

Principal Component Analysis as a Method of Measuring the Performance of Turkish Non-Life Insurance Companies

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Outline

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Introduction

- One of the important service industry in developing countries like Turkey, is the insurance sector.
- Except compulsory insurances such as earthquake insurance and compulsory motor third party liability insurance, insurance is an optional preferred system.
- Individuals are needed to take out insurance when the utility existing insurance is more than the utility in the absence of insurance.
- This situation creates a strong competitive environment for insurance companies.

Introduction

- Insurance companies which operate effectively continue their existence, but others be going into administration.
- The effectiveness of insurance companies depend on efficient use of the sources.
- Insurance is a system which has inputs (premium payments) and outputs (claim/damage payments).
- Insurance companies should consider many calculations such as technical reserves, commission expenses paid to intermediaries, taxes payable, paid social security provisions except premiums and claim payments.

Introduction

- In Turkey, Republic of Turkey Prime Ministry Undersecretariat of Treasury and Insurance Association of Turkey publish the annual activities reports of life, non-life, pension and reinsurance companies at the end of the each year.
- An incomprehensive performance analysis can be done by technical profit and loss information in these reports.
- But for more comprehensive performance analysis, mathematical methods are needed.

Literature-Methods for Performance Analysis

- Data Envelopment Analysis(DEA) (Hao and Chou, 2005),(Tone and Sahoo, 2005),(Yang, 2006),(Harton, 2010)(widely used method)
- **Principal Component Analysis (PCA)** (Wang and Du, 2000), (Zhongsheng and Dong, 2008), (Mashhadifarahani et al., 2013)
- Comparison of DEA and PCA as Methods of Performance Measurement (Zhu, 1998), (Kardiyen and Örkçü, 2006), (Shanmugam and Johnson, 2007)
- Non-Hierarchical Cluster Analysis
- Tobit Regression Model (Kılıçkaplan and Karpaz, 2004)
- Stochastic Frontier (Akan and Çalmaşur, 2011)
- The Malmquist Total Factor Productivity Index (Çingir and Tarım,2000)

The Aim of the Study

Compare the performance of Turkish non-life insurance companies between 2010-2014 using PCA (actually PCA is a data reduction method for other analysis) as a method of measuring the performance.

Principal Component Analysis (PCA)

PCA is one of the multivariate analysis techniques used for,

- Dimension reduction (Reduction of the number of variables)
- Correlation analysis
- Preparing data for other analysis
- Destruction of the structure of dependence between variables
- Performance assessment (Mashhadifarahani et al., 2013), (Tatlıdil, 2002).

Rank Correlation

- A rank correlation coefficient measures the degree of similarity between two rankings, and can be used to assess the significance of the relation between them.
- Some of the more popular rank correlation statistics are as follows;
 - Spearman's ρ
 - Kendall's τ
 - Goodman and Kruskal's γ
 - Somers' D

Multidimensional Scaling (MDS)

- MDS is a technique that creates a map displaying the relative positions of objects, given only a table of the distances between them.

Application

Data Source

In this study data in "**Insurance and Private Pensions Reports**" **about the insurance activities in Turkey between 2010 and 2014** taken from Republic of Turkey Prime Ministry Undersecretariat of Treasury Insurance Auditing Board is used. According to this report there are a total of 30 nonlife insurance companies.

Variables

Returns On Assets (**ROA**), Gross Written Premiums (**GWP**), Company Size (**CS**), Insurance Leverage Ratio (**ILR**), Expense-Revenue Ratio (**ERR**), Market Share (**MS**), Current Ratio (**CR**), Equity-Asset Ratio (**EAR**), Premium-Asset Ratio (**PAR**), Returns On Equity (**ROE**)

Application-PCA Scores for 2010-2014

- PCA which is actually a data reduction method, is used as an effectiveness measurement method in this study.
- Using the results of PCA, new scores are calculated for five years.
- These scores are calculated as a weighted average of new components and the percentages values of Extraction Sums of Squared Loadings of Variance are taken as weightes.

Application-Ranking Companies using PCA Scores for 2010-2014

Table : Rank Values of Nonlife Insurance Companies

Company	2010	2011	2012	2013	2014	Average
Ace	24	26	29	29	29	27.4
Aksigorta	4	5	3	4	4	4.00
Allianz	3	4	2	3	1	2.60
Anadolu	2	1	1	2	3	1.80
Ankara	14	17	19	18	19	17.4
Atradius	29	27	30	30	30	29.2
Aviva	11	11	17	14	16	13.8
Axa	1	2	10	1	2	3.20
Bnp	27	21	27	28	27	26.0
Coface	25	24	26	22	25	24.4

Application-Ranking Companies using PCA Scores for 2010-2014

Table : Rank Values of Nonlife Insurance Companies (Con't)

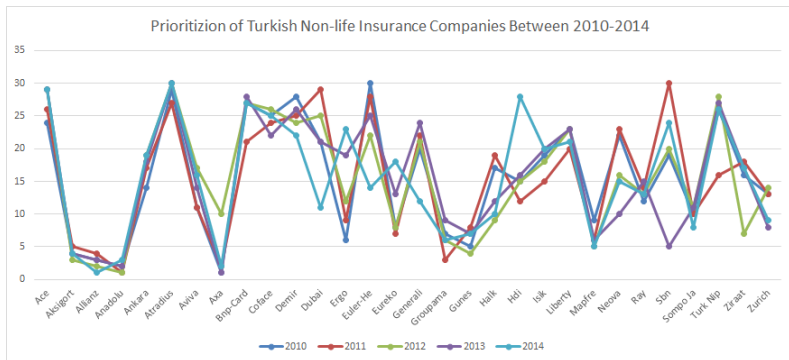
Company	2010	2011	2012	2013	2014	Average
Demir	28	25	24	26	22	25.0
Dubai	21	29	25	21	11	21.4
Ergo	6	9	12	19	23	13.8
Euler	30	28	22	25	14	23.8
Eureko	8	7	8	13	18	10.8
Generali	20	22	21	24	12	19.8
Groupama	7	3	6	9	6	6.20
Gunes	5	8	4	7	7	6.20
Halk	17	19	9	12	10	13.4
Hdi	15	12	15	16	28	17.2

Application-Rank Values for 2010-2014

Table : Rank Values of Nonlife Insurance Companies (Con't)

Company	2010	2011	2012	2013	2014	Average
Isik	19	15	18	20	20	18.4
Liberty	23	20	23	23	21	22.0
Mapfre	9	6	5	6	5	6.20
Neova	22	23	16	10	15	17.2
Ray	12	14	13	15	13	13.4
Sbn	19	30	20	5	24	19.6
Sompo Jap.	10	10	11	11	8	10.0
Turk Nipp.	26	16	28	27	26	24.6
Ziraat	16	18	7	17	17	15.0
Zurich	13	13	14	8	9	11.4

Prioritization of Turkish Non-life Insurance Companies Between 2010-2014



Application-Rank Correlation Matrix for five years

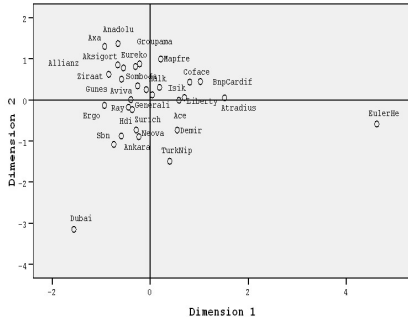
Table : Rank Correlation Matrix of Rank Values(Sperman's Rho)

	2010	2011	2012	2013	2014
2010	1.000	0.898	0.886	0.842	0.717
2011	0.898	1.000	0.821	0.693	0.635
2012	0.886	0.821	1.000	0.854	0.782
2013	0.842	0.693	0.854	1.000	0.776
2014	0.717	0.635	0.782	0.776	1.000

Application-MDS of 30 Turkish Non-life Insurance Companies in 2010

Derived Stimulus Configuration

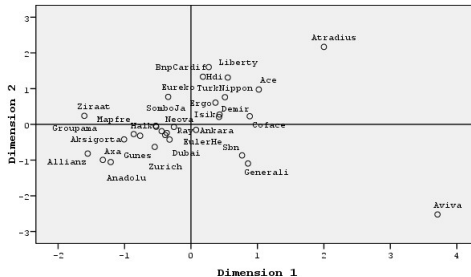
Euclidean distance model



Application-MDS of 30 Turkish Non-life Insurance Companies in 2014

Derived Stimulus Configuration

Euclidean distance model




Results of Application

Results of Table and Graph (Rank Values)

- The companies with the best performance are **Anadolu, Allianz, Axa, Aksigorta**
- The companies which have the most unsuccessful performance are **Demir,Bnp,Atradius**
- Stable companies for five years:**Aksigorta,Anadolu,Atradius,Liberty,Ray,S Japan**
- Unstable companies:**Axa,Ergo,Euler,Sbn**

Results of Rank Correlation

- There is a significant correlation between ranking values from first year(2010) to last year(2014).
- The highest correlation is 0,898 between 2010 and 2011 while the lowest correlation is 0.635 between 2010 and 2014.
- It is rational that the correlations between consecutive years are high. 

Results of Application

Results of MDS

2010

- **Euler** is the company with most unsuccessful performance in 2010.
- **Dubai** and **Euler** are in a farther position from other companies. Both of companies show an increase in five-year period.
- **Axa, Anadolu, Aksigorta, Allianz** are at same location (successful companies)

2014

- **Atradius** is the company with most unsuccessful performance in 2014.
- **Aviva** and **Atradius** are in a farther position from other companies. It may be due to the decline of **Aviva** to rank 16 from rank 11.
- **Axa, Anadolu, Aksigorta, Allianz** are at same location (successful companies)

Conclusion

- PCA is used as a method of measuring the performance by weighted average of new components.
- Companies are ranked according to PCA scores, and results are supported by rank correlation matrix.
- Relations between companies are investigated by MDS.
- Using these study non-life insurance companies can compare themselves with other companies. Companies can do some modifications on their own resources and assets to operate more efficiently.

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