

Bankruptcy Prediction of Turkish Commercial Banks Using Financial Ratios

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Abstract

In the last few years Turkey experienced a serious financial crisis. In the aftermath of this crisis, immediate economic effects of the crisis were felt almost in all areas of the business world, and several banks were taken over by the Savings Deposits Insurance Fund (SDIF). The main purpose of this research is to make a bankruptcy prediction of Turkish Commercial Banks using data compiled from the years 1997 and 1999. Logistic Regression was used to form a prediction model with financial ratios. 42 commercial banks were included in this research. Those which were taken over by the Savings Deposits Insurance Fund (SDIF) were determined as failed banks: 8, 3, and 7 in 1999, 2000, and 2001, respectively. Prediction models were created using 1997 – 1999 period data set and validated using 1999 - 2001 data set for prediction. It was observed that 80% of failed banks could be predicted two years a priori, and Logistic Regression can be used as a part of an “early warning” system. As is known, predicting bank failures reduces the losses incurred and helps avoid misallocation of resources.

Mathematics Subject Classification: 62H30

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1 Introduction

Before 1980, the Turkish economy presented a different picture compared to the following years. It was a planned economy, and the state was the major player in almost all areas of the financial world, controlling prices and interest rates.

In the following years after 1980, the government put an economic stabilization and structural adjustment program into effect, and this helped change the

macroeconomic situation in Turkey quickly. The new program's emphasis was toward a freer economy, reducing the government's role in financial activities such as eliminating price controls.

Furthermore, as part of the government's effort to implement structural reforms to provide deregulated and liberal financial markets, in 1985 major changes were made in the Banking Law. All these reforms changed the picture of the financial sector and the banking system drastically. Ultimately, at the final stage of all structural changes was the lifting of the regulatory barriers which restricted the entry into the banking system. This final reform set the stage for increasing the number of banks in Turkey thanks to the opening of some new banks and the arrival of some foreign banks.

As a result, the number of banks increased rapidly from 43 in 1980 to 66 in 1990. As of December 1999, there were 81 banks operating in Turkey [4]. The move toward the liberalization of financial markets and the opening of many new whether they be local or foreign increased the fragility of the economy, making it more vulnerable to economic crisis. Thus, as in most countries, the banking crisis in Turkey occurred after a period of economic expansion [11].

Instabilities in macroeconomic values caused interest rates to increase more and more, leaving no time for the economy to stabilize and regain balance. In response to the volatile economic situation, the central bank turned to some measures such as reducing interest rates although worse inflation figures were expected in the economic circles. An economic crisis was brewing, and as was expected in the first quarter of 1994 a severe economic crisis hit the financial sector. The Turkish currency, TL, lost its value rapidly; wholesale average inflation skyrocketed; interest rates spiralled out of control; and domestic demand decreased.

This crisis also severely hit the banking system. During the crisis, there was a substantial withdrawal of deposits from banks because of the panic created by a sharp depreciation of TL and an upswing in interest rates. The government halted banking activities of three small-sized banks and introduced full guaranty for all savings deposit holders.

After that a new banking law was put into effect. This new law aimed at strengthening the banking sector and improving the supervision standards in conjunction with international norms. To achieve this goal, the government established the Banking Regulation and Auditing Institution as the new regulatory body of the Turkish banking sector; this new government agency had full administrative and financial autonomy. The decision body of this institution, The Board, consisted of seven members and was recognized as the sole authority to license as well as cancel the license of banks, and to decide on the take-over of failing banks by the Savings Deposits Insurance Fund (SDIF).

2 Motivation for the Study

One of the most significant threats of a national economy is the bankruptcy of its banks since it creates a serious funding and confidence crisis that threatens the whole economy. Estimation of bankruptcy provides invaluable information on which governments, investors and shareholders can base their financial decisions in order to prevent possible losses. Furthermore, it can also be used to screen potential failures to suggest potential stress on bank capital and possible write-downs.

In Turkey, after new regulations in banking law and economical crisis were put into practice, several banks were taken over by SDIF. For many, it was important to estimate which banks were going to be taken over.

One of the major motivations for this study was the non-existence of research on bank insolvency prediction during this crisis period in Turkey. This kind of research could supply invaluable information about the future of the banks to the authorities.

Since Altman's Z model, some studies have been carried out on failure classification. Altman and Narayan conducted a survey called "An International Survey of Business Failure Classification Models" [3]. One of these studies was done by Briones, Marin and Queto. In this study, a classification of failed and successful banks was made using financial ratios in Discriminant Analysis. Meyer and Pifer [10] in their paper, Prediction of Bank Failures, matched failed and non-failed banks and analyzed them with both Multivariate Discriminant Analysis and Multivariate Regression Analysis, and then compared the classification results. The Logistic Regression approach was first proposed for bank failure prediction by Martin [1] and for the prediction of business failure by Ohlson [8].

Tam and Kiang [9] made a Neural Network application in the case of bank failure prediction and compared the results with some other methods such as Discriminant Analysis and Logistic Regression.

In this paper, Logistic Regression was used to find models and make ex ante predictions in order to determine the banks which were financially in bad condition. Despite the existence of other multivariate statistical models that could be used in modelling and prediction, Logistic Regression model was preferred because of its statistical advantages. Logistic Regression does not face the strict assumptions such as multivariate normality and equal variance-covariance matrices across groups [7].

3 Data Set

42 Commercial banks were included in this research. State-run and special investment banks were not included. Banks are listed in Table 1.

Data set was provided by The Banks Association of Turkey (BAT) (1999, 2000, 2001). Financial reports of 42 banks are annually examined and gathered in spreadsheets using Excel software. Most of the financial ratios were already calculated by BAT, and some ratios which could be significant for our models were calculated using Excel tables. NCSS (1997-2001) statistical software was used in the analysis of data set and modelling Logistic Regression.

4 Selection of Predictor Variables

Several researchers have used financial accounting ratios in their empirical studies of bankruptcy prediction. There are many ratios in financial tables which show the success level of banks. However, there is no consensus on the issue of which one of these ratios should be taken into consideration when making judgments. Different financial analysts try to create different models using different set of financial ratios. Moreover, the theoretical models do not provide a very sound foundation as to which one to choose. A table of ratios implemented by several researchers is given by Karels and Prakash [5].

In this research, in order to determine the statistically significant ratios many suggested methods were used, such as Single Logistic Regression, Multivariate Variable Selection Procedure, All Possible Regression, Forward and Backward Elimination methods.

20 financial ratios were examined for each year for the 1997-1999 periods. Although in some research papers and books [7] it was emphasized that multicollinearity would not be a problem if the research were focused on classification rather than on knowing which independent variable was more important. Here in this study, Factor Analysis was used in order to avoid multicollinearity problem. Because it was observed that there was a severe multicollinearity problem, and almost all financial ratios seemed as if they were not significant. After using Factor Analysis, the forward logistic regression and backward elimination methods were applied, and different combinations of the ratios were tested. The selection of the final ratios was based on the statistical significance (at 10% level) of the estimated parameters and the model classification results. Financial Ratios are listed in Table-2.

Banks Used in Analysis	1999	2000	2001
Akbank	1	1	1
Alternatif Bank A.Ş.	1	1	1
Anadolubank A.Ş.	1	1	1
Arap Türk Bankası A.Ş.	1	1	1
Bank Ekspres A.Ş.	0	0	0
Bank Kapital Türk A.Ş.	1	0	0
Bayındırbank A.Ş.	1	1	0
Birleşik Türk Körfez Bankası A.Ş.	1	1	1
Citibank N.A.	1	1	1
Demirbank T.A.Ş.	1	0	0
Denizbank A.Ş.	1	1	1
Egebank A.Ş.	0	0	0
Eskişehir Bankası T.A.Ş.	0	0	0
Etibank A.Ş.	1	0	0
Finans Bank A.Ş.	1	1	1
İktisat Bankası T.A.Ş.	1	1	0
İnterbank	0	0	0
Kentbank A.Ş.	1	1	0
Koçbank A.Ş.	1	1	1
M.N.G. Bank A.Ş.	1	1	1
Milli Aydın Bankası T.A.Ş.	1	1	0
Osmanlı Bankası A.Ş.	1	1	1
Oyak Bank A.Ş.	1	1	1
Pamukbank T.A.Ş.	1	1	1
Şekerbank T.A.Ş.	1	1	1
Sitebank A.Ş.	1	1	0
Sümerbank A.Ş.	0	0	0
Tekstil Bankası A.Ş.	1	1	1
Toprakbank A.Ş.	1	1	0
Türk Dış Ticaret Bankası A.Ş.	1	1	1
Türk Ekonomi Bankası A.Ş.	1	1	1
Türk Eximbank	1	1	1
Türk Sakura Bank A.Ş.	1	1	1
Türk Ticaret Bankası A.Ş.	0	0	0
Türkiye Garanti Bankası A.Ş.	1	1	1
Türkiye İmar Bankası T.A.Ş.	1	1	1
Türkiye İş Bankası A.Ş.	1	1	1
Türkiye Tütüncüler B. Yaşarbank A.Ş.	0	0	0
Türkiye Vakıflar Bankası T.A.O.	1	1	1
Ulusal Bank T.A.Ş.	1	1	0
Yapı ve Kredi Bankası A.Ş.	1	1	1
Yurt Ticaret ve Kredi Bankası A.Ş.	0	0	0
Table - 1: Banks and their codes.			
The Banks are sorted alfabetically. 0=Failed, 1=Successful			

	Capital Ratios (%)
C1	(Shareholders' Equity+T.Income)/Total Assets
C2	(Shareholders' Equity+T.Income)/(Deposits+Non-deposit Funds)
C3	Net Working Capital/Total Assets
C4	(Shareholders' Equity+ T.Income)/(T.Assets+Contin.and Com.)
	Assets Quality (%)
C5	Total Loans/Total Assets
C6	Non Performing Loans/Total Loans
C7	Permanent Assets/Total Assets
C8	Fx Assets/Fx Liabilities
	Liquidity (%)
C9	Liquity Assets/Total Assets
C10	Liquity Assets/(Deposits + Non-deposit Funds)
C11	Fx Liquid Assets/Fx Liabilities
	Profitability (%)
C12	Net Income(Loss)/Average T.Assets
C13	Net Income(Loss)/Average Shareholders' Equity
C14	Net Income(Loss)/Average Share-in Capital
	Income-Expenditure Structure (%)
C15	Net Interest Income After Provision/Average T. Assets
C16	Interest Income/Interest Expenses
C17	Non-Interest Income/Non-Interest Expenses
C18	Total Income/Total Expenditure
C19	Loan Loss Provision/Total Loans
C20	((Total non specialized credit*0,005)+ Provision for Loan Losses
	+ Other Expenditure))/Total non specialized credit
Table - 2 : Financial Ratios	

5 Logistic Regression

Logistic Regression [2] is a method coming from Statistics whose objective is to obtain a functional relationship between a transformation from a qualitative variable called logit and predictor variables which can be either quantitative or qualitative.

Where $B(X)$ is a classification model, the Logistic Regression model is described by the following formula:

$$Pr ob(X) = \frac{1}{1+e^{-B(X)}}$$

It is used to classify new individuals starting from rules in the following way:

“If $Prob(x) < c$ then individual is classified as 0, otherwise it is classified as 1”.

“c” is the cut off point. The cut off point or level of probability that is used to categorize a bank as “failed” is usually chosen as 0,5 in literature. In this research bankrupt banks were classified as “0” and successful banks were classified as “1”. Cut off point was chosen as 0,5. Those under 0,5 were classified as “0” and above 0,5 as “1”.

In some studies it is noted that classifying a “failed” bank as a “non-failed” bank can have more severe consequences than classifying a “non-failed” bank as a “failed” bank [6]. So, it may be better to use 0,8 or higher cut off point for successful banks, especially in developing countries.

6 Analysing Data Set Using Logistic Regression

Firstly 1997 data of predictor variables were analyzed using 1999 response (dependent) variable data and the model was formed as below;

$$XB = -13,20738 + ,626098x C2 - 2,169955x C12 + 9,429545E-02x C14 + 5,528393E-02x C16 + 2,361215E-02x C17 - 1,704793x C19$$

$$\text{Correct classification percent} = 95\%$$

The Model is in transformation form. $\text{Prob}(Y=1)$ is counted using the $\text{Prob}(Y=1) = 1/(1+\text{Exp}(-XB))$ transformation formula. An Excel table is used for this purpose. A list of banks ranked by Prob values (probability of being successful) was given in Table 3.

Ratios which were chosen as significant are as follows;

$$C2 = (\text{Shareholders' Equity} + \text{Total Income}) / (\text{Deposits} + \text{Non-deposit Funds})$$

$$C12 = \text{Net Income (Loss)} / \text{Average Total Assets}$$

$$C14 = \text{Net Income (Loss)} / \text{Average Share-in Capital}$$

$$C16 = \text{Interest Income} / \text{Interest Expenses}$$

$$C17 = \text{Non-Interest Income} / \text{Non-Interest Expenses}$$

$$C19 = \text{Provision for Loan Losses} / \text{Total Loans}$$

This model was used in order to rank and classify the banks according to their performances.

The model was tested with the data set compiled from 1999, and this way an ex ante prediction was made. The model was transformed using logistic form. Probabilities were calculated using transformed model. Banks were ranked by probabilities. And they were classified using 0,5 cut-off point. Those under 0,5 were classified as failed and above 0,5 as successful. The results can be seen in Table 3.

Banks Used in Analysis	XB	Prob(Y=1)	Predicted
M.N.G. Bank A.Ş.	23,1952	1,0000	1
Koçbank A.Ş.	15,1512	1,0000	1
Arap Türk Bankası A.Ş.	10,4640	1,0000	1
Oyak Bank A.Ş.	8,9946	0,9999	1
Türk Eximbank	8,5127	0,9998	1
Akbank	8,3127	0,9998	1
Alternatif Bank A.Ş.	8,2620	0,9997	1
Tekstil Bankası A.Ş.	7,3989	0,9994	1
Citibank N.A.	6,7803	0,9989	1
Türk Ekonomi Bankası A.Ş.	5,9280	0,9973	1
Demirbank T.A.Ş.	4,8831	0,9925	1
Türkiye Garanti Bankası A.Ş.	4,4287	0,9282	1
Anadolubank A.Ş.	4,4238	0,9282	1
Sitebank A.Ş.	4,2355	0,9857	1
Yapı ve Kredi Bankası A.Ş.	3,1873	0,9604	1
Osmanlı Bankası A.Ş.	2,9972	0,9524	1
Pamukbank T.A.Ş.	2,9441	0,9500	1
Ulusal Bank T.A.Ş.	2,6749	0,9355	1
Türkiye İş Bankası A.Ş.	2,3795	0,9152	1
Birleşik Türk Körfez Bankası A.Ş.	1,6296	0,8361	1
Şekerbank T.A.Ş.	1,3227	0,7896	1
Finans Bank A.Ş.	1,2339	0,7745	1
Denizbank A.Ş.	0,6745	0,6625	1
Bayındırbank A.Ş.	-0,2136	0,4468	0
Kentbank A.Ş.	-0,6943	0,3331	0
İktisat Bankası T.A.Ş.	-1,1438	0,2416	0
Türkiye Vakıflar Bankası T.A.O.	-1,4445	0,1908	0
Etibank A.Ş.	-2,0526	0,1138	0
Türkiye İmar Bankası T.A.Ş.	-2,5442	0,0728	0
Türk Dış Ticaret Bankası A.Ş.	-2,5990	0,0692	0
Toprakbank A.Ş.	-4,0562	0,0170	0
Bank Kapital Türk A.Ş.	-4,8777	0,0076	0
Milli Aydın Bankası T.A.Ş.	-7,3224	0,0007	0
Türk Ticaret Bankası A.Ş.	-15,2503	0,0000	0
Bank Ekspres A.Ş.	-21,1643	0,0000	0
Türkiye Tütüncüler B. Yaşarbank A.Ş.	-27,6056	0,0000	0
İnterbank	-36,1826	0,0000	0
Eskişehir Bankası T.A.Ş.	-187,0663	0,0000	0
Egebank A.Ş.	-289,0026	0,0000	0
Sümerbank A.Ş.	-397,5459	0,0000	0
Yurt Ticaret ve Kredi Bankası A.Ş.	-1664,0686	0,0000	0

Table -3 : Banks ranked due to the model.

See counted XB values and their probs.

7 Results

In 1999 there were 8 banks taken over by Turkish Savings Deposits Insurance Fund. With this *ex ante* prediction it was observed that besides these 8 banks there were an additional 10 banks which were classified as failed and had to be examined properly. They were Milli Aydın Bankası, Bank Kapital, Toprakbank, Dış Ticaret Bankası, İmar Bankası, Etibank, Vakıflar Bankası, İktisat Bankası, Kentbank, and Bayındırbank. And it was seen that if cut-off point had been chosen as 0,8 or higher in order to classify a bank as successful, other three banks would be counted as failed banks. They were Denizbank, Şekerbank, Finansbank.

Since the model was constructed using 1997 predictors and 1999 dependent variables (two years priori model), it made a prediction for the year 2001. The length of time for this research was enough for the evaluation test of the model.

8 Discussion

In summary, the validation of the results of this study indicates that a Logistic Regression model with six variables –a capital ratio, two profitability's, two income-expenditure and a provision for loan losses variables– can provide reasonably good results in predicting financial distress in Turkey and has a good predictive value of bankruptcy failures.

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