalized values and the reference sequence are calculated. After the normalization process, Table 12 provides the difference matrix that was generated by using Equation (7).

Table 12.
Difference matrix

Insurance Companies	Capital Adequacy Ratios			Operating Ratios		Profitability Ratios					Asset Quality and Liquidity Ratios	
	CAR1	CAR2	CAR3	OR1	OR2	PR1	PR2	PR3	PR4	PR5	AQL1	AQL2
2013-2019	CAR1	CAR2	CAR3	OR1	OR2	PR1	PR2	PR3	PR4	PR5	AQL1	AQL2
C1	0.859	0.935	0.457	0.257	0.916	0.467	0.402	0.716	0.740	0.752	0.000	0.061
C2	0.048	0.125	0.015	0.036	0.952	0.441	0.223	0.872	0.847	0.754	0.863	1.000
C3	0.207	0.399	0.030	1.000	0.599	1.000	1.000	0.809	0.807	0.646	0.480	0.461
C4	0.513	0.464	0.167	0.225	0.669	0.000	0.000	0.000	0.000	0.000	0.430	0.000
C5	0.029	0.336	0.172	0.972	0.529	0.637	0.348	0.932	0.935	0.864	0.887	0.729
C6	1.000	1.000	1.000	0.731	0.186	0.260	0.195	0.897	0.904	0.877	0.702	0.453
C7	0.254	0.195	0.122	0.308	0.009	0.298	0.658	0.517	0.512	0.423	0.485	0.495
C8	0.349	0.453	0.059	0.619	0.853	0.201	0.446	0.448	0.347	0.345	0.133	0.042
C9	0.518	0.001	0.024	0.380	1.000	0.359	0.738	0.701	0.534	0.380	0.510	0.403
C10	0.203	0.316	0.053	0.496	0.982	0.642	0.613	1.000	1.000	1.000	1.000	0.791

After calculating the absolute value of the differences between the normalized values and the reference sequence, the next step is to calculate the grey relational coefficients. The distinguishing coefficient “ ζ ” which can take a value between 0 and 1, is generally applied as 0.5 in the studies. In this study, the distinguishing coefficient is applied as 0.5 and grey relational coefficients are calculated as in equation (9). The grey relational coefficient matrix is presented in Table 13.

Table 13.*Grey relational coefficient matrix*

Insurance Companies	Capital Adequacy Ratios			Operating Ratios		Profitability Ratios				Asset Quality and Liquidity Ratios		
	2013-2019	CAR1	CAR2	CAR3	OR1	OR2	PR1	PR2	PR3	PR4	PR5	AQL1
C1	0.389	0.349	0.538	0.708	0.359	0.517	0.555	0.411	0.403	0.399	1.000	0.892
C2	0.965	0.802	1.000	1.000	0.351	0.531	0.691	0.364	0.371	0.399	0.367	0.333
C3	0.748	0.558	0.971	0.357	0.463	0.333	0.333	0.382	0.383	0.436	0.510	0.520
C4	0.522	0.520	0.771	0.740	0.436	1.000	1.000	1.000	1.000	1.000	0.538	1.000
C5	1.000	0.600	0.766	0.364	0.495	0.440	0.590	0.349	0.348	0.367	0.360	0.407
C6	0.352	0.334	0.343	0.436	0.742	0.658	0.719	0.358	0.356	0.363	0.416	0.525
C7	0.701	0.721	0.827	0.664	1.000	0.626	0.432	0.492	0.494	0.542	0.508	0.503
C8	0.622	0.526	0.921	0.479	0.376	0.713	0.528	0.527	0.590	0.592	0.790	0.922
C9	0.520	1.000	0.982	0.609	0.339	0.582	0.404	0.416	0.483	0.568	0.495	0.554
C10	0.752	0.614	0.930	0.538	0.344	0.438	0.449	0.333	0.333	0.333	0.333	0.387

In the next step, the grey relational grades are calculated for all insurance companies and insurance companies are ranked according to the decreasing order of their grey relational grades. In this study, the importance of all financial ratios were assumed to be equal. Thus the weights of the 12 financial ratios were all the same in the analysis in order to calculate the grey relational grades. Table 14 shows the grey relational grades of each insurance company were calculated by using equation (10) and the financial performance rankings of these companies.

Table 14.*Grey relational grades and rankings of the insurance companies*

Insurance Companies	Grey Relational Grades	Rank
Creditwest	0.79	1
Kıbrıs	0.63	2
Güven	0.62	3
Can	0.59	4
Limasol	0.57	5
As can	0.54	6
Eurocity	0.51	7
Commercial	0.50	8
Segure	0.48	9
Gold	0.46	10

For the 2013-2019 period, the ranking results of the grey relational analysis are shown in column 3 of Table 14. In the grey relational analysis, the higher grey relational grade shows better financial performance. In the 2013-2019 period, the grey relational analysis results based on 12 financial ratios showed that Creditwest Insurance, which has the highest grey relational grade, took the first order among the 10 non-life insurance companies operating in the TRNC. Creditwest Insurance was followed by Kıbrıs Insurance and Güven Insurance. In addition, the results also showed that among the financial ratios employed in the analysis, profitability ratios have the greatest impact on the financial performance of non-life insurance companies operating in the TRNC. The findings of this study, which was carried out using the data of 12 financial ratios belonging to 10 non-life insurance companies operating in the TRNC for the period 2013-

2019, are in line with the findings obtained by Kung et al. (2006), Öner Kaya (2016), Kula et al. (2016), Venkateswarlu and Bhishma Rao (2016), and Suvvari et al. (2019).

In this study, the distinguishing coefficient was initially applied as 0.5. Then, the analysis was repeated using some other different distinguishing coefficients (0.1, 0.3, 0.7, and 0.9) to see the impact of the distinguishing coefficients on the results (Kuo et al., 2008: 87-88). Table 15 shows the grey relational grades and rankings obtained when different distinguishing coefficients were applied.

Table 15.

The impact of distinguishing coefficient on the results of grey relational analysis

Insurance Companies	0.1	0.3	0.7	0.9
As Can	0.274 (6)	0.443 (6)	0.612 (6)	0.662 (6)
Can	0.370 (2)	0.514 (4)	0.655 (4)	0.698 (4)
Commercial	0.223 (8)	0.395 (8)	0.572 (8)	0.626 (8)
Creditwest	0.631 (1)	0.737 (1)	0.830 (1)	0.855 (1)
Eurocity	0.236 (7)	0.404 (7)	0.578 (7)	0.631 (7)
Gold	0.174 (10)	0.357 (10)	0.543 (10)	0.599 (10)
Güven	0.316 (3)	0.519 (3)	0.693 (3)	0.739 (3)
Kıbrıs	0.315 (4)	0.526 (2)	0.698 (2)	0.744 (2)
Limasol	0.309 (5)	0.479 (5)	0.647 (5)	0.695 (5)
Segure	0.208 (9)	0.378 (9)	0.555 (9)	0.608 (9)

Note: Rankings of the insurance companies are shown in parentheses.

The analysis results obtained by applying different distinguishing coefficients showed that the impact of distinguishing coefficients on grey relational analysis results is small. This result is in line with the findings obtained by Kuo et al. (2008).

6. CONCLUSIONS

The financial performances of 10 non-life insurance companies operating in the TRNC were assessed via the grey relational analysis method, using 12 financial ratios related to capital adequacy, asset quality and liquidity, operating, and profitability calculated for the 2013-2019 period. Depending on the existence of data, the financial performance of 10 non-life insurance companies operating in the TRNC was analysed. The usability of the grey relational analysis method in cases with limited data was also effective in its preference in this study.

Grey relational analysis results showed that profitability ratios have the greatest impact on the financial performance of non-life insurance companies operating in the TRNC. When an evaluation is made considering the profitability ratios, it is possible to state that the loss ratio and the technical profitability ratio are more effective on financial performance.

As a result of the grey relational analysis, non-life insurance companies operating in the TRNC were ranked according to their grey relational grades. The grey relational analysis results showed that Creditwest Insurance, which has the highest grey relational grade, took the first order among the 10 non-life insurance companies operating in the TRNC for the 2013-2019 period. It is possible to state that factors such as the capital adequacy, premium generation, pricing policy, underwriting strategy, marketing techniques, and product line diversification of insurance companies are effective on the results of the grey relational analysis.

In this study, the financial performances of 10 non-life insurance companies operating in the TRNC for the period 2013-2019 were analysed using the grey relational analysis method. To the best knowledge of the authors, the study is the first to analyse financial performance in the TRNC insurance sector using the

grey relational analysis method. The results of this study depend on the data set used in the grey relational analysis and the time covered. Performing a financial performance analysis for the TRNC insurance sector, by using different analysis techniques with a more comprehensive data set that can include more insurance companies, will contribute to the relevant literature.

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