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MUĞLA SITKI KOÇMAN UNIVERSITY, FETHİYE FACULTY OF MANAGEMENT, DEPARTMENT OF ECONOMICS AND FINANCE, TURKEY

G. CENK AKKAYA

DOKUZ EYLÜL UNIVERSITY, FACULTY OF ECONOMICS AND ADMINISTRATIVE SCIENCES, DEPARTMENT OF BUSINESS ADMINISTRATION, TURKEY

PROFITABILITY ANALYSIS OF BANKS BY USING CLUSTERING METHOD: AN APPLICATION ON TURKISH BANKING SECTOR

Abstract:

Clustering analysis is currently one of the most popular and advanced mathematical grouping methods both in finance and other existing sciences. The purpose of cluster analysis is to determine the units similar to each other in terms of their characteristics studied, and to define their clustering structures. The banking sector is the most important partner of organizations and countries against developing world economy and fluctuations in global competitive environment. The importance of profitability is clear for banks so in this study we want to cluster banks in Istanbul Stock Exchange based on profitability. There are three public banks, eleven private banks and twelve foreign banks in Turkey.

This study aims to cluster 26 banks, listed in the Istanbul Stock Exchange by using profitability ratios. Four profitability ratios employed in the clustering were obtained through the end of the financial statements of the banks. The financial statements are taken from the internet sites of the Banks Association of Turkey. The average of the values of the profitability ratios belonging to the years 2003-2013 were used as the data of the analysis. As a result of the k-cluster analysis, the first, second and third clusters consist of 11, 2, 11 banks respectively. We have found the most similar banks and the less similar banks in our data set and also it is concluded that banks have formed a homegenous structure with the banks except existing groups (public, private and foreign).

Keywords:

banks, profitability, clustering analysis

JEL Classification: G00

Introduction

Cluster analysis is, to classify units surveyed in a study to gather in groups according to certain similarities between them, to demonstrate the common features of the unit and a method for making general descriptions related to these classes (Akgül and Başkır, 2013, p.54).

The overall objective of cluster analysis is to reduce the data by dividing the specific subset of meaningful groups based on similarity of the unit, which consists of data collected from a large number ungrouped observation. Thus, researchers will have to be understood more clearly defined observations, with minimal loss of information. (Günay Atbaş, 2008, p.10). The other aim of Cluster analysis, dealing with the determination of classification of individuals, belongs in masses (of the group) is that the grouping together similar or close in a data set of multivariate observation (Yıldız, 1998, p.9).

Many algorithms have been proposed for clustering analysis. However, the literature on these algorithms, are grouped under two headings, hierarchical clustering techniques and non-hierarchical clustering techniques (k-means technique). The common goal in both techniques is, to raise the differences and similarities between clusters within clusters to the highest level. The main difference between these two types of analysis; hierarchical clustering analysis method in determining the number of clusters without any prior knowledge of the data sets will be divided into several clusters, while the other method of analysis is done by determining how many initial cluster (Akın and Eren, 2012, p.176).

Although which technique will be used dependent on the number of clusters, the use of both techniques together is much more useful. Thus, it is possible to compare both results of which of the two techniques give more favourable results (Akın, 2008, p. 8).

Literature

The banking sector in Turkey, as well as all over the world, is the most important partner in all sectors of the global competitive environment. Organizations are focused on the possibility of the bank they choose as partners and sectorial ratings. Therefore, a scientific approach in the evaluation and selection of banks has come to the fore.

In the literature, there are many studies on the Turkish banking sector. According to the studies, it appears that rather than focus on the profitability analysis of banks. In this context, multivariate statistical methods, data mining techniques such as regression analysis are commonly used. Following examples are given for the studies: Tunay and Silpar (2006), made Turkish commercial banking sector profitability based on performance analysis and commercial banks allocated to the groups by cluster

analysis. Other studies on the profitability of the Turkish banking sector are done by Yıldırım (1999), Çingi and Tarım (2000), İnan (2000) and Kaplan and Çelik (2008).

The International studies to measure the performance of the banking sector by analyzing bank profitability are done by , (Neely and Wheelock, 1997), (Atanasieff et al., 2002),(Guru et all., 2002) and studies examining the mutual banking sector in many countries are done by (Abreau and Mendes, 2002), (Bashir, 2000), (Demirgüç-Kunt and Huizingha,1999) In addition to these studies, by Camilleri (2005) banking sector in Malta, grouped in small and large banks, profitability, and growth in risk were examined.

Methods And Practices

The purpose of this research is to analyse the profitability of clustering analysis with the help of banks operating in Turkey, between the years 2003-2013. In order to analyse the bank which is concerned, it is first used hierarchical clustering analysis. Later, with the help of k-means clustering, cluster analysis was conducted. Hierarchical cluster analysis is a number of methods typically used effectively in the analysis of a small sample of less than 250 (Everitt and Landau, 2001, p.15). Data were obtained from Union Bank Turkey website. Banks that will be subject to the cluster analysis are presented in Table 1. In the analysis, the codes given to the banks are used instead of the names of the relevant bank. In Turkey, three state-owned banks, eleven privately owned banks, twelve foreign capital bank is established. The codes of Public banks are respectively K1, K2 and K3. The codes of Privately-owned bank are O1, O2, O3 and O4, O5, O6, O7, O8, O9, O11.
The foreign-owned banks incorporated in Turkey, respectively, Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8, Y9, Y10, Y11, Y12 code is given. Bank profitability ratios used to clusters, codes, and their calculations are presented in Table 1.

Table 1: Calculating Profitability Ratios for the Year 2003-2013

Profitability Codes	**Ratios**
KR1	Net Profit-Loss for the period/ Total Assets
KR2	Net Profit-Loss for the period /Equity Capital
KR3	Profit Before Tax/Total Assets
KR4	Net Profit-Loss for the period /Paid-in Capital

In this study, firstly, hierarchical cluster analysis model was used to determine the most similar to each bank. Hierarchical cluster analysis method, tree diagram (dendrogram) the number of clusters has been identified as three. In the study, Ward method, often preferred from these methods, is used for hierarchical clustering analysis. In this method, taking into account all the variables is measured in the presence of similarity between the two sets of total least squares. The goal is to create heterogeneity between clusters of clusters to maximize homogeneity within the cluster. (Sharma, 1996, p.25).

Then, the k-means clustering was made using the technique. In the K-means technique, the number of clusters is based on the researcher's pre-knowledge and experience. The reliability of the method is the most significant advantage (Yaz, 2014, p.7). If there is preliminary information on the number of clusters or if the researchers have decided the number of clusters that will be significant, in this case non-hierarchical clustering method can be used (Tatlıdil, 1996, p.13). In this regard, in this study, the number of clusters is determined as three.

In the initial phase of the clustering process, each observation is a cluster. At the end of the process all the observations are grouped in a cluster. This method can be expressed by the following algorithm (Tatlıdil, 2002, p.34).

Step 1: n number of observation and n number of cluster has started the process.
Step 2: The nearest two sets (from the smallest value) is combined.
Step 3: Replicated distance matrix is located by reduced a number of cluster.
Step 4: Steps 2 and 3 are repeated n-1 times.

Agglomerative hierarchical clustering method obtained with the help of the table, in 2003 and 2013, depending on the variables used in this study, the most similar to each other and each other at least similar banks have been identified. When viewed 2003-2013 year average is obtained according to the Agglomerative table (Table 2); 1. It is seen that the coded O6 and Y4 in each step of the bank is most similar to each other at least K1 banks and bank-like and Y5-coded banks. Other very similar banks are O6 and Y12 coded banks and, K3 and O10 coded banks.

Table 2: Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	9	18	,807	0	0	2
2	9	26	5,236	1	0	10
3	3	13	10,740	0	0	8
4	8	22	17,553	0	0	9
5	5	20	27,509	0	0	18
6	15	16	38,281	0	0	14
7	11	23	55,077	0	0	16
8	3	12	77,275	3	0	16
9	6	8	103,098	0	4	12
10	9	10	129,718	2	0	14
11	7	14	158,816	0	0	13
12	6	24	235,813	9	0	20
13	4	7	331,604	0	11	19
14	9	15	456,089	10	6	19
15	1	2	587,079	0	0	21
16	3	11	733,946	8	7	18

17	19	21	1036,195	0	0	23
18	3	5	1543,836	16	5	20
19	4	9	2688,253	13	14	22
20	3	6	4585,014	18	12	21
21	1	3	10178,872	15	20	22
22	1	4	27348,754	21	19	23
23	1	19	85511,256	22	17	0

In Table 3, by the k- means clustering technique it is shown by the formation of clusters of bank profitability indicators. According to Table 3, the public aspects of the cluster are similar to each other profitability indicators of the bank, private and foreign banks are seen to occur except of a clustering the current clusters. In the first cluster six private banks and five foreign banks, in the second cluster two foreign banks, and in the third cluster there are three state-owned banks, it is understood that five private banks and three foreign banks took place. Hence, the profitability indicator of private capital aspect of banking operations, unlike that in terms of public banks and private banks with which they share similar objectives and public banks in ancient times would not be wrong to say that they can compete with the banks. Y5 and Y7 coded banks, seems to create a separate group from other foreign banks. This two foreign banks, take part in a separate group from the rest of the profitability ratios can be interpreted as the ways they differ from other foreign banks. Total 26 banks were included in the study, but 24 banks were available the average value of the 2003-2013 years.

Table 3: Cluster Formations Based on Bank's Profitability Indicators

Cluster 1	**Cluster 2**	**Cluster 3**
O1	Y5	K1
O3	Y7	K2
O4		K3
O6		O2
O7		O5
O11		O8
Y1		O9
Y2		O10
Y4		Y6
Y10		Y8
Y12		Y9
11	**2**	**11**

Table 4 shows sets of variables in the average and the Anova test results. According to this, when the KR1 variables examined the highest average of KR1 belongs to the 2nd cluster. When KR2 variables examined, 3rd cluster has the highest average. When looking at the average KR3 variable, 2nd cluster has the highest average. When we look at the average of KR4 variable belongs to the highest average 2nd cluster.

The intended results of Anova are to examine the variables showing differences as clusters. Our expectations; variables as clusters are different Sig Values in Table 4 as Anova test results is less than 0.05, which gives the results vary depending on the variables of our cluster.

Table 4: Final Cluster Centers and Anova Test Results

	Cluster			Sig.
	1	2	3	Df
KR1	-,27	4,24	1,97	,021
KR2	3,27	14,74	17,26	,000
KR3	-,07	5,89	2,56	,008
KR4	8,36	214,08	63,88	,000

Conclusion

In the study, between the years 2003-2013 the profitability of banks operating in Turkey was examined using cluster analysis. In order to analyse the bank which is concerned, it is first used hierarchical clustering analysis. Later, with the help of k-means clustering, cluster analysis was conducted. Agglomerative hierarchical clustering method obtained with the help of the table, in 2003 and 2013, depending on the variables used in this study, the most similar to each other and each other at least similar banks have been identified. When viewed 2003-2013 year average is obtained according to the Agglomerative table, it is seen that the coded O6 and Y4 in each step of the bank is most similar to each other at least K1 banks and bank-like and Y5-coded banks. Other very similar banks are O6 and Y12 coded banks and, K3 and O10 coded banks.

According to k-means technique, the public aspect of the cluster are similar to each other profitability indicators of the bank, private and foreign banks are seen to occur except of a clustering the current clusters. In the first cluster six private banks and five foreign banks, two foreign banks in the second cluster, and in the third cluster of three state-owned banks, it is understood that five private banks and three foreign banks took place.

Looking at the average the cluster of variables, KR1 (return on assets) when the variables examined, when the KR1 variables examined, the highest average of KR1 belongs to the 2nd cluster. When KR2 variables examined, 3rd cluster has the highest average. When looking at the average KR3 variable 2nd cluster has the highest average. When we look at the average of KR4 variable belongs to the highest average 2nd cluster.

When evaluating clusters as return on assets, the second set of foreign-owned banks (Y5 and Y7) the average return on assets appears to be more than the other clusters. In terms of the KR3 and KR4 variable, second cluster has the highest average. In the second cluster, it said that there is a significant cluster with two foreign banks.

However; the third cluster has the highest average return on equity. In the third cluster the three state-owned banks (K1, K2, K3), five private banks (O2, O5, O8,09 and O10) and three foreign banks (Y6, Y8 and Y9) are available and is a cluster that has the highest average in terms of average equity. In terms of return on equity; public, private and foreign banks is said to constitute a significant cluster.

The first cluster of six private (O1, O3, O4, O6, O7 and O11) and five foreign-owned banks (Y1, Y2, Y4, Y10 and Y12), the average of the variable KR3 and KR1 is negative. The average of KR2 and KR4 variable is lower than the second and third sets. These banks are said to constitute a significant cluster. Finally, the ANOVA results, which give the results, vary depending on the variables of our cluster.

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